PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

Pegasus

Cotmoor Solar Farm

7th July 2020

ADMINISTRATION PAGE

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Issue	Date	Detail of Changes
1	19th March 2020	Initial issue
2	7th July 2020	Second issue – Wording revisions and analysis of additional dwelling

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a solar photovoltaic (PV) development near Halloughton, Nottinghamshire, UK.

The assessment pertains to the possible impact upon surrounding road users, dwellings, and aviation activity associated at RAF Syerston.

Guidance

Pager Power has undertaken over 450 glint and glare assessments in the UK, Europe and internationally. The company's own glint and glare guidance is based on industry experience and extensive consultation with industry stakeholders including airports and aviation regulators.

Conclusions

Overall, no significant impacts upon any of the assessed ground-based receptors have been identified and therefore mitigation is not required.

Modelling Results

- No detailed assessment is recommended for RAF Syerston as it can be safely presumed that if solar reflections are possible, intensities would be acceptably low. This is due to the orientation of the runways and the distance from the proposed development;
- Solar reflections are geometrically possible towards 37 out of the 39 assessed road receptors, however all these receptors will be significantly screened and therefore will not experience solar reflections in reality. No impacts are predicted towards road users on the surrounding roads and mitigation is therefore not required;
- Solar reflections are geometrically possible towards 21 out of the 27 assessed dwelling receptors. All predicted solar reflections will however not be experienced in reality due to the significant screening in the form of vegetation and surrounding dwellings, which will obstruct the views of the reflecting panels. No impacts are predicted towards observers located at any of the surrounding dwellings and mitigation is therefore not required.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 48 countries within Europe, Africa, 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 effects of glint and glare from a solar photovoltaic (PV) development near Halloughton, Nottinghamshire, UK.

The assessment pertains to the possible impact upon surrounding road users, dwellings, and aviation activity associated at RAF Syerston.

This report contains the following:

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

1.2 Pager Power's Experience

Pager Power has undertaken over 450 Glint and Glare assessments in the UK and internationally. The studies have included assessment of civil and military aerodromes, railway infrastructure and other ground-based receptors including roads and dwellings.

1.3 Glint and Glare Definition

The definition of glint and glare can vary however, the definition used by Pager Power is as follows[1]:

- 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.

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

[1]These definitions are aligned with those of the Federal Aviation Administration (FAA) in the United States of America.

2 SOLAR DEVELOPMENT LOCATION AND DETAILS

2.1 Development Location

Figure 1 below shows the proposed solar farm location.

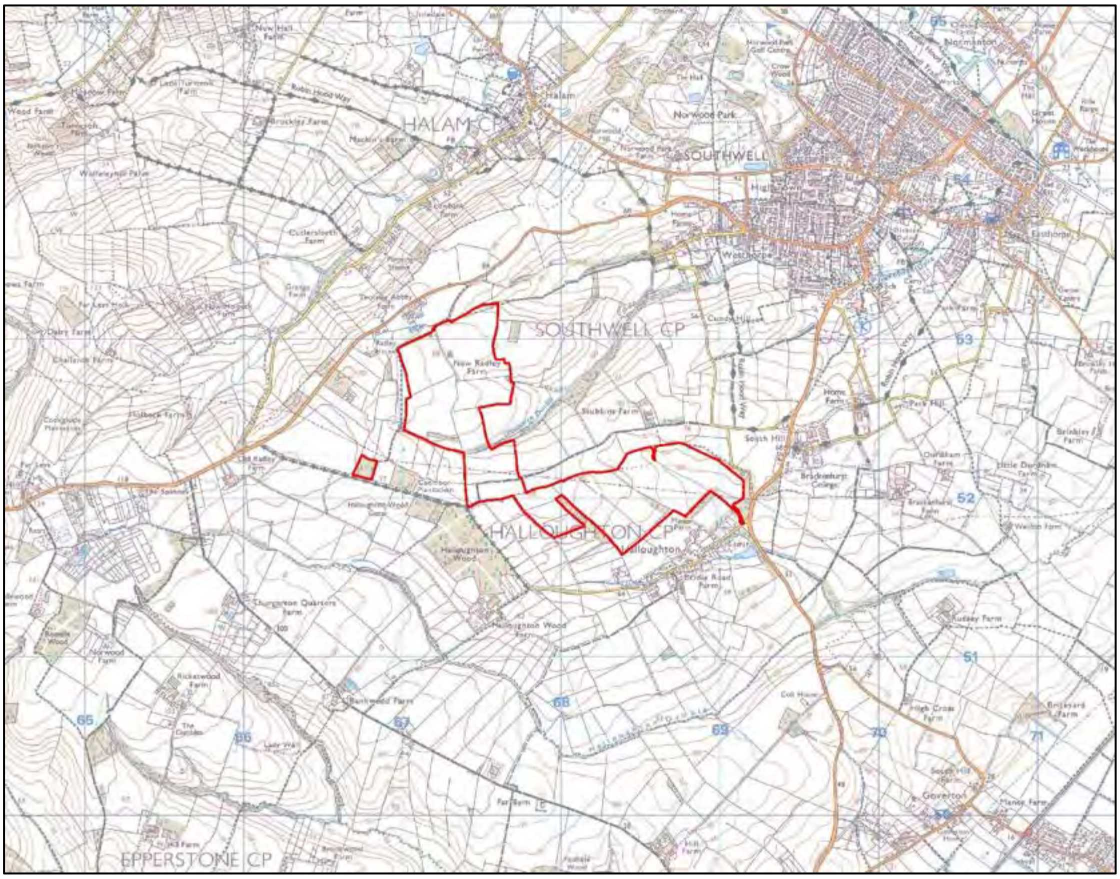

Figure 1 *Site location*

2.2 Development Details

Figure 2 on the following page shows the site layout showing the solar panels and areas of vegetation screening surrounding the panels[2]. All solar panel areas share the same characteristics and are shown in Table 1 on the following page. The middle of the solar panel has been used as the assessed height in metres above ground level (agl).

The bounding coordinates (See Appendix I) have been extrapolated from the site drawings.

[2] Source: P18-2917_12H Site Layout LR.pdf

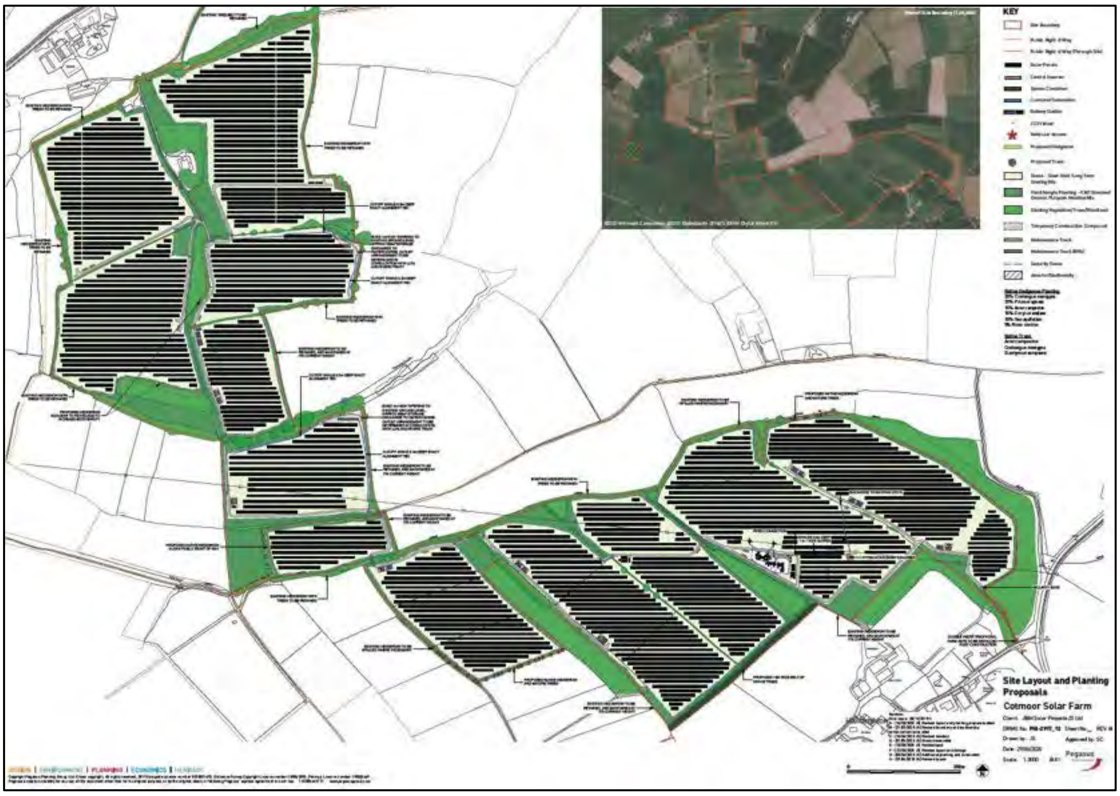

Figure 2 *Site layout*

Panel Information	
Azimuth angle (°)	180
Elevation angle (°)	20
Assessed height (m)	1.86 agl

Table 1 *Panel information*

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Guidance and Studies

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

- Specular reflections of the Sun from solar panels 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. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment.

3.2 Background

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

3.3 Pager Power's Methodology

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

- Identify receptors in the area surrounding the solar development.
- Consider direct solar reflections from the solar development towards the identified receptors by undertaking geometric calculations.
- Consider the visibility of the panels from the receptor's location. If the panels are not visible from the receptor then no reflection can occur.
- Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur.
- Consider both the solar reflection from the solar 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 – including intensity calculations where appropriate.
- Determine whether a significant detrimental impact is expected in line with the process presented in Appendix D.

Within the Pager Power model, the solar development 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.

3.4 Assessment Methodology and Limitations

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

4 HIGH-LEVEL AVIATION CONSIDERATIONS

4.1 Overview

There is no formal buffer distance within which aviation effects must be modelled. However, in practice, concerns are most often raised for developments within 10 km of a licensed airport. Requests for modelling at ranges of 10-20 km are far less common. Assessment of aviation effects for developments over 20 km from a licensed airfield is a very unusual requirement.

4.2 RAF Syerston

RAF Syerston, primarily used for training glider pilots is located 5.7 km southeast from the proposed development with three active asphalt/concrete runways:

- 06/24 – northeast/southwest;
- 11 Stub – east;
- 15/33 – southeast/northwest.

And eight active grass runways:

- 02L/20R and 02R/20L – northeast/southwest;
- 06L/24R and 06RL/24L - northeast/southwest;
- 11L/29R and 11R/29L – east/west;
- 15L/33R and 15L/33R – southeast/northwest.

The aerodrome chart is shown in Figure 3 on the following page.

For all runways oriented northeast/southwest and east/west (see above), even if a solar reflection is predicted towards pilots approaching from either bearing, the reflection will originate from outside the pilot's field of view and therefore will not be deemed significant.

For the remaining runways, pilots approaching from the northwest will not be facing towards the panels and therefore cannot be affected. Pilots approaching from the southeast could be facing the general development direction however it can be safely presumed that if effects are possible towards pilots approaching from southwest, the intensity would be acceptably low.

Finally, the airfield is primarily used for training glider pilots and is not expected to host significant MOD operations.

Overall, no significant impact on aviation interests at RAF Syerston is expected and no detailed assessment is recommended.

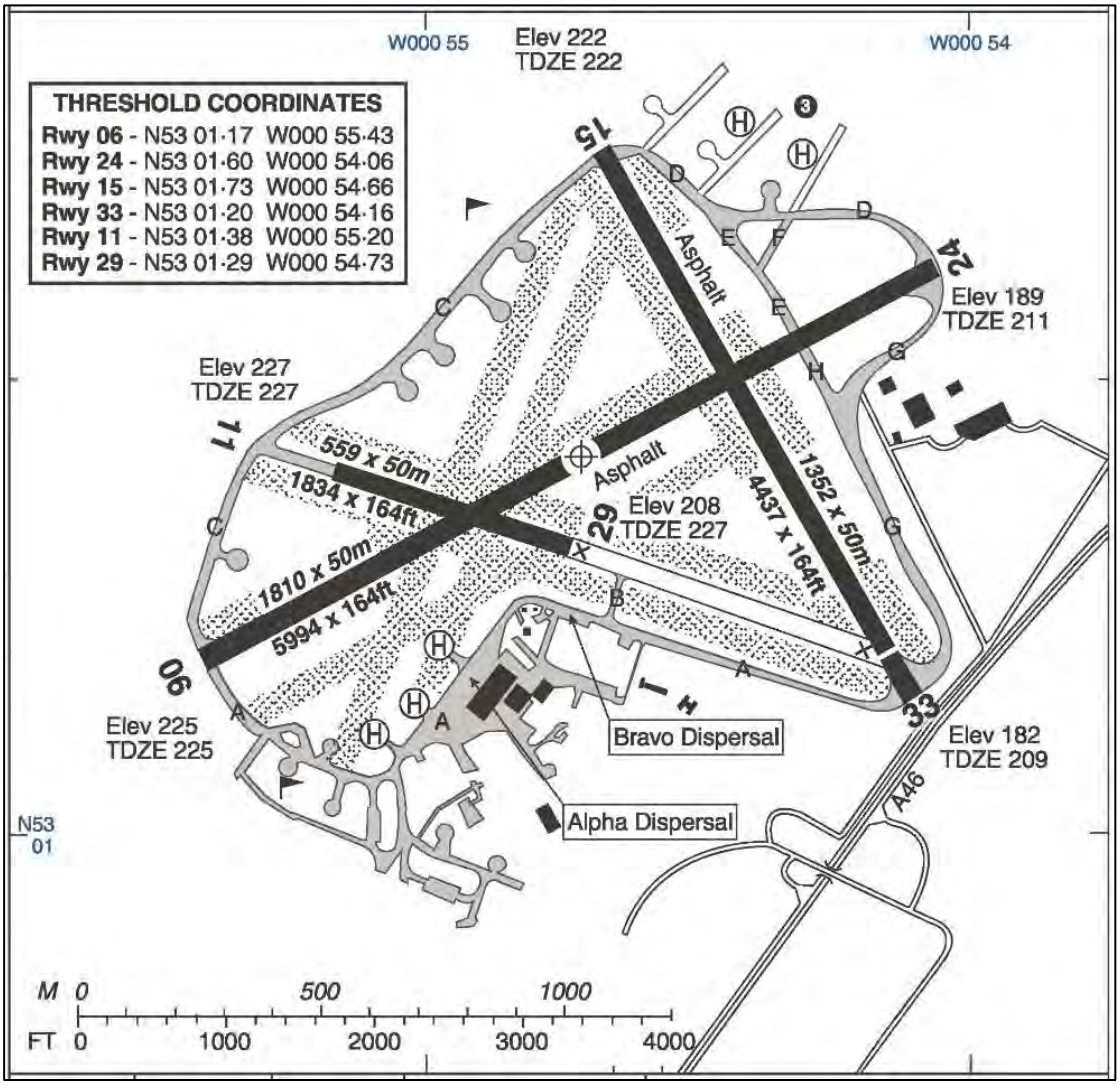

Figure 3 *RAF Syserston aerodrome chart (cropped)*

5 GROUND-BASED RECEPTORS

5.1 Ground-Based Receptors – Overview

There is no formal guidance with regard to the maximum distance at which glint and glare should be assessed. From a technical perspective, there is no maximum distance for potential reflections.

However, the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances.

A 1km buffer is considered appropriate for glint and glare effects on ground-based receptors. Receptors within this distance are identified based on mapping and aerial photography of the region.

An initial judgement of potential visibility 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 reflections would be possible. Reflections towards ground-based receptors to the north of the panels are unlikely at this latitude for fixed panels facing south and therefore have been discarded. A more detailed assessment is made if the modelling reveals a reflection would be geometrically possible.

Terrain elevation heights have been interpolated based on OSGB36 data. The co-ordinates for the receptor points are presented in Appendix H.

5.2 Road Receptors

Road types can generally be categorised as:

- Major National;
- National;
- Regional; and
- Local.

Assessment is recommended for major national, national, and regional roads where views of reflecting panels are considered possible.

Many roads surrounding the solar farm, including Bath Lane and Cotmoor Lane, are considered local roads where traffic volumes and/or speeds are likely to be relatively low. Assessment is not recommended for local roads as any solar reflections from the proposed development that are experienced by a road user would be considered 'low' impact in the worst case. These roads have therefore not been considered further.

The assessed road receptor points along the B6386 (1 – 18) and the A612 (19 – 39) are shown in Figure 4 below[3]. A height of 1.5 metres above ground level has been taken as typical eye level for a road user.

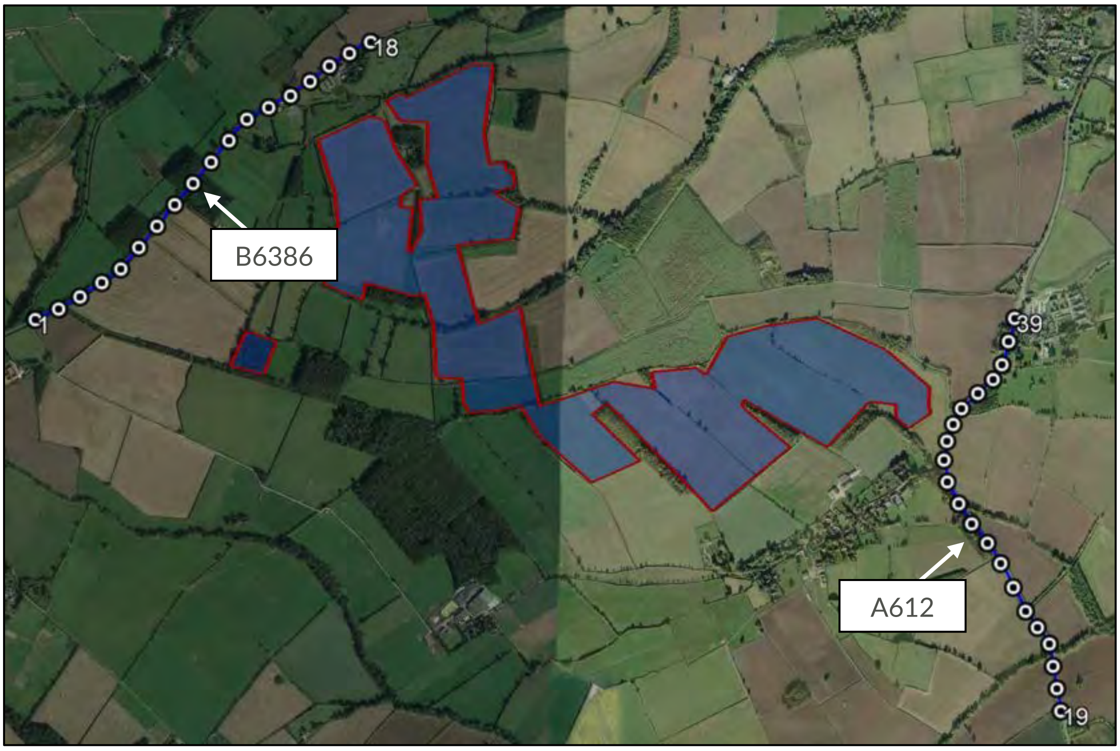

Figure 4 *Road receptors*

5.3 Dwelling Receptors

The analysis has considered dwellings that:

- Are within, or close to one kilometre of the proposed development; and
- Have a potential view of the panels.

