No.24018	Brighton Paddel Court	DESIGN NOTE	001

Date:	08/08/2025	
Subject:	Glint and Glare Assessment	
Circulation:		

M-E Engineers Limited
Europoint Centre
5-11 Lavington Street
London, SE10NZ
T: +44 (0) 20 7401 8382

Rev	Date	Description	Prepared By
00	31/03/2025	For Discussion	M.M
01	08/08/2025	For Issue – Incorporating Brighton Airport comments	M.M

1.0 EXECUTIVE SUMMARY

MEE has been commissioned to conduct a glint and glare assessment for a proposed rooftop solar photovoltaic (PV) installation on the Padel court at the Elite Football Performance Centre, located immediately west of Brighton City Airport, Brighton, UK.

The purpose of this assessment is to evaluate the potential impacts of solar reflections on aviation operations associated with Brighton City Airport. Particular focus has been given to the runways approach paths, the Air Traffic Control (ATC) Tower and the Helicopter training route considering their operational significance and visibility sensitivity.

This revision incorporates Brighton Airport Comments dated (14/07/2025).

Results Summary

ATC Tower

Modelling results indicate that solar reflections from the proposed development toward the Air Traffic Control (ATC) tower are not geometrically possible.

As such, no impacts are anticipated for ATC personnel, and no mitigation measures are required.

Runways Approach

The modelling indicates no glare potential for the following runway approaches.

1- Runway 02 (Asphalt) and Runway 20 (Asphalt)

2- Runway 02 (Grass) and Runway 20 (Grass)

3- Runway 06 (Grass) and Runway 24 (Grass)

4- Runway 13 (Grass)

For Runway 31 (Grass). The PV array is expected to produce the following glare for this receptor:

- 2,199 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 20 minutes on any single day which is acceptable.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

The PV array is expected to produce the following glare for helicopter circuit:

- 6,762 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 35 minutes on any single day which is acceptable.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

The PV array is expected to produce the following glare for left circuit:

- 2,704 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 22 minutes on any single day which is acceptable.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

Based on the results, no impacts are predicted for personnel in the ATC tower, and no mitigation measures are required.
No significant impacts are anticipated for pilots on approach to the assessed runways at Brighton City Airport.
No significant impacts are anticipated for pilots on Fixed wing circuit routes and helicopter training route.

Brighton Airport Comment Resolution

No.	Comment	Reply
1	The glidepath angle for runway 20 be re-assessed with the correct angle of 4.5 degrees.	Noted and the analysis has been amended accordingly.
2	The glidepath angle for runway 02 be re-assessed with the correct angle of 3.5 degrees.	Noted and the analysis has been amended accordingly.
3	The fixed wing training circuit depicted in figure 13 is not correct and must show the correct training circuit.	Noted. The analysis has been revised to include the training circuit for fixed wing planes per the received information.
4	No account has been taken for the helicopter training route. This needs to be included into the report.	Noted, it has been included in the analysis.
5	In figure 7, runway 04 is referenced however, there is no runway 04 at Brighton City Airport and we believe this to be a typo and should reference runway 06.	Noted, typo has been corrected.
6	In Table 1, runway 04 is referenced and we believe this to be a typo and should reference runway 06.	Noted, typo has been corrected.
7	Since the completion of this report, a new touchdown point has been promulgated into the AIP for runway 06. Therefore, this new runway touchdown point needs to be considered not the previous touchdown point.	Noted, it has been included in the analysis per the received coordinates.

2.0 INTRODUCTION

MEE has been commissioned to conduct a glint and glare assessment for a proposed rooftop solar photovoltaic (PV) installation on the Padel court at the Elite Football Performance Centre, located immediately west of Brighton City Airport, Brighton, UK.

The purpose of this assessment is to evaluate the potential impacts of solar reflections on aviation operations associated with Brighton City Airport. Particular focus has been given to the runways approach paths, the Air Traffic Control (ATC) Tower and the Helicopter training route considering their operational significance and visibility sensitivity.