The assessed dwelling receptors are shown in Figures 5 and 6 on the following page[4]. A height of 1.8 metres above ground level has been taken as typical eye level for an observer on the ground floor of the dwelling.

[3] Source: Aerial imagery copyright © 2020 Google.

[4] Source: Copyright © 2020 Google.

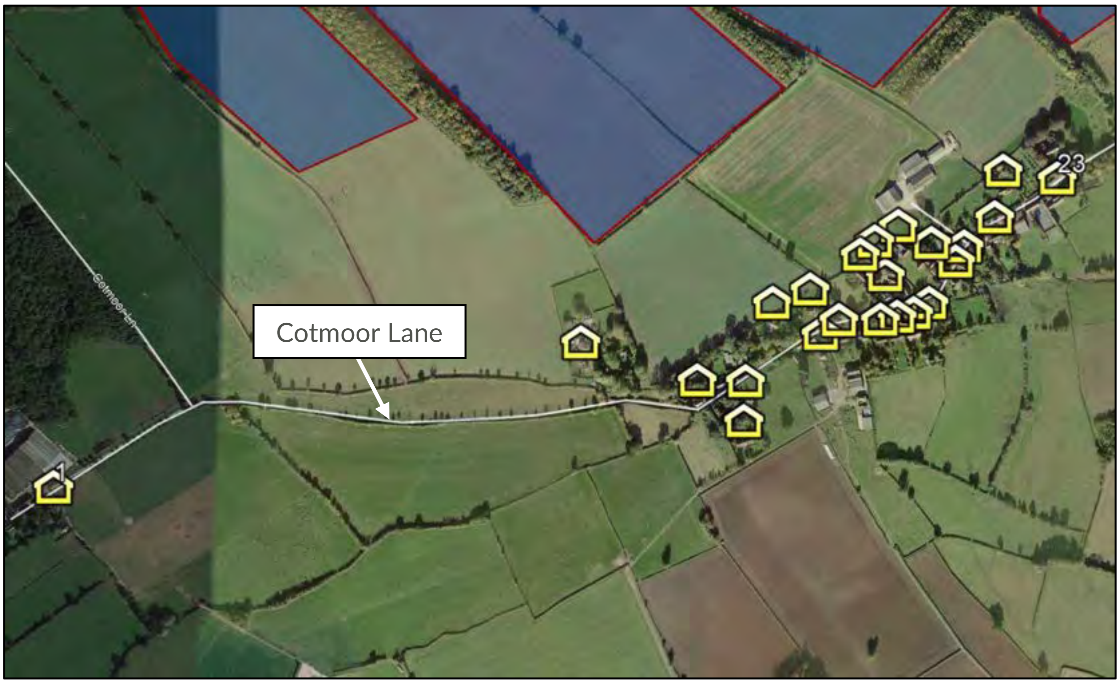

Figure 5 *Assessed dwelling receptors 1 to 23*

Figure 6 *Assessed dwelling receptors 24 to 27*

6 ASSESSED REFLECTOR AREA

6.1 Overview

The following section presents the modelled reflector area.

6.2 Reflector Area

A number of representative panel locations are selected within the proposed reflector area with the number of modelled reflector points being determined by the size of the reflector area and the assessment resolution. The bounding co-ordinates for the proposed solar development have been extrapolated from the site plans. All ground heights have been based on OSGB36 terrain data and the and building and panel elevation data has been extrapolated and/or estimated. 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 area. This resolution is sufficiently high to maximise the accuracy of the results – increasing the resolution further would not significantly change the modelling output. If a reflection is experienced from an assessed panel location, then it is likely that a reflection will be viewable from similarly located panels within the proposed solar development.

The assessed reflector area is shown in Figure 7 below.

Figure 7 *Assessed reflector area*

7 GLINT AND GLARE ASSESSMENT – TECHNICAL RESULTS

7.1 Overview

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

The modelling output showing the precise predicted times and the reflecting panel area is shown in Appendix J.

7.2 Geometric Calculation Results Overview – Road Receptors

7.2.1 B6386

Receptor	Pager Power Results		Comments
	Reflection Possible Towards Receptor?		
	am	pm	
1 – 16	Yes.	No.	Predicted solar reflections will not be experienced in practice as the solar panels will be significantly screened by vegetation. No impact predicted.
17 - 18	No.	No.	No solar reflections geometrically possible. No impact possible.

Table 2 *Geometric analysis results – B6386*

7.2.2 A612

Receptor	Pager Power Results		Comments
	Reflection Possible Towards Receptor?		
	am	pm	
19	No.	No.	No solar reflections geometrically possible. No impact possible.
20 - 38	No.	Yes.	Predicted solar reflections will not be experienced in practice as the solar panels will be significantly screened by vegetation. No impact possible.
39	No.	No.	No solar reflections geometrically possible. No impact possible.

Table 3 *Geometric analysis results – A612*

7.3 Geometric Calculation Results Overview – Dwelling Receptors

Receptor	Pager Power Results		Comments
	Reflection Possible Towards Receptor?		
	am	pm	
1 – 5	No.	No.	No solar reflections geometrically possible. No impact possible.
6 – 23	No.	Yes.	Predicted solar reflections will be significantly screened by vegetation and/or surrounding dwellings. No impact predicted.
24 – 26	Yes.	No.	
27	Yes.	Yes.	Predicted solar reflections will be significantly screened by vegetation. No impact predicted.

Table 4 *Geometric analysis results – Dwellings*

8 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

8.1 Overview

The results of the glint and glare calculations are presented in the following sub-sections.

8.2 Road Receptors

The process for quantifying impact significance is defined in the report appendices. For road users, the key considerations are:

- Whether a reflection is predicted in practice.
- The type of road (and associated likely traffic levels/speeds).
- The location of the reflecting panel relative to a road user's direction of travel (a reflection directly in front of a driver is more hazardous than a reflection from a location off to one side).

8.2.1 B6386 Results

The modelling has shown that solar reflections are predicted towards 16 out of the 18 assessed road receptors along the B6386. However, the imagery shows that all receptors where a solar reflection is predicted will be significantly screened by hedgerows adjacent to the road or by vegetation that will be maintained at the site boundary[5].

The views of a road user at three locations along the B6386 are shown in Figures 8 to 10 on the following page, which represents the level of screening along the entirety of this section of road[6]:

- Figure 8: Road receptor 1 – proposed development to the right;
- Figure 9: Road receptor 9 – proposed development to the right;
- Figure 10: Road receptor 14 – proposed development to the right.

Overall, no impacts are predicted upon road users along the B6386 and mitigation is therefore not required.

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[5] Maintained vegetation screening can be seen in Figure 2 in Section 2.2.
[6] Source: Copyright © 2020 Google.

Figure 8 *View at road receptor 1 (travelling northeast)*

Figure 9 *View at road receptor 9 (travelling northeast)*

Figure 10 *View at road receptor 14 (travelling northeast)*

8.2.2 A612 Results

The modelling has shown that solar reflections are predicted towards all of the assessed road receptors along the A612. However, the imagery shows that all receptors will be significantly screened by hedgerows adjacent to the road or by vegetation that will be maintained at the site boundary.

The views of a road user at two locations along the A612 are shown in Figure 11 below and Figure 12 on the following page, which represents the level of screening along the entirety of this section of road[7]:

- Figure 11: Road receptor 31 – proposed development to the left;
- Figure 12: Road receptor 37 – proposed development to the right.

Overall, no impacts are predicted upon road users along the A612 and mitigation is therefore not required.

Figure 11 *View at road receptor 31 (travelling northeast)*

[7] Source: Copyright © 2020 Google.

Figure 12 *View at road receptor 37 (travelling southwest)*

8.3 Dwelling Results

The results of the modelling indicate that solar reflections are geometrically possible towards 21 out of the 27 assessed dwelling receptors. The process for quantifying impact significance is defined in the report appendices. For dwelling receptors, the key considerations are:

- Whether a significant reflection is predicted in practice.
- The duration of the predicted effects, relative to thresholds of:
    - 3 months per year; and
    - 60 minutes per day.

A review of the available imagery shows that screening in the form of vegetation and surrounding dwellings will obstruct views of the reflecting panels for observers located in the surrounding dwellings. All predicted solar reflections will therefore not experienced in reality.

Figures 13 and 14 on the following page show the areas of significant screening (white areas) in the form of vegetation or surrounding buildings as well as the dwellings where solar reflections are geometrically possible[8]. The location of the additional 15-metre-wide belt of native trees that will be planted along a section of the southern boundary is also shown.

Overall, no impacts upon observers located at the surrounding dwellings are predicted and mitigation is therefore not required.

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[8] Source: Copyright © 2020 Google.

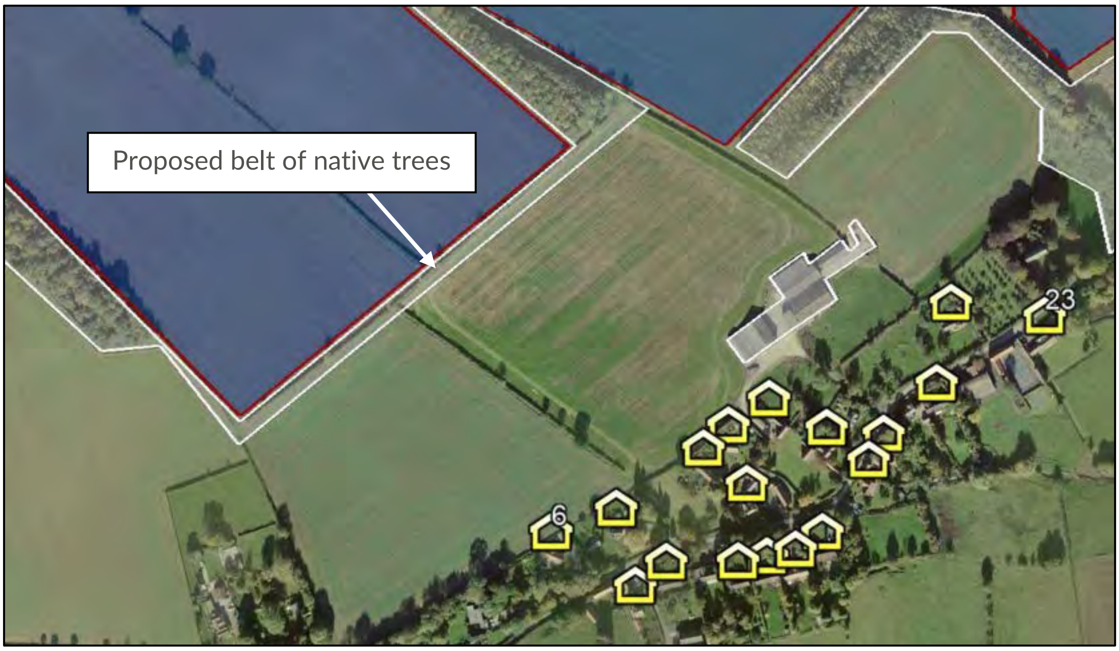

Figure 13 *Significant screening – Dwellings 6 to 23*

Figure 14 *Significant screening – Dwellings 24 to 27*

9 OVERALL CONCLUSIONS

9.1 Modelling Results

- No detailed assessment is recommended for RAF Syerston as it can be safely presumed that if solar reflections are possible, intensities would be acceptably low. This is due to the orientation of the runways and the distance from the proposed development;
- Solar reflections are geometrically possible towards 37 out of the 39 assessed road receptors, however all these receptors will be significantly screened and therefore will not experience solar reflections in reality. No impacts are predicted towards road users on the surrounding roads and mitigation is therefore not required;
- Solar reflections are geometrically possible towards 21 out of the 27 assessed dwelling receptors. All predicted solar reflections will however not be experienced in reality due to the significant screening in the form of vegetation and surrounding dwellings, which will obstruct the views of the reflecting panels. No impacts are predicted towards observers located at any of the surrounding dwellings and mitigation is therefore not required.

9.2 Conclusions

Overall, no significant impacts upon any of the assessed ground-based receptors have been identified and therefore mitigation is not required.

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

UK National Planning Practice Guidance dictates that in some instances a glint and glare assessment is required however, there is no specific guidance with respect to the methodology for assessing the impact of glint and glare.

The planning policy from the Department for Communities and Local Government (paragraph 27[9]) states:

'Particular factors a local planning authority will need to consider include… the effect on landscape of glint and glare and on ***neighbouring uses and aircraft safety****.'*

The National Planning Policy Framework for Renewable and Low Carbon Energy[10] (specifically regarding the consideration of solar farms) 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.'

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[9] http://planningguidance.planningportal.gov.uk/blog/guidance/renewable-and-low-carbon-energy/
[10]Reference ID: 5-013-20140306, paragraph 13-13,http://planningguidance.planningportal.gov.uk/blog/guidance/renewable-and-low-carbon-energy/particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines/

Assessment Process

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 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.

Ground Based Assessment Guidelines

There are no specific guidelines for assessing the impact of solar reflections upon surrounding roads, byways, footpaths and dwellings. Therefore, the Pager Power approach has been informed by the policy presented above, current studies (presented in Appendix B) and stakeholder consultation.

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

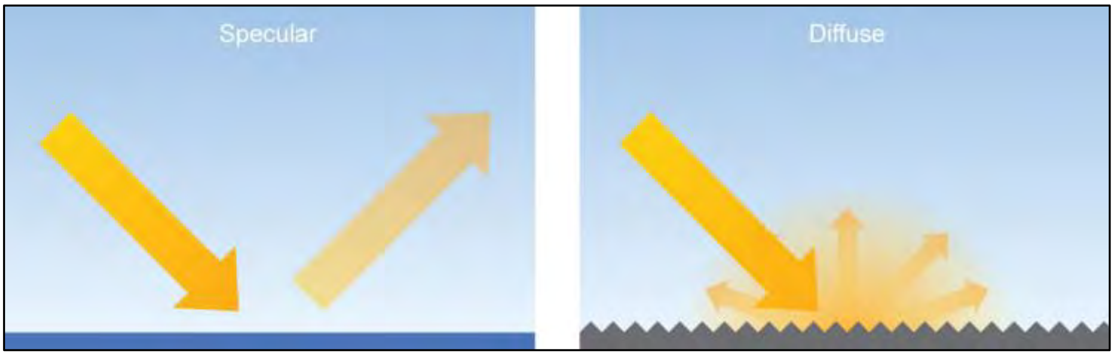
Overview

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

There are no specific studies for determining the effect of reflections from solar panels with respect to dwellings. 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[11], taken from the FAA guidance, 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

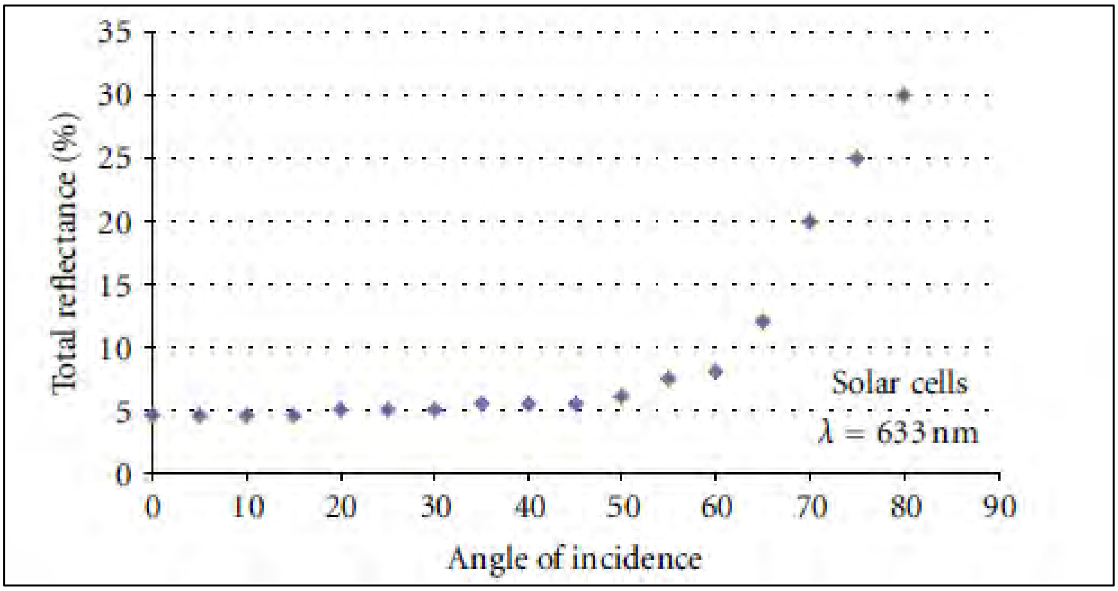
[11] http://www.faa.gov/airports/environmental/policy_guidance/media/airport_solar_guide_print.pdf

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*[12]". 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.

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[12] 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"[13]

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[14] within the FAA guidance, is presented below.

Surface	Approximate Percentage of Light Reflected[15]
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.

[13] FAA, November (2010): *Technical Guidance for Evaluating Selected Solar Technologies on Airports.*
[14] http://www.faa.gov/airports/environmental/policy_guidance/media/airport_solar_guide_print.pdf
[15] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification[16] to '*increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment*'. The study revealed that the reflectivity of a solar panel is considerably lower than that 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.

Figures within the document show the relative reflectivity of solar panels compared to other natural and manmade materials including smooth water, standard glass and steel. 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 produced from these surfaces.

[16] Technical Support, 2009. SunPower Technical Notification- Solar Module Glare and Reflectance.

APPENDIX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

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

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

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

The combination of the Sun's azimuth angle and vertical elevation will affect the direction and angle of the reflection from a reflector.

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

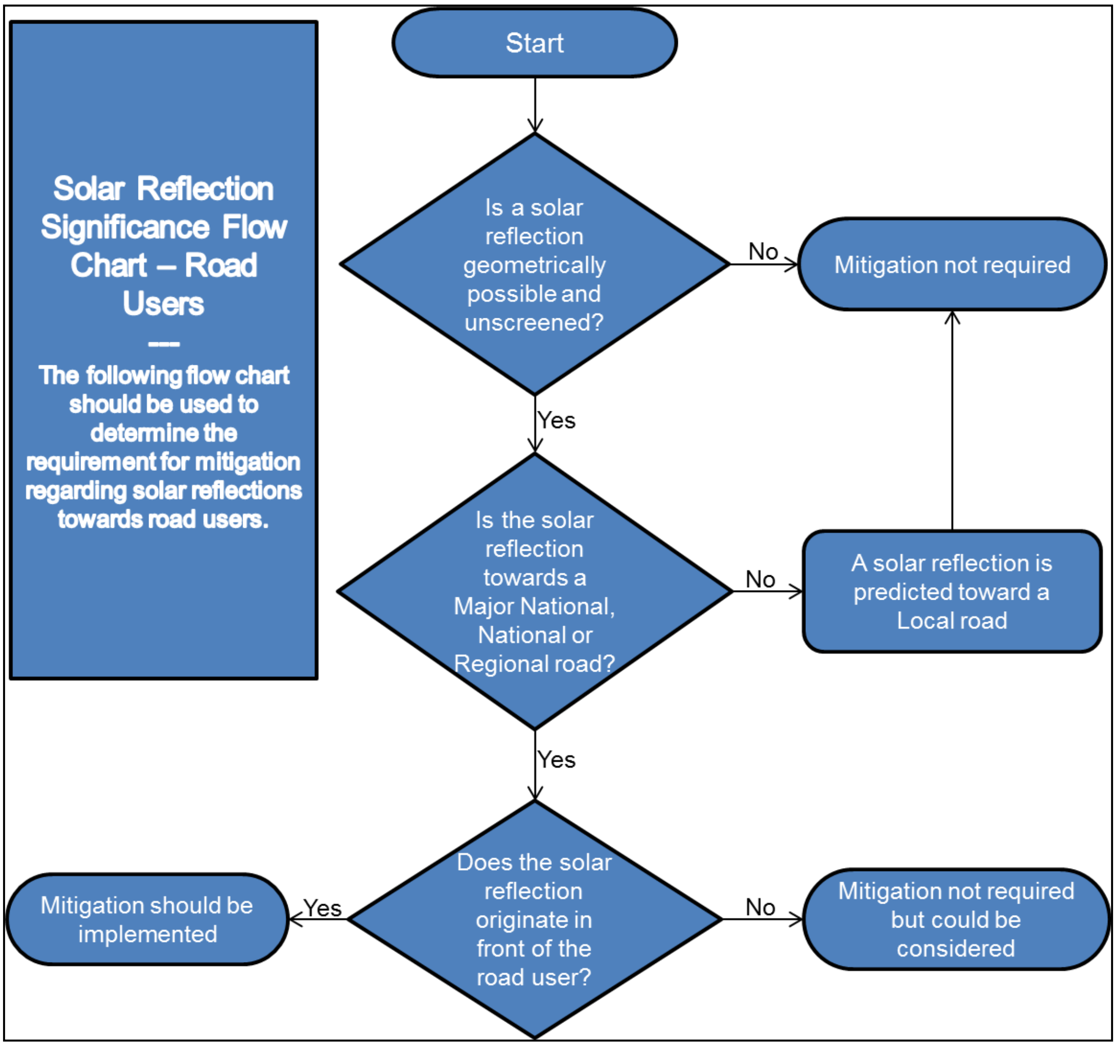
The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

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 solar development is to proceed.

Impact significance definition

Assessment Process for Road Receptors

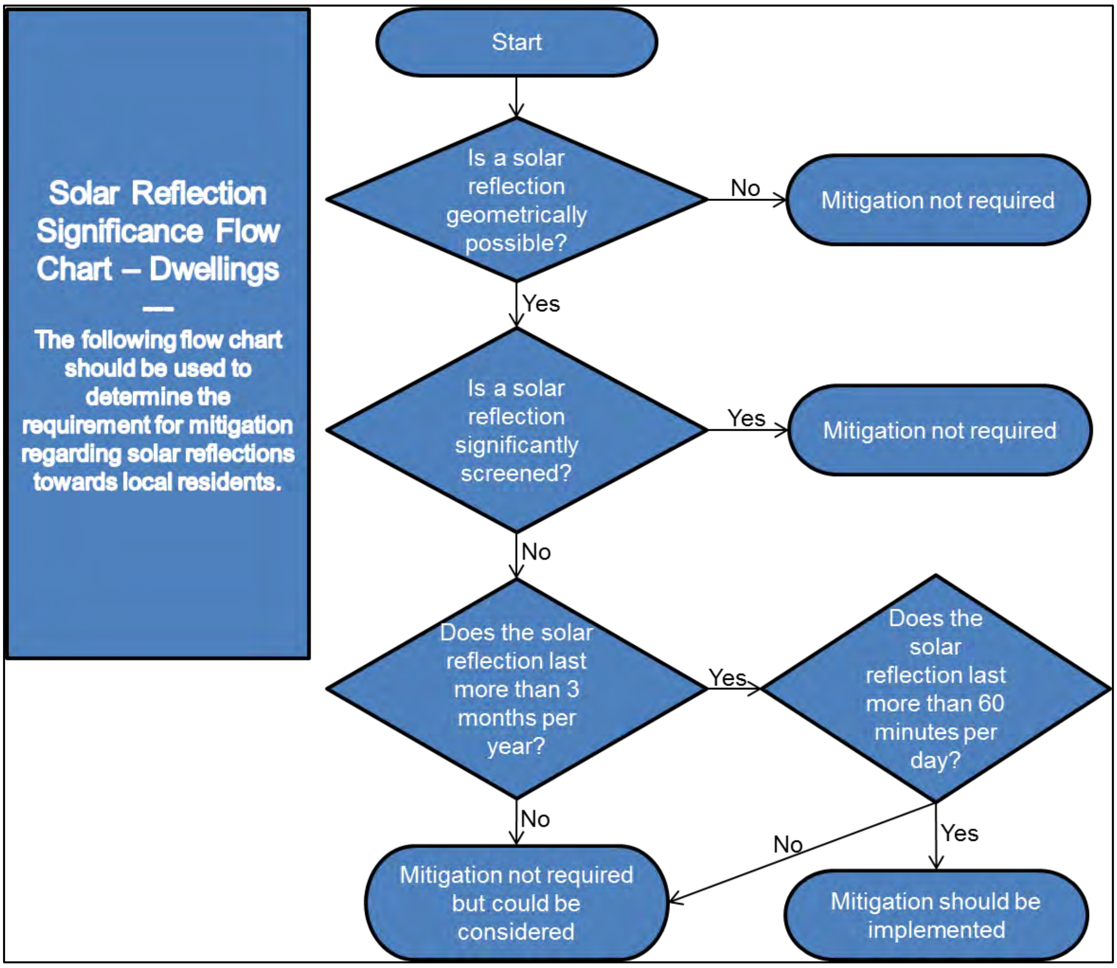
The flow chart presented below has been followed when determining the mitigation requirement for road receptors.



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.



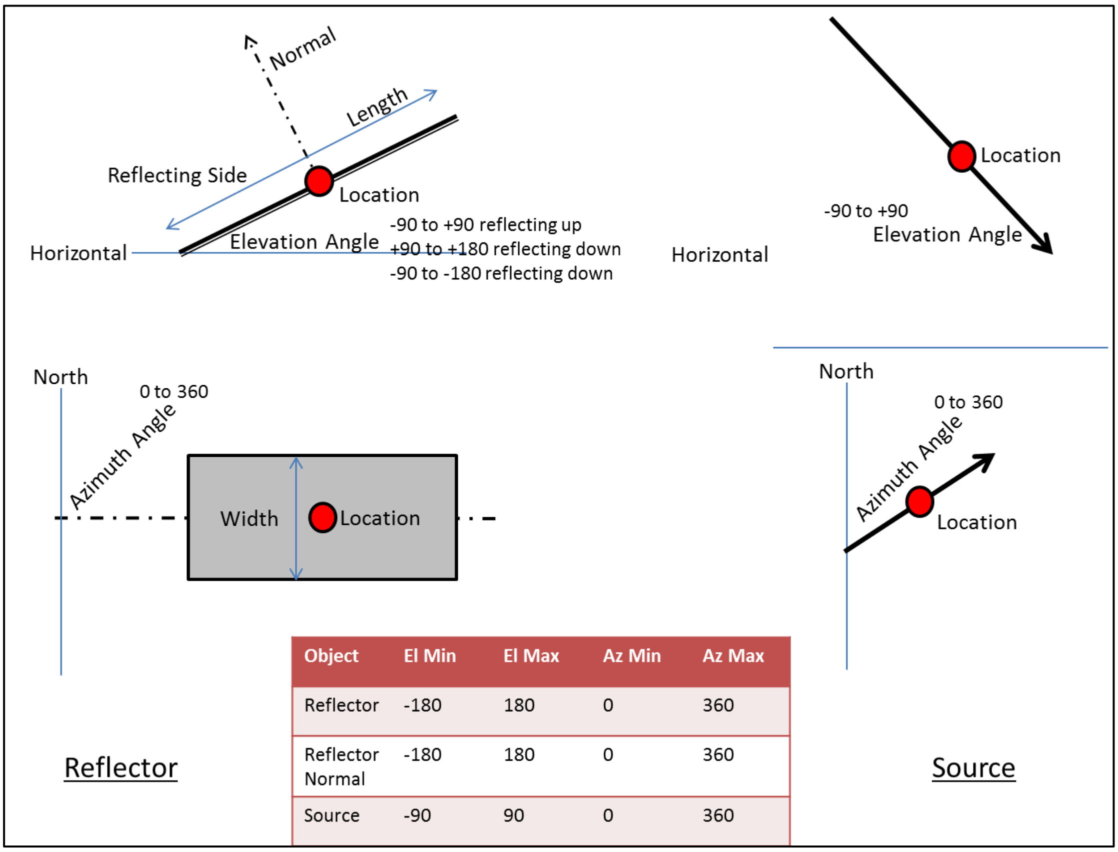
Dwelling receptor mitigation requirement flow chart

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

- It is assumed that the panel elevation angle provided by the developer represents the elevation angle for all of the panels within the solar development unless otherwise stated.
- It is assumed that the panel azimuth angle provided by the developer represents the azimuth angle for all of the panels within the solar development unless otherwise stated.
- Only a reflection from the face of the panel has been considered. The frame or the reverse of the solar panel has not been considered.
- The model assumes that a receptor can view the face of every panel within the proposed development area whilst in reality this, in the majority of cases, will not occur. Therefore any predicted reflection from the face of a solar panel that is not visible to a receptor will not occur.
- A finite number of points within the proposed development are chosen based on an assessment resolution so we can build a comprehensive understanding of the entire development. This will determine whether a reflection could ever occur at a chosen receptor. The calculations do not incorporate all of the possible panel locations within the development outline.
- A single reflection point on the panel has been chosen for the geometric calculations. This will suitably determine whether a reflection can be experienced at a location and the general time of year and duration of this 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.
- Whilst line of sight to the development from receptors has been considered, only available street view imagery and satellite mapping has been used. 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 considered unless stated.

APPENDIX G – GROUND RECEPTOR DETAILS

Terrain Height

All ground heights are interpolated based on OSGB Panorama data.

Road Receptor Data

B6386

Location	Longitude (°)	Latitude (°)	Location	Longitude (°)	Latitude (°)
1	-1.01628	53.06393	10	-1.00725	53.06886
2	-1.01509	53.06426	11	-1.00632	53.06952
3	-1.01401	53.06464	12	-1.00539	53.07019
4	-1.01290	53.06509	13	-1.00426	53.07056
5	-1.01191	53.06551	14	-1.00312	53.07093
6	-1.01098	53.06618	15	-1.00211	53.07138
7	-1.01005	53.06685	16	-1.00111	53.07186
8	-1.00912	53.06752	17	-1.00006	53.07226
9	-1.00819	53.06819	18	-0.99897	53.07262

A612

Location	Longitude (°)	Latitude (°)	Location	Longitude (°)	Latitude (°)
19	-0.96281	53.05159	29	-0.96816	53.05814
20	-0.96299	53.05229	30	-0.96878	53.05883
21	-0.96317	53.05300	31	-0.96896	53.05952
22	-0.96335	53.05370	32	-0.96881	53.06021
23	-0.96399	53.05422	34	-0.96817	53.06109
24	-0.96464	53.05474	35	-0.96730	53.06157
25	-0.96529	53.05550	36	-0.96643	53.06206
26	-0.96595	53.05625	37	-0.96599	53.06253
27	-0.96666	53.05690	38	-0.96565	53.06326
28	-0.96748	53.05750	39	-0.96532	53.06398

Dwelling Receptor Data

Dwelling	Longitude (°)	Latitude (°)	Dwelling	Longitude (°)	Latitude (°)
1	-0.99273	53.05448	15	-0.97545	53.05747
2	-0.98149	53.05634	16	-0.97514	53.05765
3	-0.97898	53.05585	17	-0.97463	53.05785
4	-0.97799	53.05532	18	-0.97391	53.05763
5	-0.97794	53.05583	19	-0.97339	53.05739
6	-0.97735	53.05685	20	-0.97320	53.05758
7	-0.97654	53.05702	21	-0.97253	53.05796
8	-0.97630	53.05645	22	-0.97236	53.05857
9	-0.97592	53.05663	23	-0.97119	53.05847
10	-0.97502	53.05663	24	-1.00383	53.07051
11	-0.97466	53.05667	25	-1.00315	53.07055
12	-0.97430	53.05672	26	-0.99958	53.07175
13	-0.97397	53.05685	27	-0.99693	53.06914
14	-0.97491	53.05721			

APPENDIX H – SOLAR PANEL MODEL DETAILS

Panel Boundary Data

Location	Longitude (°)	Latitude (°)	Location	Longitude (°)	Latitude (°)
01	-1.00177	53.06951	36	-0.98639	53.06195
02	-1.00070	53.06679	37	-0.99024	53.06118
03	-1.00118	53.06660	38	-0.99133	53.06428
04	-1.00146	53.06501	39	-0.99339	53.06378
05	-0.99946	53.06452	40	-0.99449	53.06616
06	-0.99931	53.06504	41	-0.99169	53.06638
07	-0.99679	53.06464	42	-0.99130	53.06742
08	-0.99626	53.06471	43	-0.99263	53.06790
09	-0.99575	53.06350	44	-0.99155	53.06808
10	-0.99569	53.06193	45	-0.99163	53.06857
11	-0.99436	53.06192	46	-0.99194	53.06855
12	-0.99413	53.06097	47	-0.99205	53.06882
13	-0.99128	53.06120	48	-0.99285	53.06877
14	-0.98756	53.05878	49	-0.99313	53.06973
15	-0.98501	53.05949	50	-0.99266	53.07188
16	-0.98749	53.06094	51	-0.99371	53.07191
17	-0.98672	53.06131	52	-0.99716	53.07086
18	-0.98139	53.05816	53	-0.99743	53.07096
19	-0.97742	53.06004	54	-0.99822	53.07074
20	-0.97980	53.06133	55	-0.99748	53.07013
21	-0.97962	53.06148	56	-0.99606	53.07008
22	-0.97530	53.06003	57	-0.99610	53.06878
23	-0.97308	53.06134	58	-0.99553	53.06773
24	-0.97153	53.06123	59	-0.99645	53.06763

25	-0.97151	53.06081	60	-0.99637	53.06667
26	-0.97091	53.06048	61	-0.99690	53.06603
27	-0.96980	53.06094	62	-0.99709	53.06604
28	-0.96984	53.06180	63	-0.99685	53.06739
29	-0.97211	53.06296	64	-0.99749	53.06742
30	-0.97572	53.06396	65	-0.99742	53.06780
31	-0.98045	53.06337	66	-0.99661	53.06811
32	-0.98155	53.06216	67	-0.99769	53.06917
33	-0.98207	53.06240	68	-0.99832	53.07013
34	-0.98438	53.06225	69	-0.99912	53.07025
35	-0.98423	53.06174			

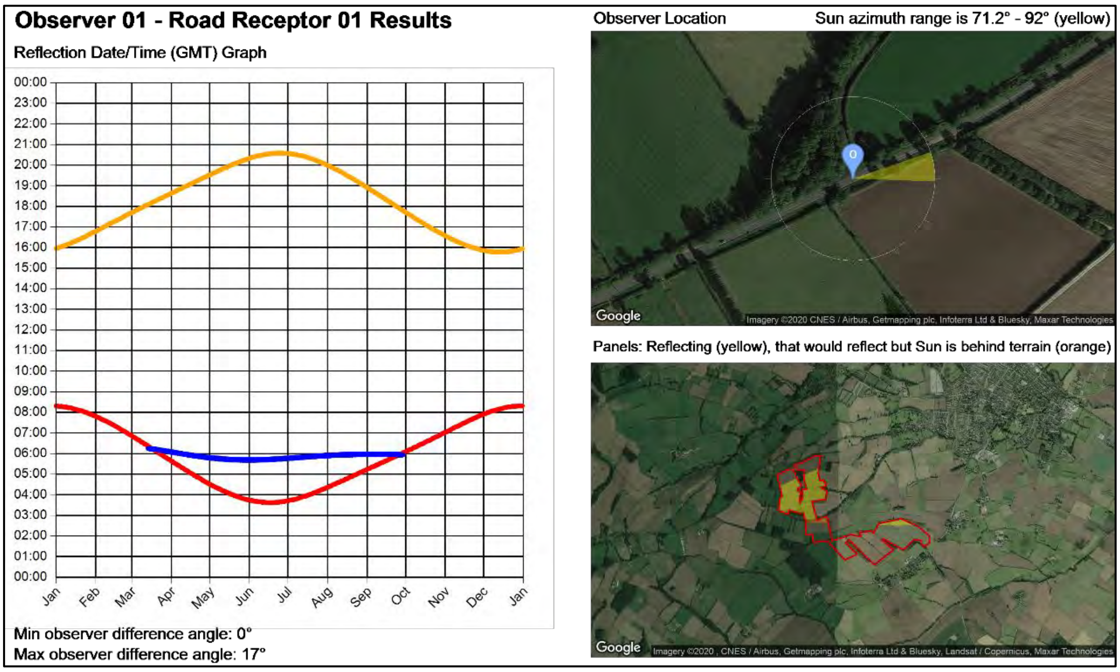
APPENDIX I – DETAILLED MODELLING RESULTS

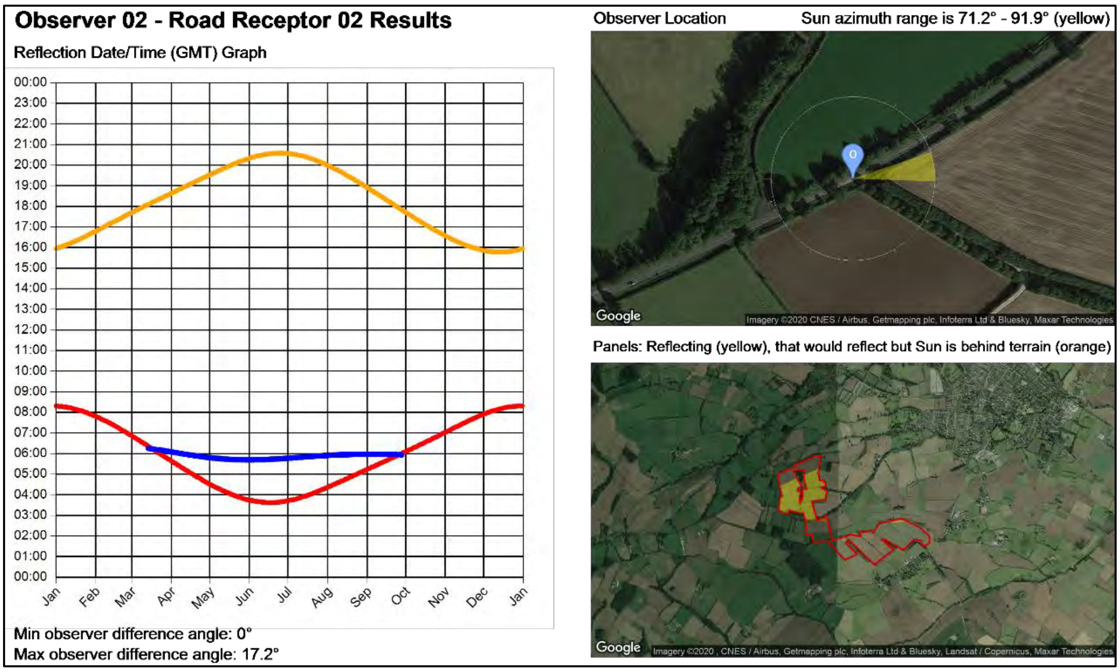
Overview

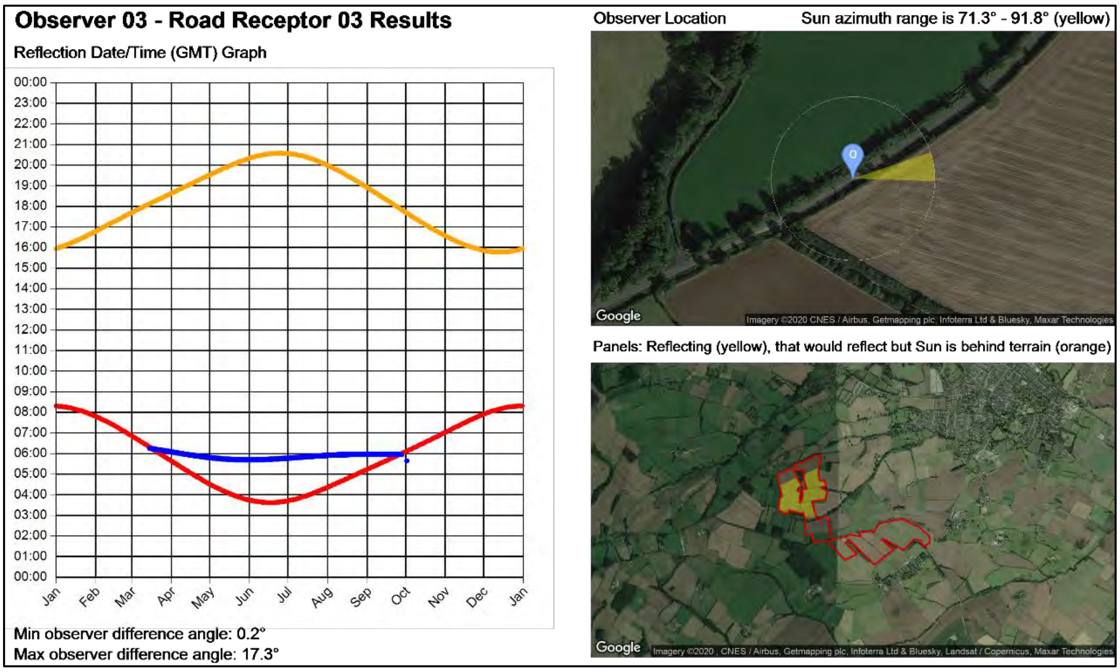
The charts for the potentially affected receptors are shown on the following pages. Each chart shows:

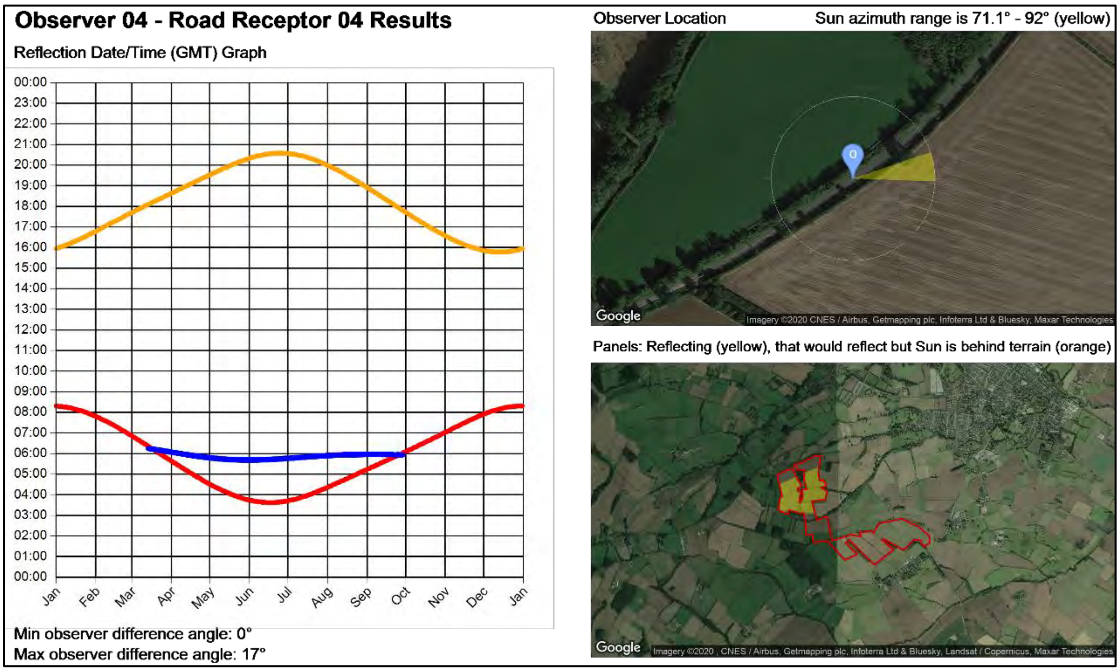
- The receptor (observer) location – top right image. This also shows the azimuth range of the Sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of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

Roads


Observer 01 - Road Receptor 01 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°
Max observer difference angle: 17°
Observer Location
Sun azimuth range is 71.2° - 92° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

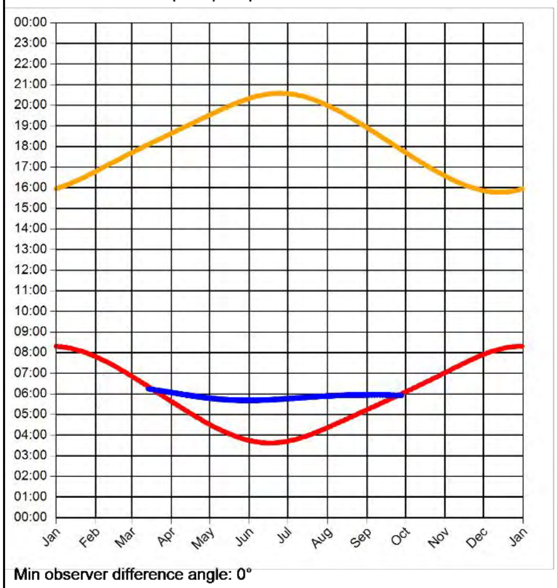

Observer 02 - Road Receptor 02 Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 0°
Max observer difference angle: 17.2°
Observer Location
Sun azimuth range is 71.2° - 91.9° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 03 - Road Receptor 03 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: 17.3°
Observer Location
Sun azimuth range is 71.3° - 91.8° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 04 - Road Receptor 04 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°
Max observer difference angle: 17°
Observer Location
Sun azimuth range is 71.1° - 92° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

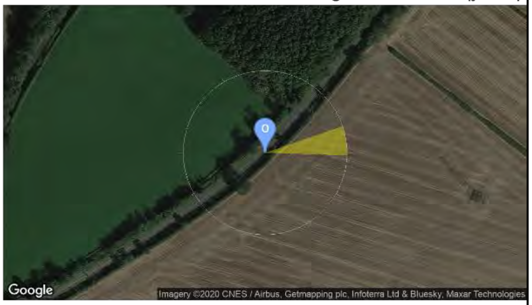
Observer 05 - Road Receptor 05 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0°
Max observer difference angle: 17.1°

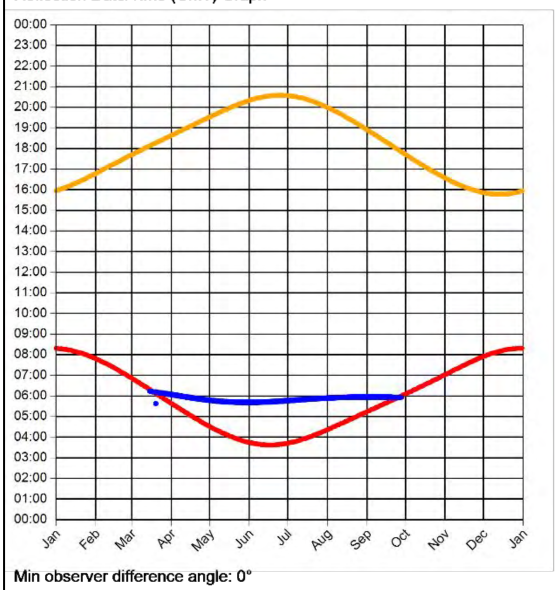
Observer Location — Sun azimuth range is 71.1° - 91.9° (yellow)



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

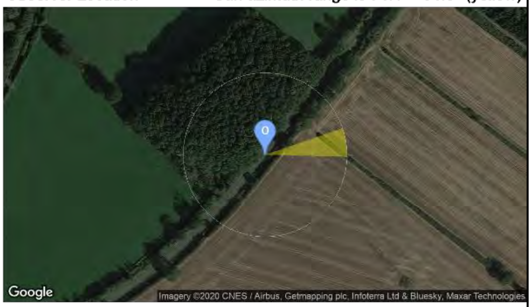
Observer 06 - Road Receptor 06 Results

Reflection Date/Time (GMT) Graph

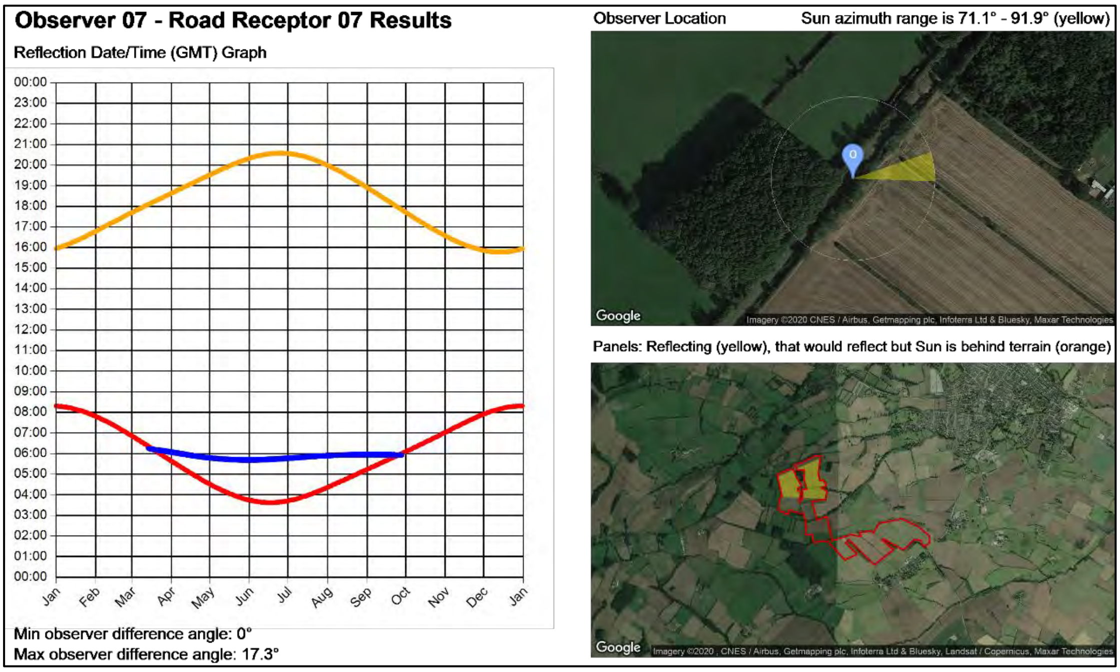


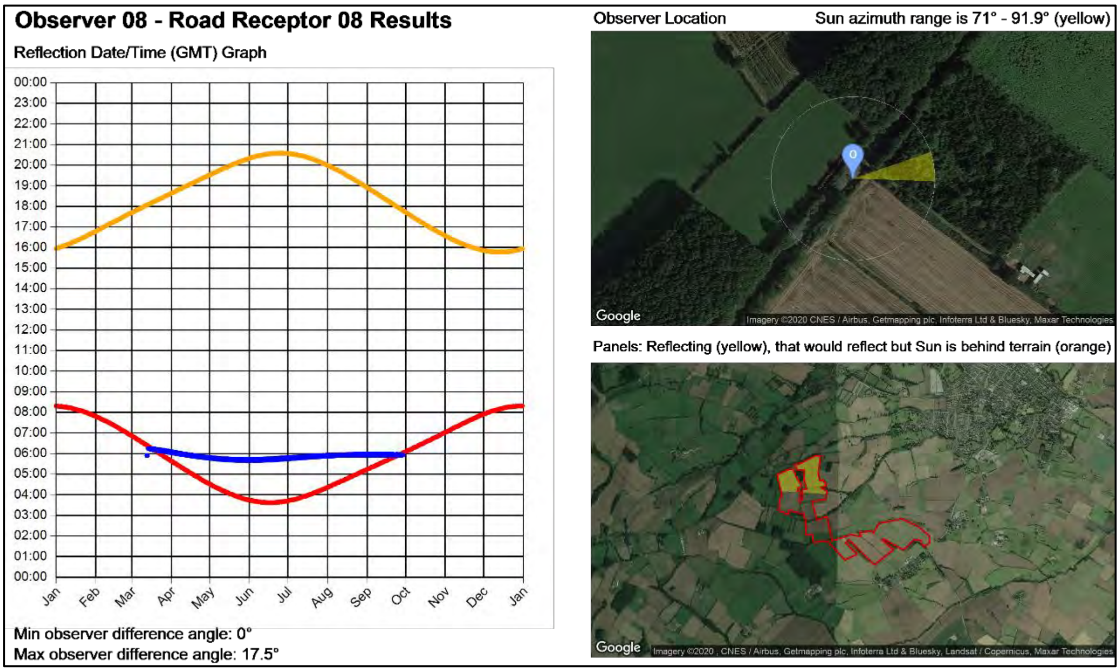
Min observer difference angle: 0°
Max observer difference angle: 17.1°

Observer Location — Sun azimuth range is 71.1° - 91.5° (yellow)



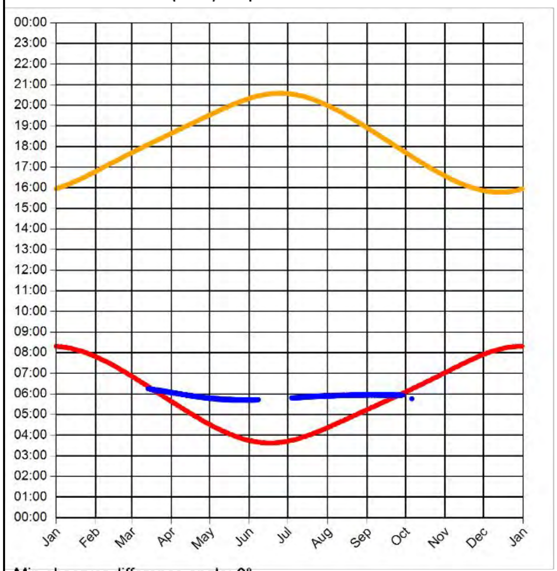
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer 07 - Road Receptor 07 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°
Max observer difference angle: 17.3°
Observer Location
Sun azimuth range is 71.1° - 91.9° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 08 - Road Receptor 08 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°
Max observer difference angle: 17.5°
Observer Location
Sun azimuth range is 71° - 91.9° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

Observer 09 - Road Receptor 09 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0°
Max observer difference angle: 17°

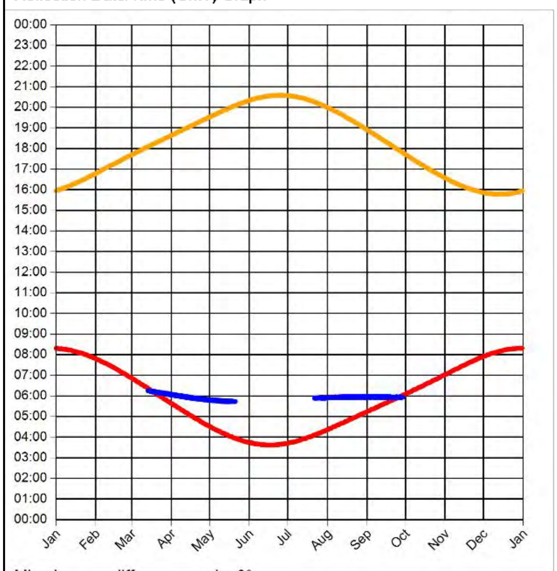
Observer Location

Sun azimuth range is 71.9° - 92.1° (yellow)

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

Observer 10 - Road Receptor 10 Results

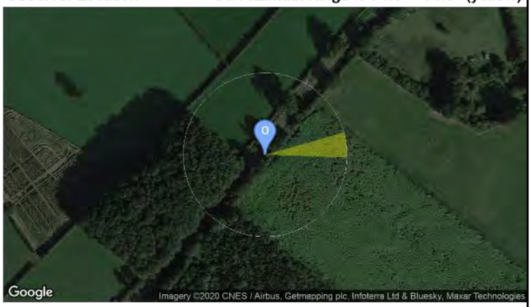
Reflection Date/Time (GMT) Graph



Min observer difference angle: 0°
Max observer difference angle: 15.3°

Observer Location

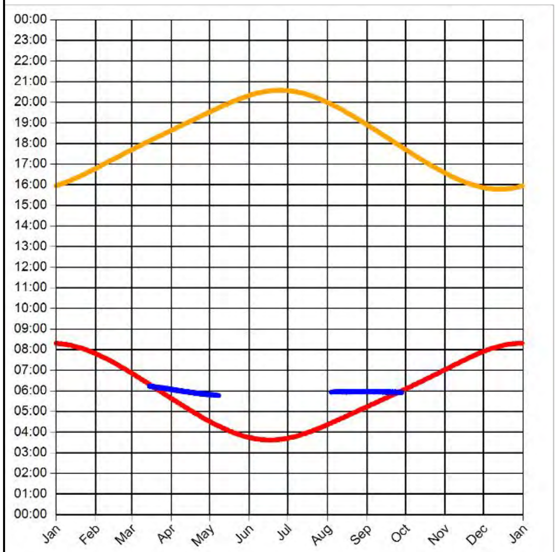
Sun azimuth range is 74.3° - 91.9° (yellow)



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

Observer 11 - Road Receptor 11 Results

Reflection Date/Time (GMT) Graph



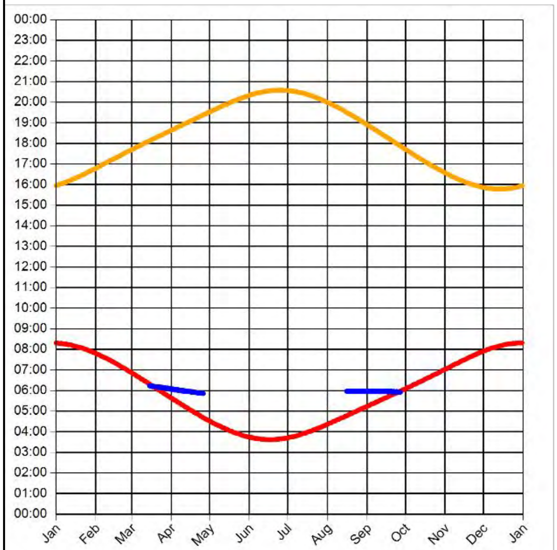
Min observer difference angle: 0°
Max observer difference angle: 13.3°

Observer Location — Sun azimuth range is 76.8° - 91.7° (yellow)

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

Observer 12 - Road Receptor 12 Results

Reflection Date/Time (GMT) Graph



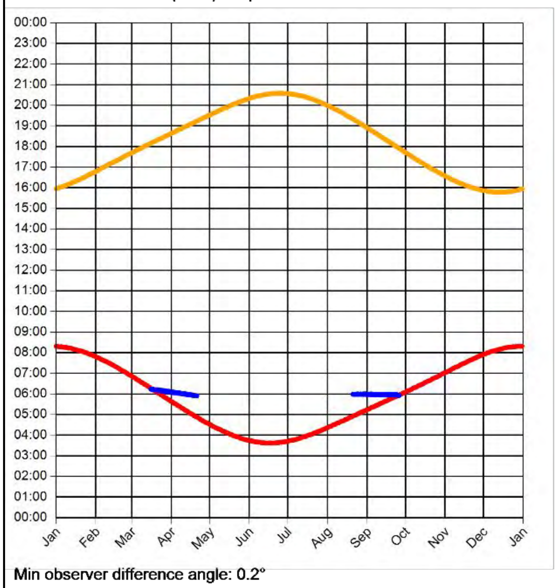
Min observer difference angle: 0°
Max observer difference angle: 10.9°

Observer Location — Sun azimuth range is 79.7° - 91.5° (yellow)

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

Observer 13 - Road Receptor 13 Results

Reflection Date/Time (GMT) Graph



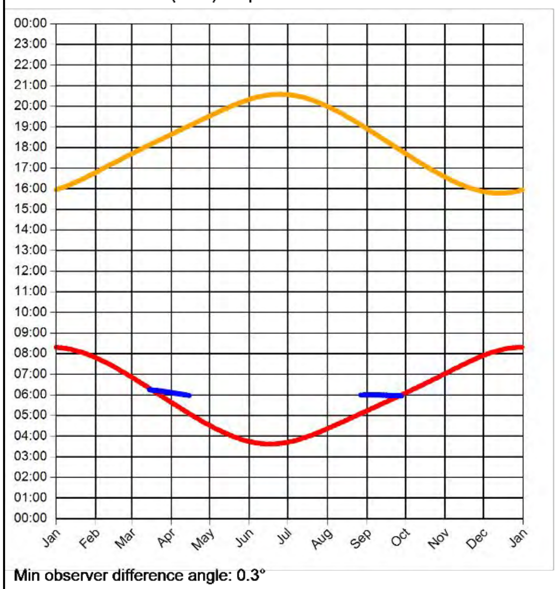
Min observer difference angle: 0.2°
Max observer difference angle: 10°

Observer Location | Sun azimuth range is 81.1° - 91.2° (yellow)

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

Observer 14 - Road Receptor 14 Results

Reflection Date/Time (GMT) Graph



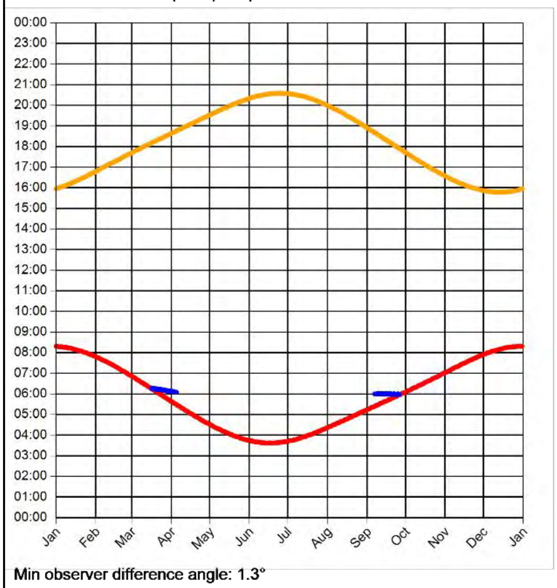
Min observer difference angle: 0.3°
Max observer difference angle: 8.8°

Observer Location | Sun azimuth range is 82.9° - 91.8° (yellow)

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

Observer 15 - Road Receptor 15 Results

Reflection Date/Time (GMT) Graph



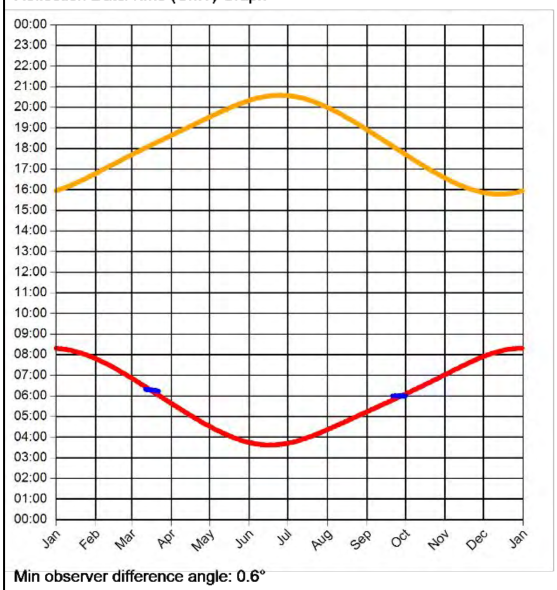
Min observer difference angle: 1.3°
Max observer difference angle: 6.4°

Observer Location — Sun azimuth range is 85.9° - 91.7° (yellow)

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

Observer 16 - Road Receptor 16 Results

Reflection Date/Time (GMT) Graph



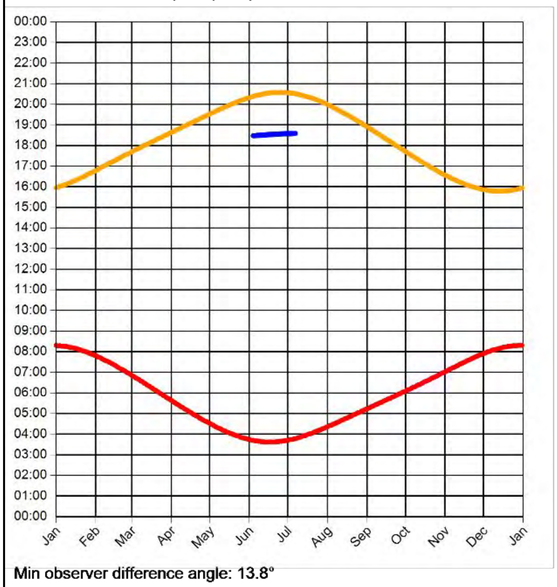
Min observer difference angle: 0.6°
Max observer difference angle: 2.9°

Observer Location — Sun azimuth range is 90.2° - 93.3° (yellow)

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

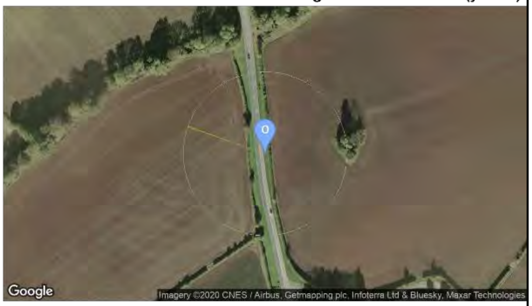
Observer 20 - Road Receptor 20 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 13.8°
Max observer difference angle: 14.5°

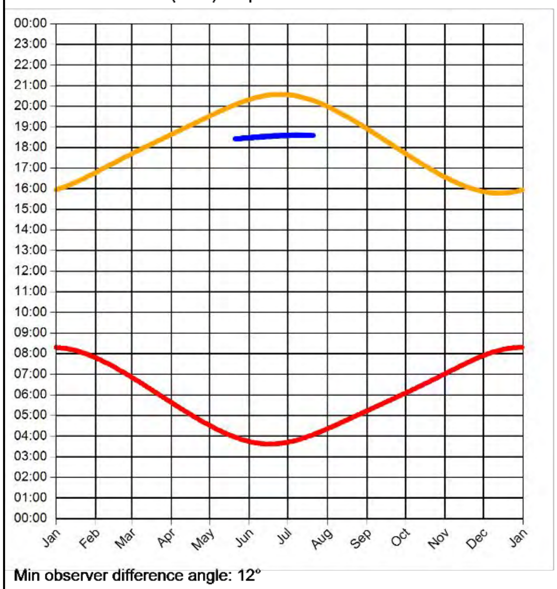
Observer Location — Sun azimuth range is 288.9° - 289.8° (yellow)



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

Observer 21 - Road Receptor 21 Results

Reflection Date/Time (GMT) Graph



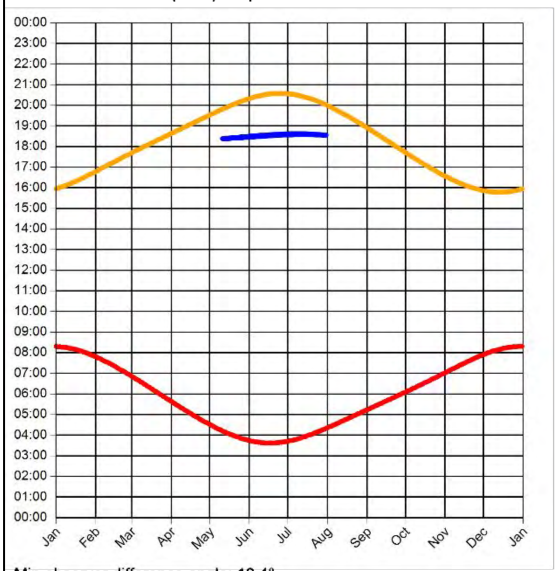
Min observer difference angle: 12°
Max observer difference angle: 14.4°

Observer Location — Sun azimuth range is 287.3° - 290.1° (yellow)

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

Observer 22 - Road Receptor 22 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 10.4°
Max observer difference angle: 14.5°

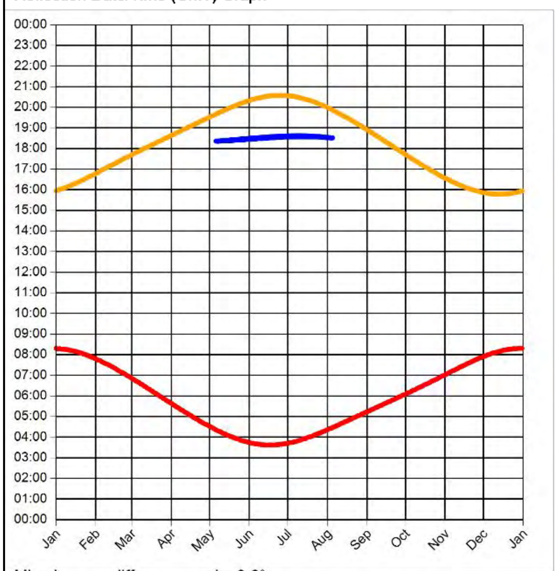
Observer Location

Sun azimuth range is 285.5° - 290.1° (yellow)

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

Observer 23 - Road Receptor 23 Results

Reflection Date/Time (GMT) Graph

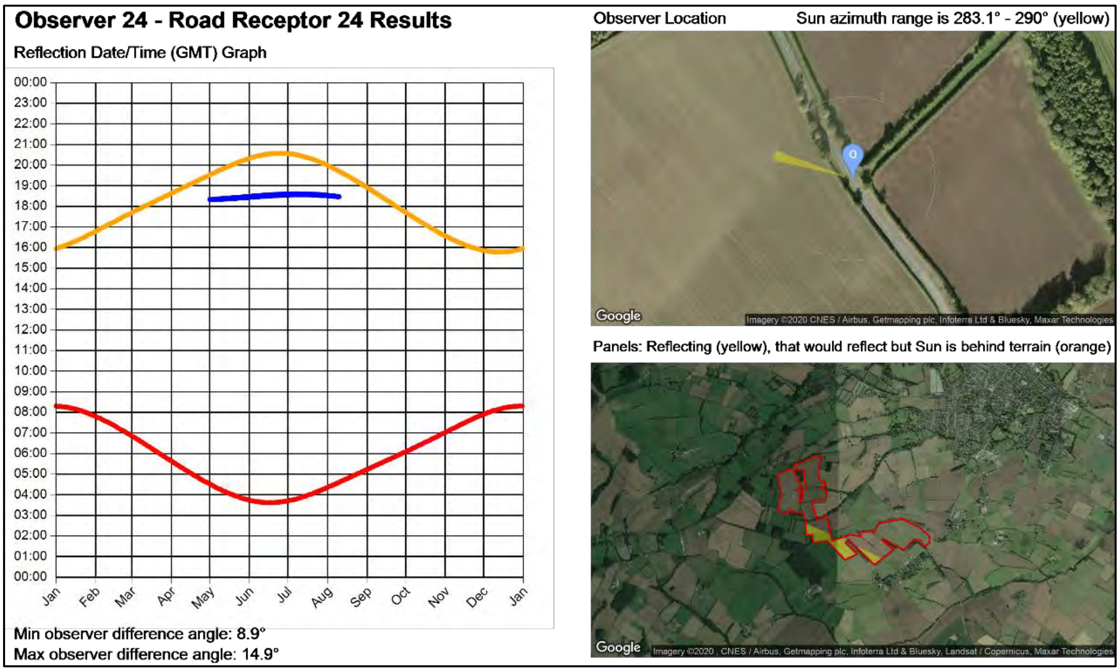


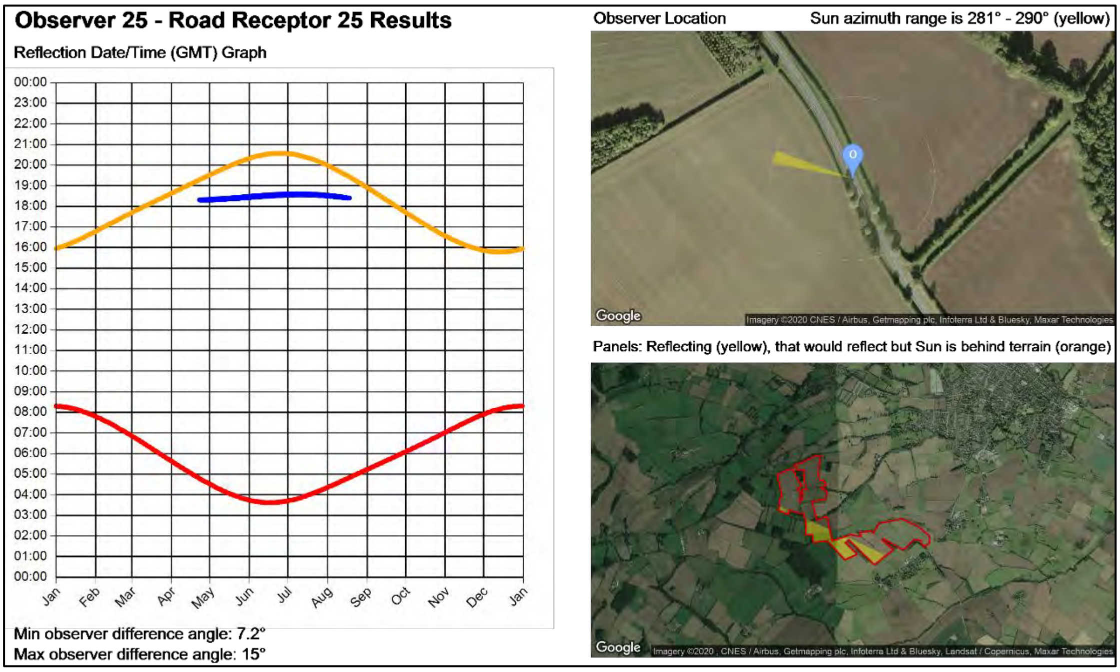
Min observer difference angle: 9.6°
Max observer difference angle: 14.7°

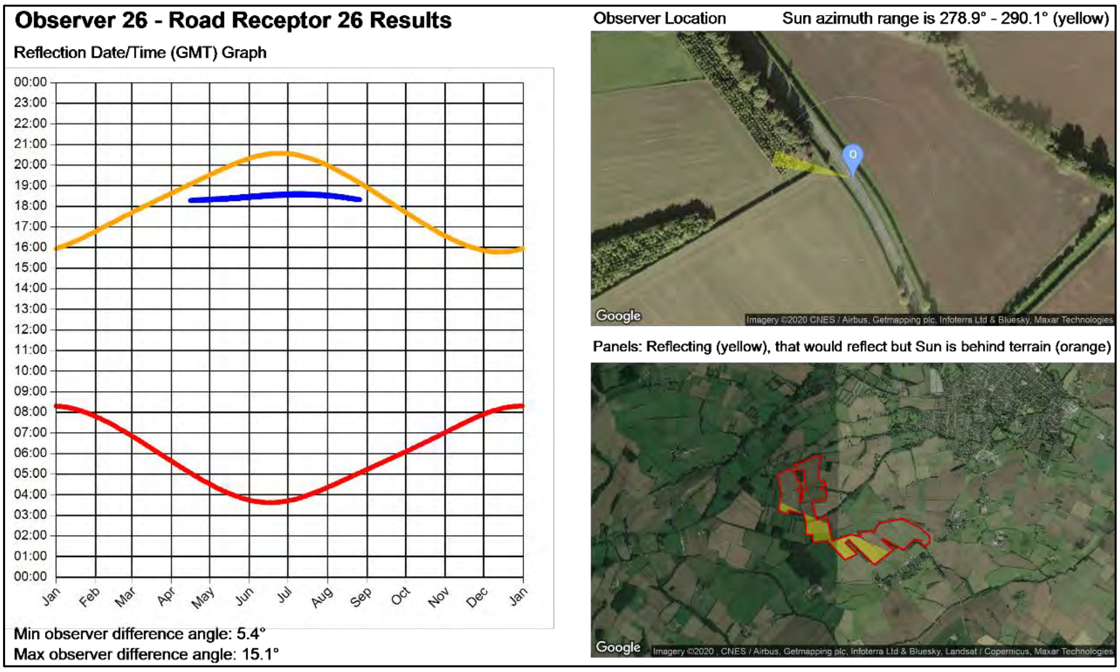
Observer Location

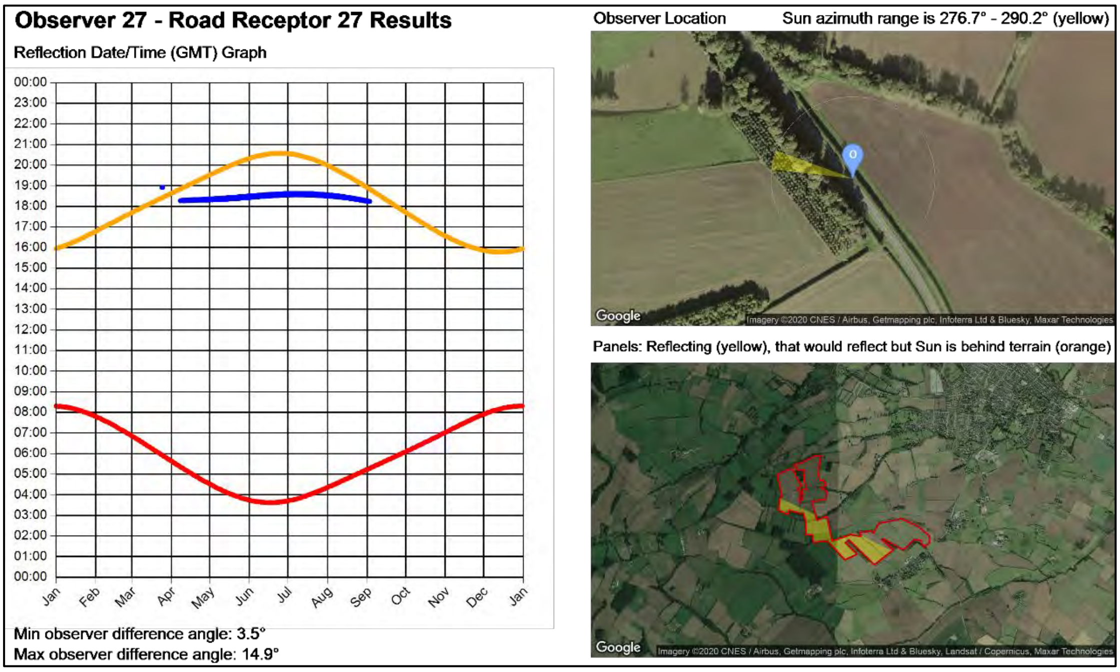
Sun azimuth range is 284.3° - 290.2° (yellow)

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


Observer 24 - Road Receptor 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: 8.9°
Max observer difference angle: 14.9°
Observer Location
Sun azimuth range is 283.1° - 290° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

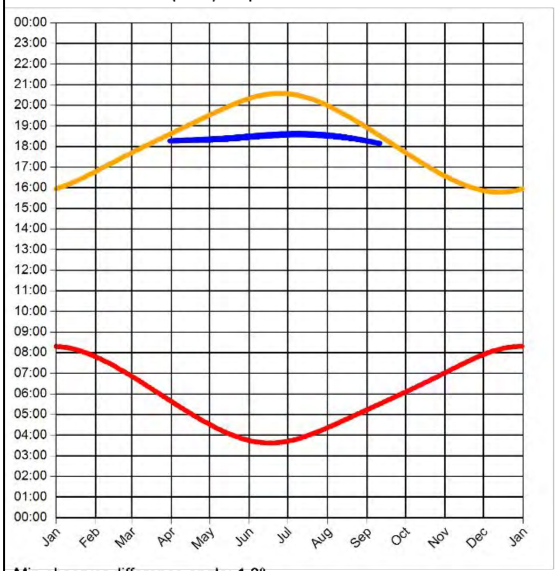

Observer 25 - Road Receptor 25 Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 7.2°
Max observer difference angle: 15°
Observer Location
Sun azimuth range is 281° - 290° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 26 - Road Receptor 26 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: 5.4°
Max observer difference angle: 15.1°
Observer Location
Sun azimuth range is 278.9° - 290.1° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer 27 - Road Receptor 27 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: 3.5°
Max observer difference angle: 14.9°
Observer Location
Sun azimuth range is 276.7° - 290.2° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 28 - Road Receptor 28 Results

Reflection Date/Time (GMT) Graph



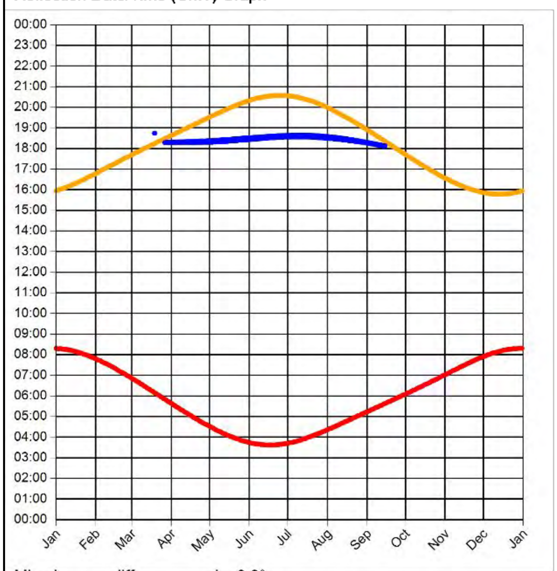
Min observer difference angle: 1.3°
Max observer difference angle: 15°

Observer Location — Sun azimuth range is 274.4° - 290.3° (yellow)

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

Observer 29 - Road Receptor 29 Results

Reflection Date/Time (GMT) Graph



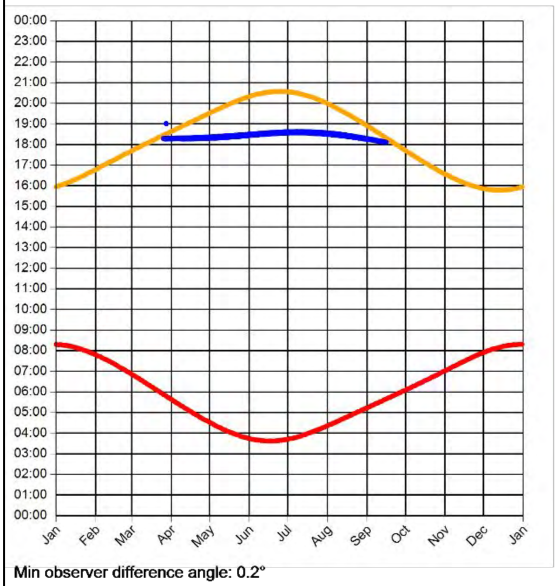
Min observer difference angle: 0.3°
Max observer difference angle: 14.6°

Observer Location — Sun azimuth range is 273.3° - 290.4° (yellow)

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

Observer 30 - Road Receptor 30 Results

Reflection Date/Time (GMT) Graph



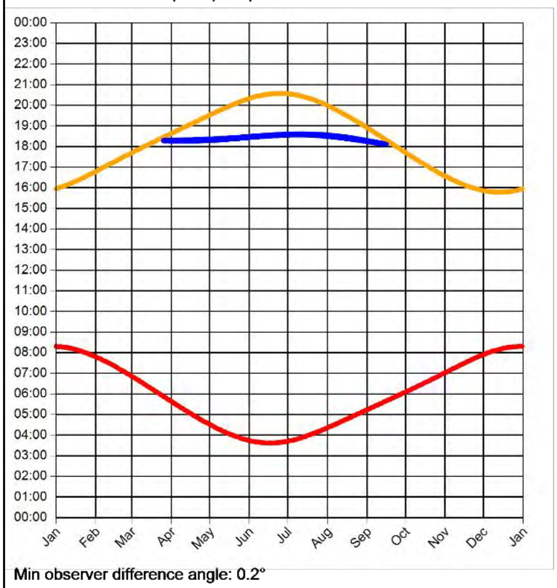
Min observer difference angle: 0.2°
Max observer difference angle: 14.8°

Observer Location — Sun azimuth range is 273° - 290.2° (yellow)

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

Observer 31 - Road Receptor 31 Results

Reflection Date/Time (GMT) Graph



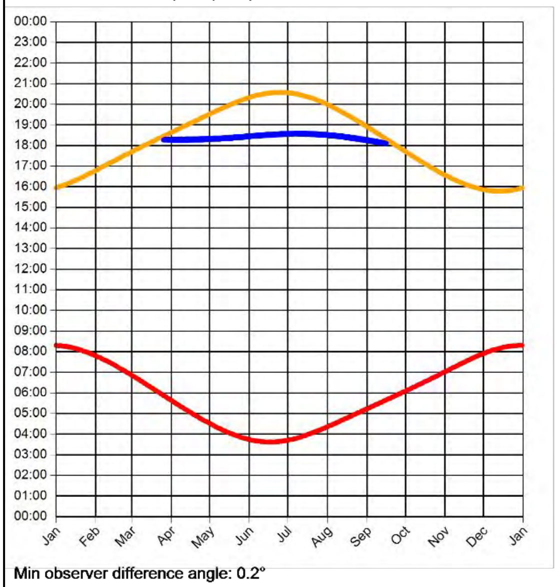
Min observer difference angle: 0.2°
Max observer difference angle: 14.8°

Observer Location — Sun azimuth range is 273° - 290° (yellow)

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

Observer 32 - Road Receptor 32 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.2°
Max observer difference angle: 15.3°

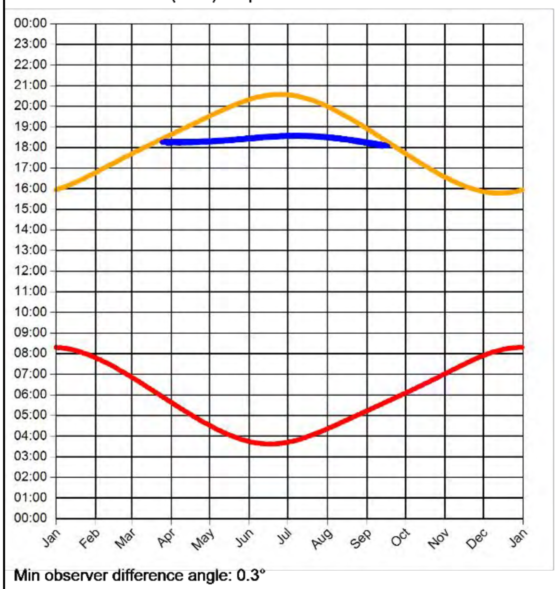
Observer Location

Sun azimuth range is 272.9° - 289.9° (yellow)

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

Observer 33 - Road Receptor 33 Results

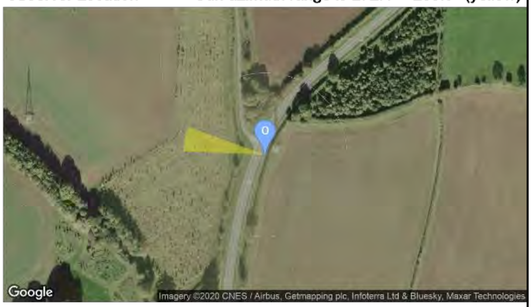
Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.3°
Max observer difference angle: 15.5°

Observer Location

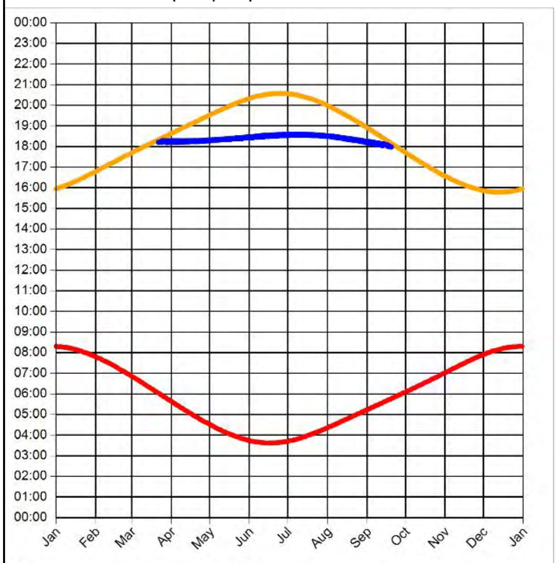
Sun azimuth range is 272.4° - 289.9° (yellow)



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

Observer 34 - Road Receptor 34 Results

Reflection Date/Time (GMT) Graph



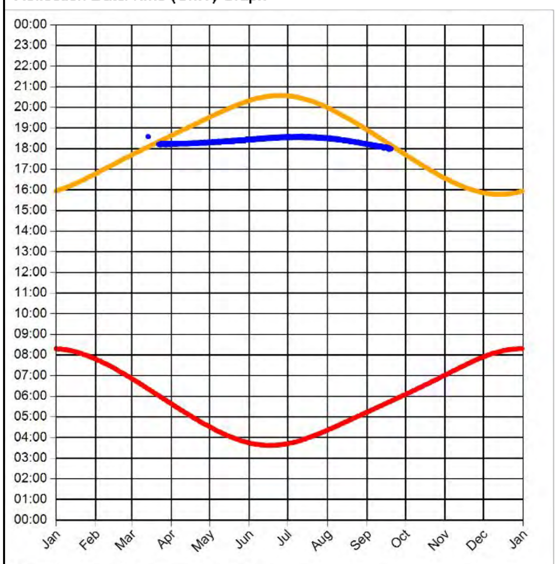
Min observer difference angle: 0.2°
Max observer difference angle: 15.3°

Observer Location — Sun azimuth range is 270.8° - 290° (yellow)

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

Observer 35 - Road Receptor 35 Results

Reflection Date/Time (GMT) Graph



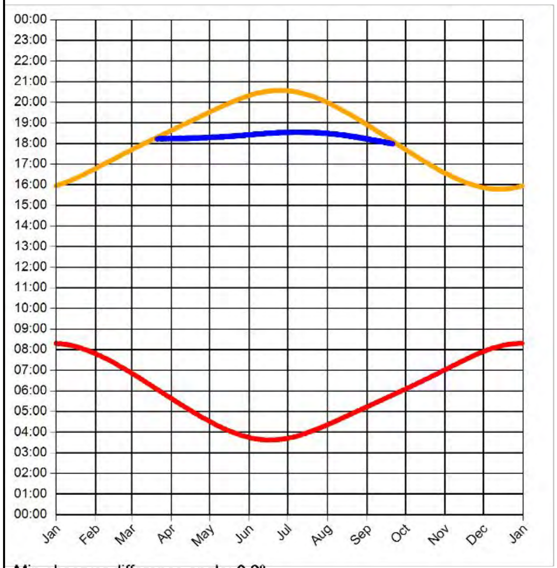
Min observer difference angle: 0.3°
Max observer difference angle: 15.3°

Observer Location — Sun azimuth range is 270.9° - 289.9° (yellow)

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

Observer 36 - Road Receptor 36 Results

Reflection Date/Time (GMT) Graph



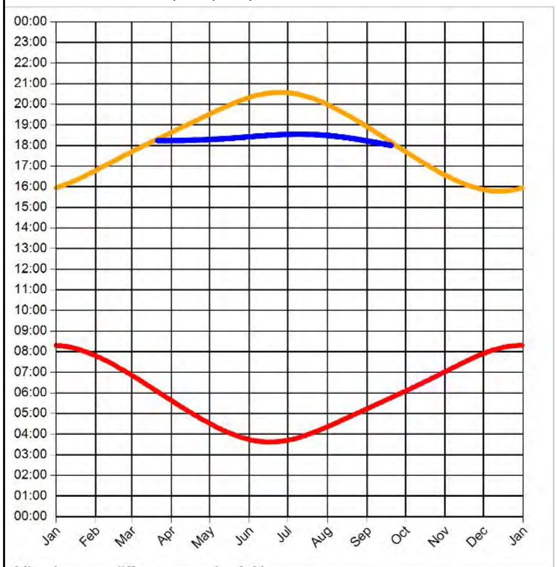
Min observer difference angle: 0.2°
Max observer difference angle: 15.3°

Observer Location | Sun azimuth range is 270.6° - 289.5° (yellow)

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

Observer 37 - Road Receptor 37 Results

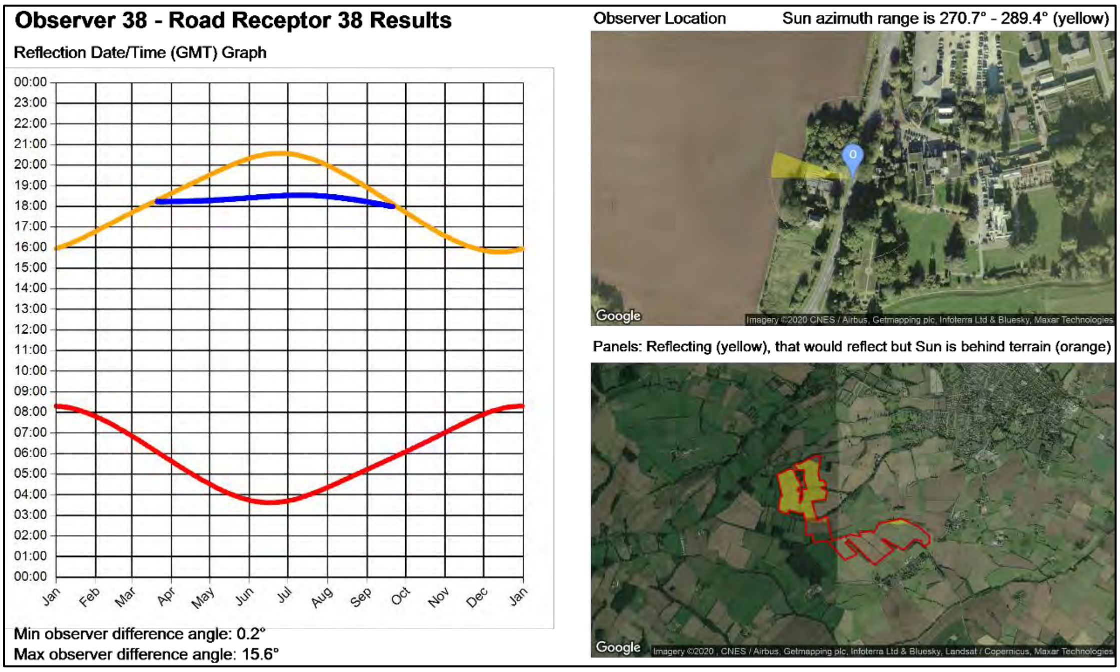
Reflection Date/Time (GMT) Graph



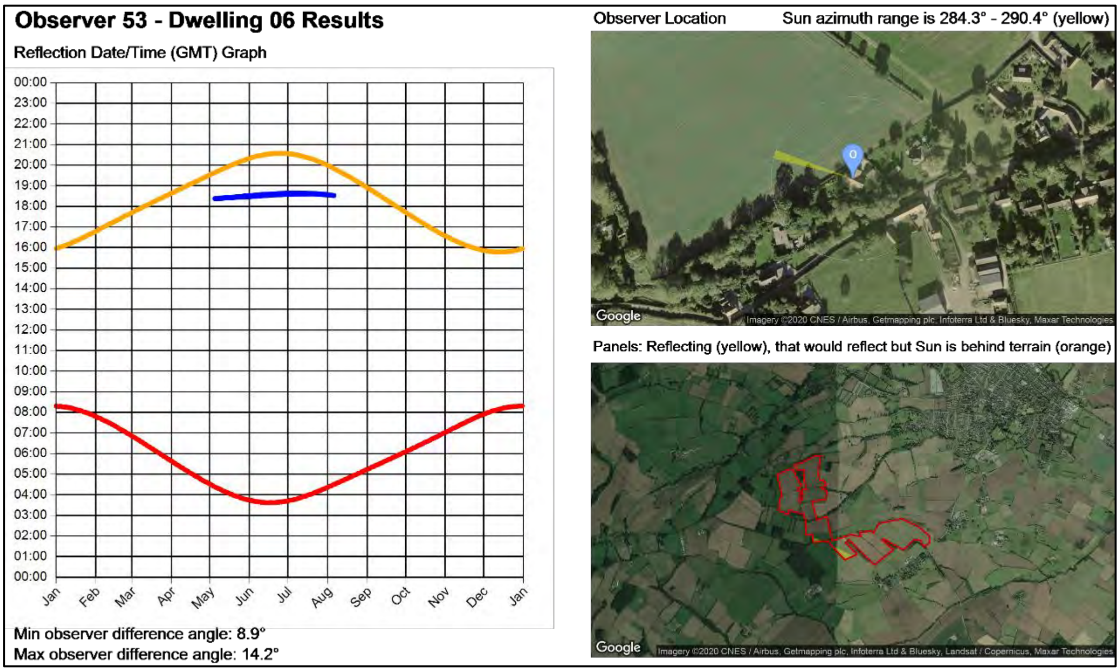
Min observer difference angle: 0.3°
Max observer difference angle: 15.4°

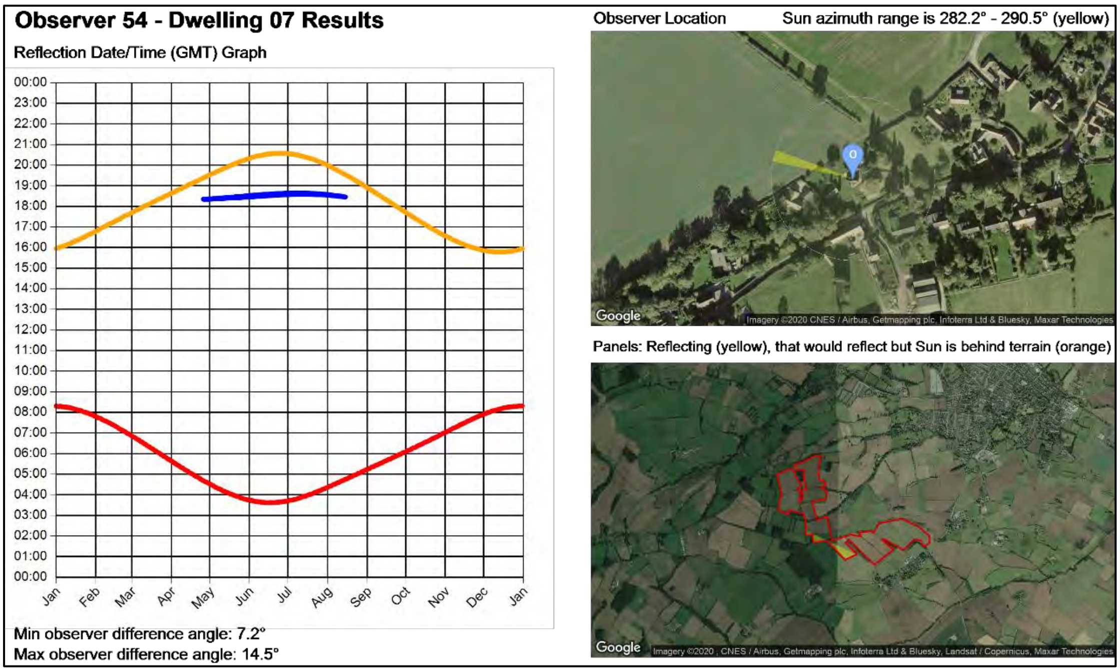
Observer Location | Sun azimuth range is 271.1° - 289.4° (yellow)

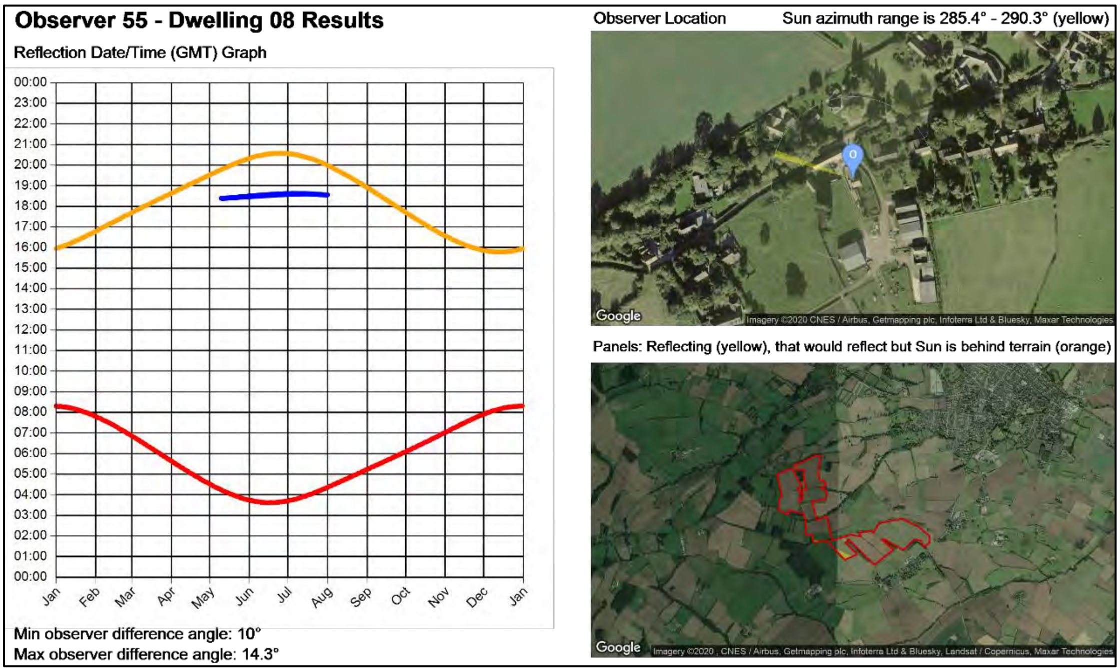
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer 38 - Road Receptor 38 Results
Reflection Date/Time (GMT) Graph
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 0.2°
Max observer difference angle: 15.6°
Observer Location
Sun azimuth range is 270.7° - 289.4° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

Dwellings

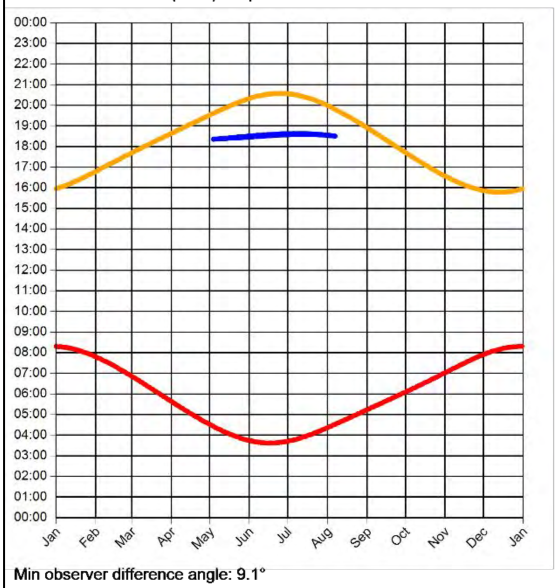

Observer 53 - Dwelling 06 Results
Reflection Date/Time (GMT) Graph
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 8.9°
Max observer difference angle: 14.2°
Observer Location
Sun azimuth range is 284.3° - 290.4° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 54 - Dwelling 07 Results
Reflection Date/Time (GMT) Graph
Observer Location
Sun azimuth range is 282.2° - 290.5° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Min observer difference angle: 7.2°
Max observer difference angle: 14.5°


Observer 55 - Dwelling 08 Results
Reflection Date/Time (GMT) Graph
Observer Location
Sun azimuth range is 285.4° - 290.3° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Min observer difference angle: 10°
Max observer difference angle: 14.3°

Observer 56 - Dwelling 09 Results

Reflection Date/Time (GMT) Graph



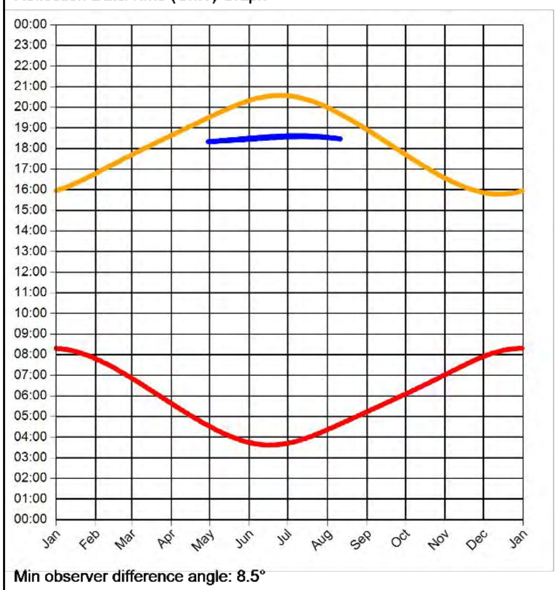
Min observer difference angle: 9.1°
Max observer difference angle: 14.5°

Observer Location — Sun azimuth range is 283.9° - 290.3° (yellow)

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

Observer 57 - Dwelling 10 Results

Reflection Date/Time (GMT) Graph



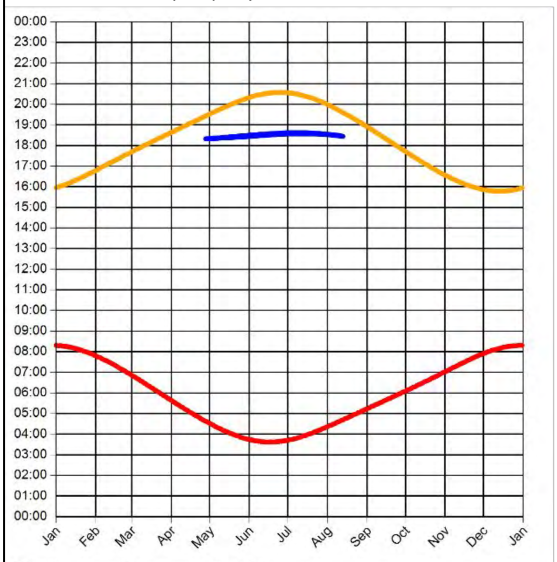
Min observer difference angle: 8.5°
Max observer difference angle: 14.7°

Observer Location — Sun azimuth range is 282.8° - 290.2° (yellow)

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

Observer 58 - Dwelling 11 Results

Reflection Date/Time (GMT) Graph



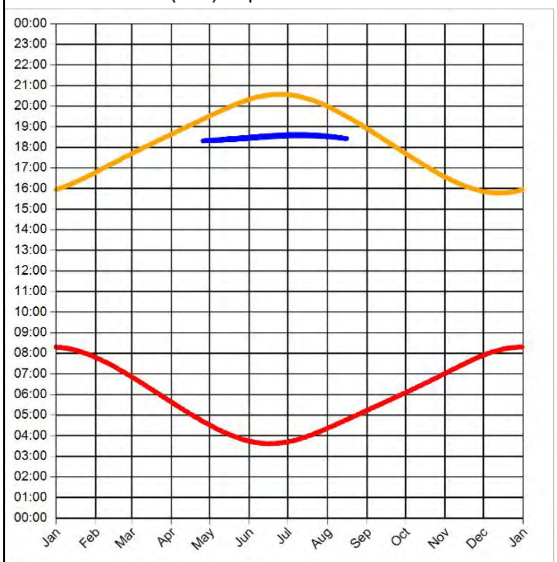
Min observer difference angle: 8.1°
Max observer difference angle: 14.8°

Observer Location — Sun azimuth range is 282.3° - 290.2° (yellow)

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

Observer 59 - Dwelling 12 Results

Reflection Date/Time (GMT) Graph



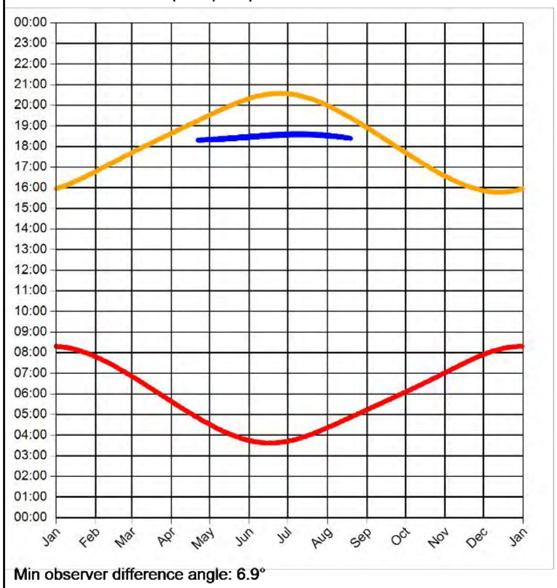
Min observer difference angle: 7.5°
Max observer difference angle: 14.8°

Observer Location — Sun azimuth range is 281.7° - 290.1° (yellow)

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

Observer 60 - Dwelling 13 Results

Reflection Date/Time (GMT) Graph



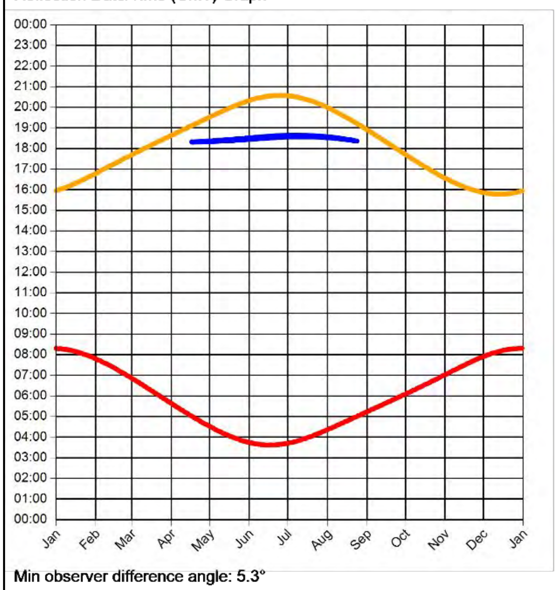
Min observer difference angle: 6.9°
Max observer difference angle: 14.9°

Observer Location   Sun azimuth range is 280.8° - 290.1° (yellow)

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

Observer 61 - Dwelling 14 Results

Reflection Date/Time (GMT) Graph



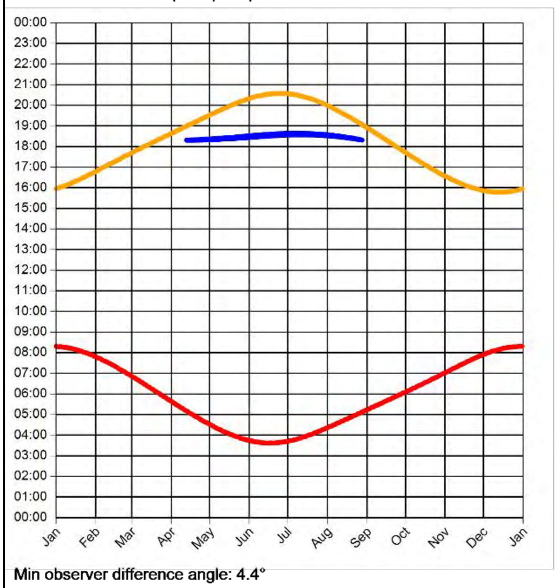
Min observer difference angle: 5.3°
Max observer difference angle: 14.8°

Observer Location   Sun azimuth range is 279.6° - 290.5° (yellow)

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

Observer 62 - Dwelling 15 Results

Reflection Date/Time (GMT) Graph



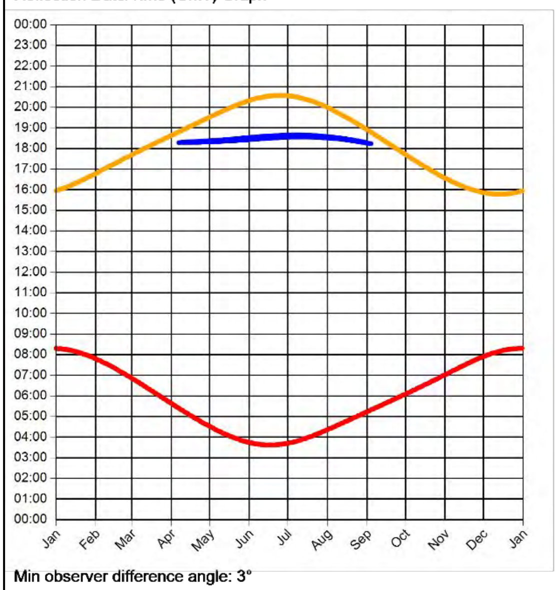
Min observer difference angle: 4.4°
Max observer difference angle: 14.9°

Observer Location Sun azimuth range is 278.4° - 290.4° (yellow)

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

Observer 63 - Dwelling 16 Results

Reflection Date/Time (GMT) Graph

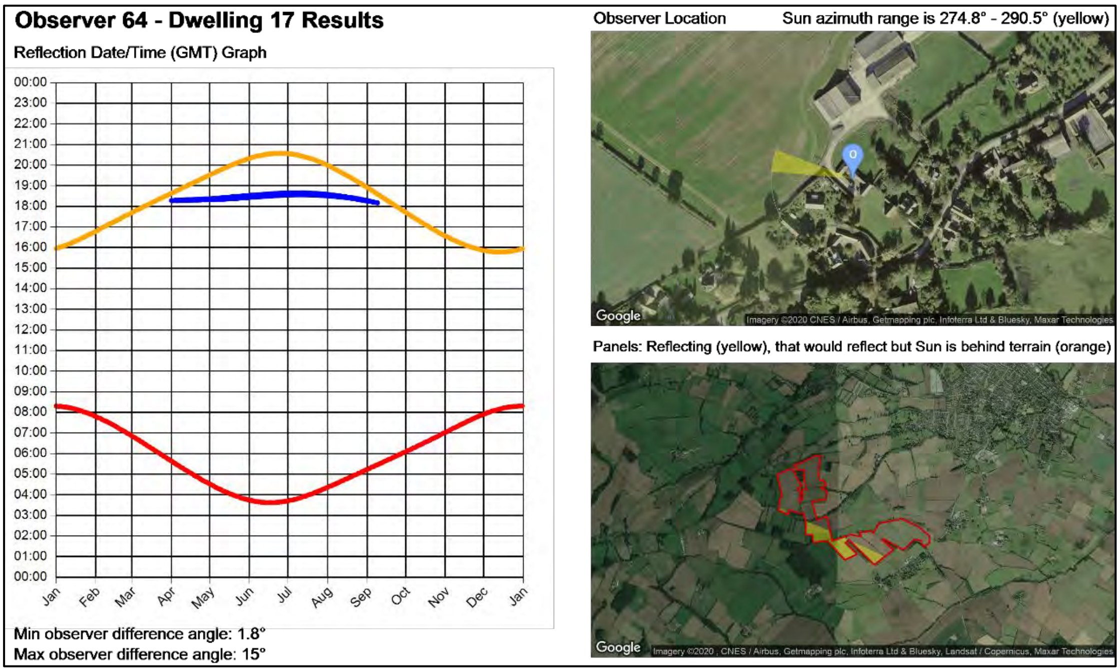


Min observer difference angle: 3°
Max observer difference angle: 14.9°

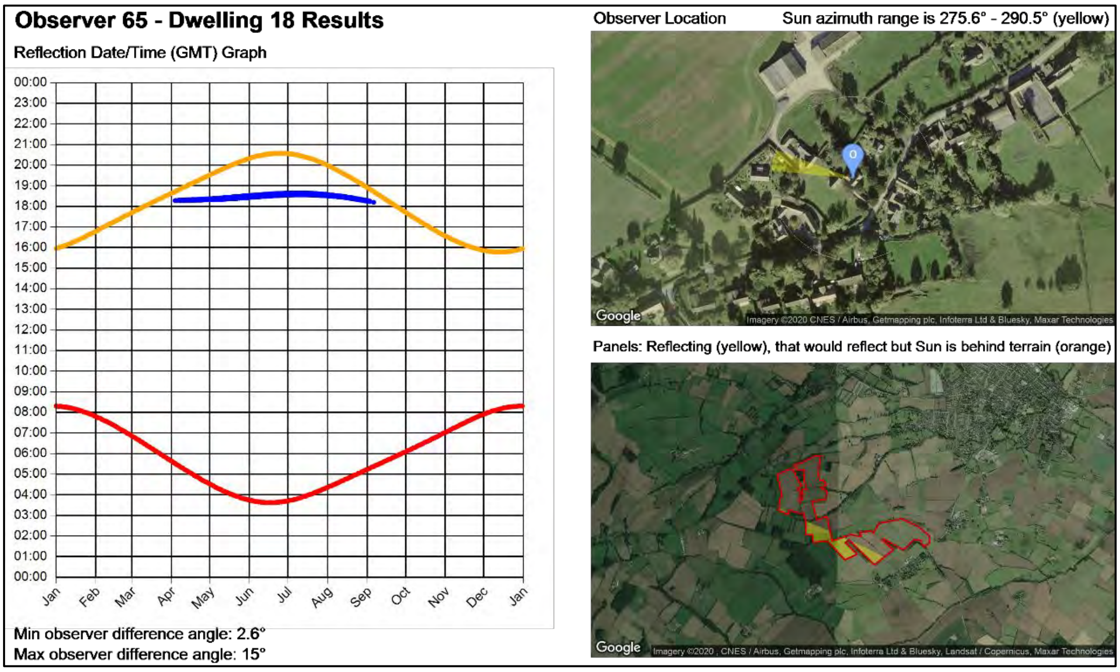
Observer Location Sun azimuth range is 276.5° - 290.5° (yellow)

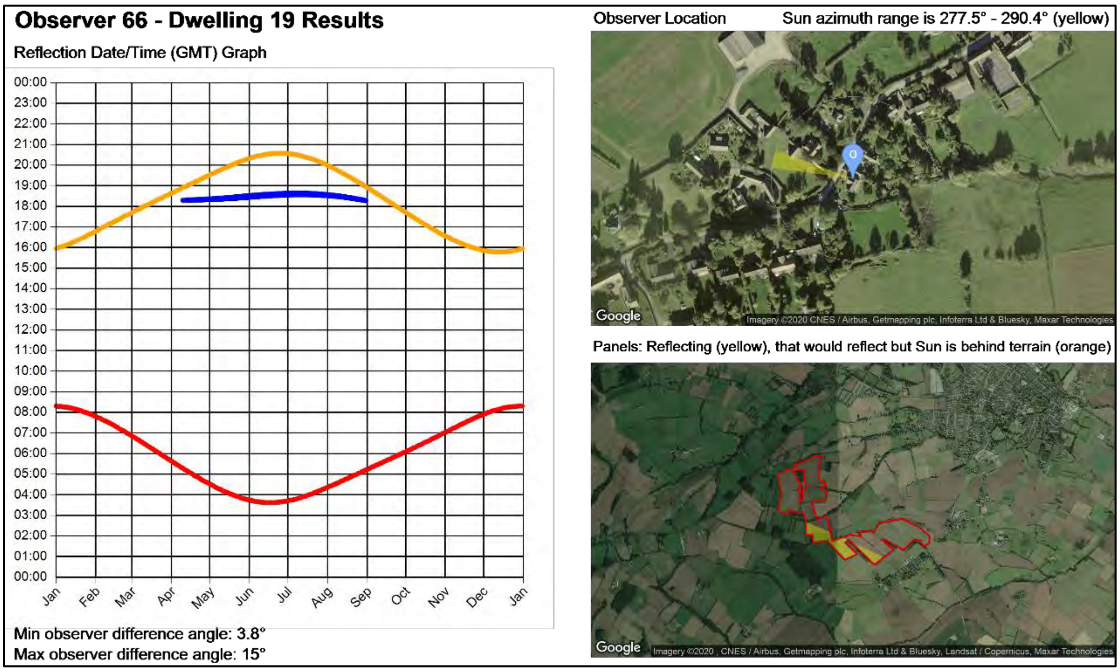
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

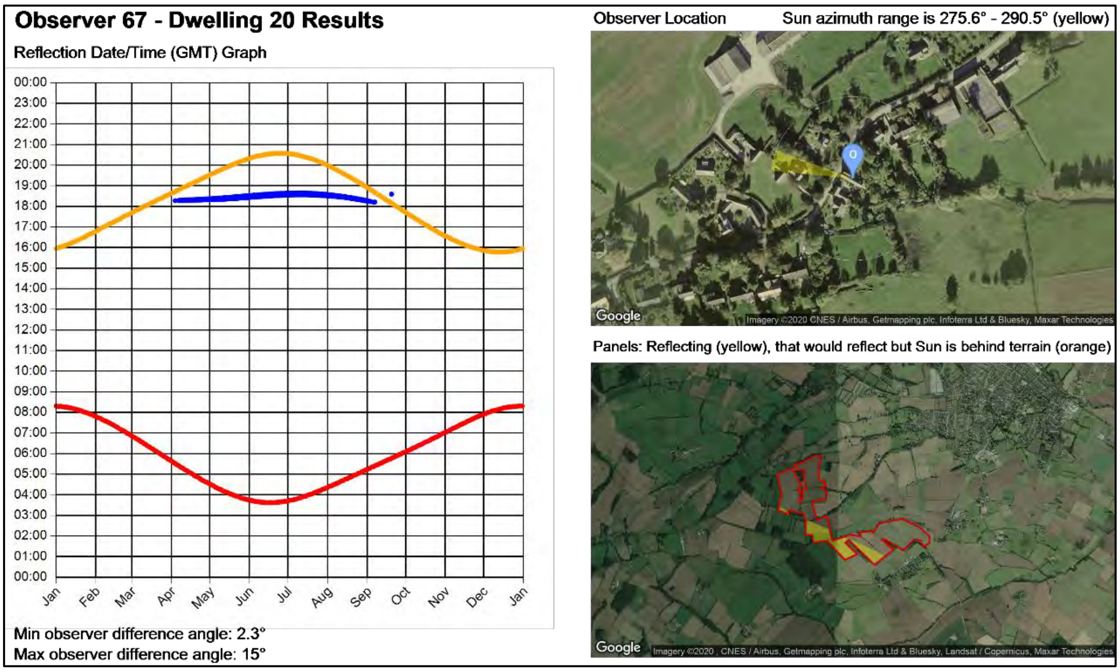
Observer 64 - Dwelling 17 Results



Observer 65 - Dwelling 18 Results

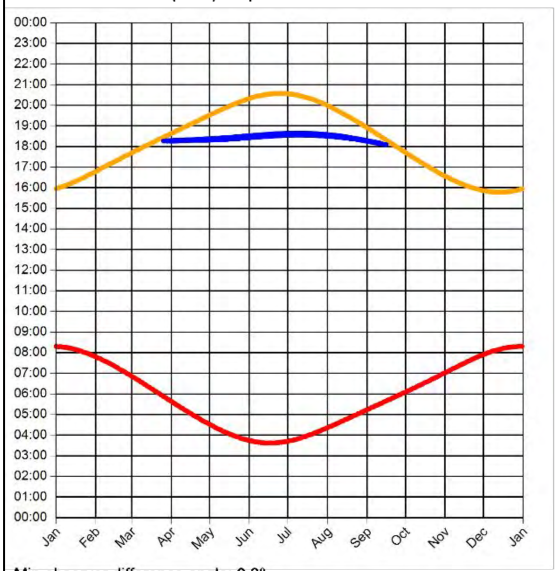



Observer 66 - Dwelling 19 Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 3.8°
Max observer difference angle: 15°
Observer Location
Sun azimuth range is 277.5° - 290.4° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 67 - Dwelling 20 Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 2.3°
Max observer difference angle: 15°
Observer Location
Sun azimuth range is 275.6° - 290.5° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

Observer 68 - Dwelling 21 Results

Reflection Date/Time (GMT) Graph



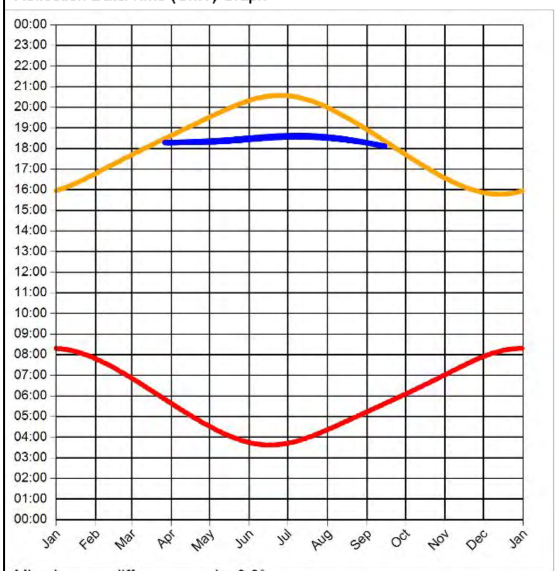
Min observer difference angle: 0.3°
Max observer difference angle: 15°

Observer Location — Sun azimuth range is 272.8° - 290.5° (yellow)

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

Observer 69 - Dwelling 22 Results

Reflection Date/Time (GMT) Graph



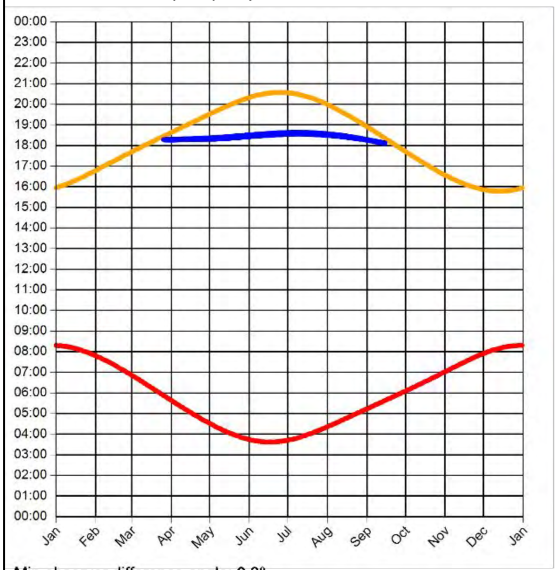
Min observer difference angle: 0.3°
Max observer difference angle: 15.1°

Observer Location — Sun azimuth range is 273.3° - 290.4° (yellow)

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

Observer 70 - Dwelling 23 Results

Reflection Date/Time (GMT) Graph



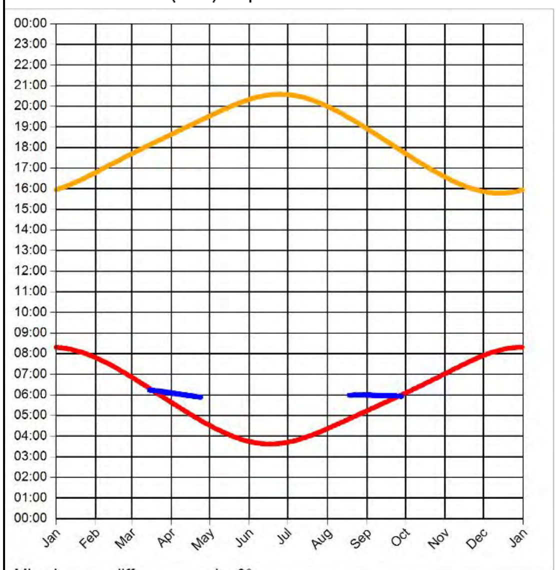
Min observer difference angle: 0.3°
Max observer difference angle: 15.2°

Observer Location — Sun azimuth range is 273.1° - 290.4° (yellow)

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

Observer 71 - Dwelling 24 Results

Reflection Date/Time (GMT) Graph



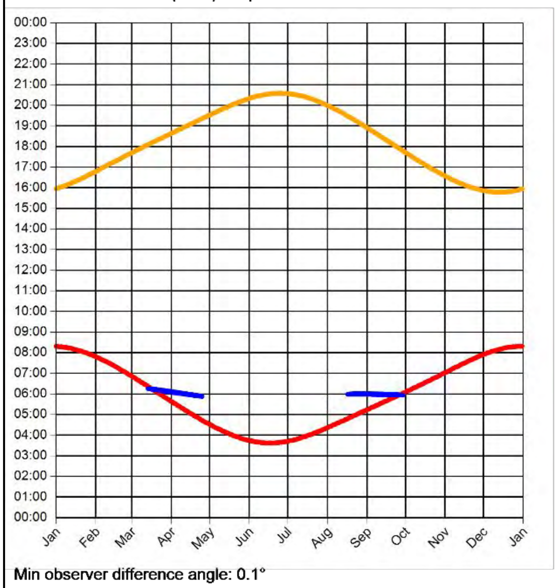
Min observer difference angle: 0°
Max observer difference angle: 10.8°

Observer Location — Sun azimuth range is 80.4° - 91.7° (yellow)

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

Observer 72 - Dwelling 25 Results

Reflection Date/Time (GMT) Graph



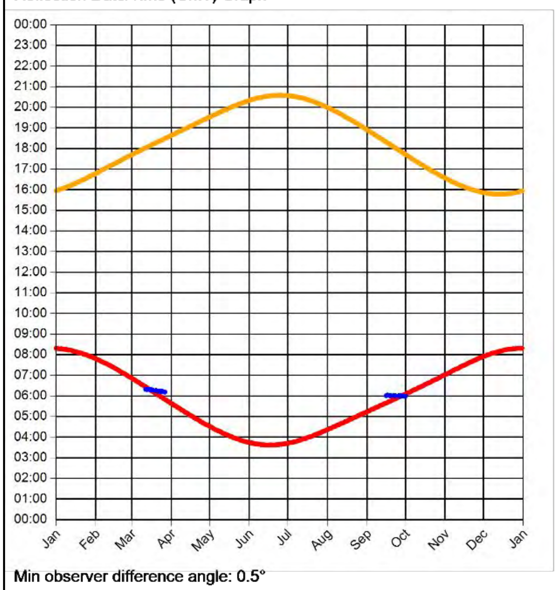
Min observer difference angle: 0.1°
Max observer difference angle: 11.1°

Observer Location — Sun azimuth range is 80.1° - 92° (yellow)

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

Observer 73 - Dwelling 26 Results

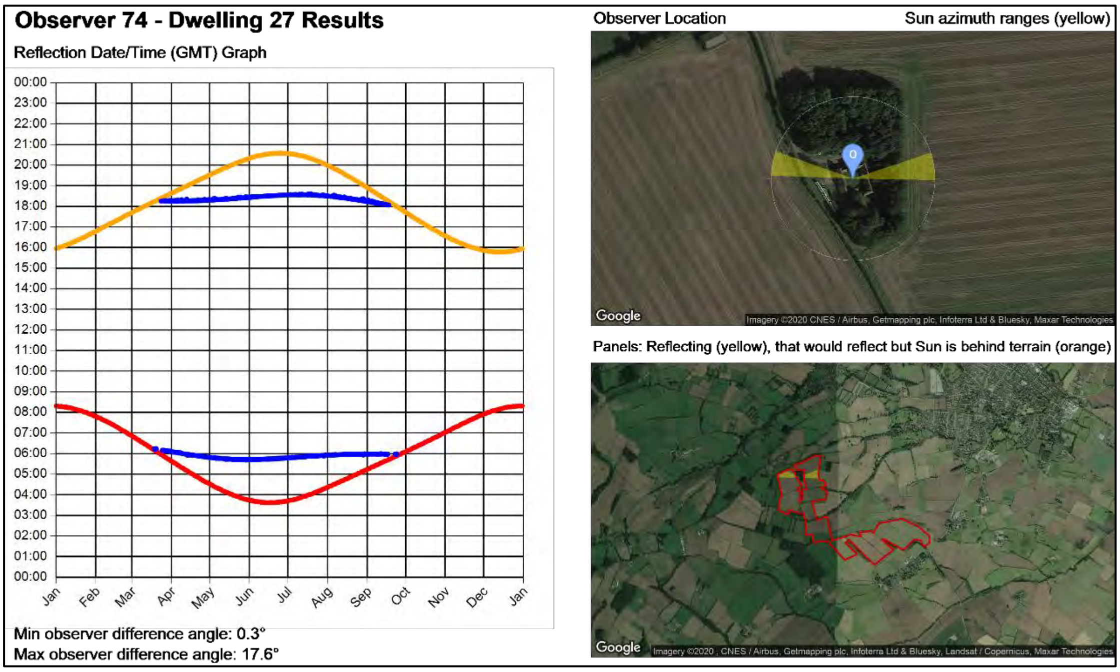
Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.5°
Max observer difference angle: 4.6°

Observer Location — Sun azimuth range is 88.8° - 93.2° (yellow)

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


Observer 74 - Dwelling 27 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: 17.6°
Observer Location
Sun azimuth ranges (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

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