The findings of this assessment will determine whether the proposed PV installation poses any safety or operational risks due to solar reflections affecting pilots or air traffic controllers, and whether mitigation measures are necessary.

This report includes the following sections:

- Details of the proposed solar development
- Explanation of glint and glare phenomena
- Overview of relevant national and international guidance
- Overview of Sun path
- Description of the assessment methodology
- Identification of Critical receptors including aviation-related concerns.
- Glint and glare assessment for identified receptors
- Discussion of results and conclusions

3.0 GUIDELINES

This section summarises the key guidance documents and studies related to the assessment of solar reflections specifically glint and glare and their potential impact on aviation and surrounding environments. The content here highlights the most influential parameters and recommendations that have informed the current assessment.

UK National Planning Guidance

Under the National Planning Policy Framework (NPPF), the Planning Practice Guidance for Renewable and Low Carbon Energy (Paragraph 013) addresses planning considerations for large-scale solar PV developments. It acknowledges that such developments can have negative visual impacts, particularly in undulating landscapes. However, with appropriate planning and screening, visual effects including glint and glare can be mitigated. The guidance highlights the need to consider:

- Visual impacts, including glint and glare,
- Effects on neighbouring land uses and aviation safety,
- Additional impacts of solar tracking systems, and
- Cumulative visual impacts, similar to those from wind turbines.
- UK Civil Aviation Authority (CAA) Interim Guidance

The CAA released interim guidance on 17 December 2010 (CAA Information Alert 2010/53), which, although formally withdrawn in 2012, remains relevant until superseded by formal policy. Key recommendations include:

- Developers should submit safety assurance documentation, including a risk assessment, to address potential aviation impacts.
- Reflectivity data should be provided for installations located within aerodrome boundaries.
- Consultation with aerodrome operators, NATS, and military or technical aviation stakeholders may be required.
- CAP 738 and CAP 793 outline safeguarding procedures for licensed and unlicensed aerodromes, respectively.

- For Electricity Act developments, government departments should consult the CAA.
- While construction (e.g., crane use) does not require CAA approval, coordination with nearby aerodromes is advised

Federal Aviation Administration (FAA) Guidance (USA)
The FAA has produced the most detailed guidance available to date:

- 2010 – *Technical Guidance for Evaluating Selected Solar Technologies on Airports*
- 2013 – *Interim Policy on FAA Review of Solar Projects on Federally Obligated Airports*
- 2018 – *Technical Guidance Version 1.1*

Key Elements of FAA Guidance:

- Glint and glare are collectively referred to as "glare" and defined as either momentary flashes or sustained bright light that may cause temporary vision impairment.
- Solar Glare Hazard Analysis Tool (SGHAT) is the FAA's standard for evaluating ocular impact on control towers and approach paths.
- Solar PV installations on or near federally obligated airports must demonstrate:
    - No potential for glare toward the ATC tower.
    - No or low potential for after-image glare along the final approach path, defined as 2 miles from 50 ft above the runway threshold along a 3° glide path.
- Impact must be analysed over the entire calendar year in 1-minute intervals from sunrise to sunset.
- Assessment Approaches:

1. Qualitative Review – In consultation with air traffic control personnel.
2. Field Testing – Solar panels are temporarily installed and evaluated on-site.
3. Geometric Analysis – Utilises sun angles and panel geometry to predict solar reflection impacts throughout the year.

Additional guidance from the FAA advises airports to consider baseline reflectivity conditions from existing sources such as rooftops, vehicles, or water surfaces. It also recommends comparing the potential glare from solar panels within this context.

UK Aviation Safety Legislation – ANO 2009

The Air Navigation Order 2009 includes legal provisions aimed at protecting aircraft from hazardous light emissions:

- Article 137 prohibits any action that recklessly endangers aircraft.
- Article 221 prohibits displaying lights that may endanger aircraft during take-off or landing due to glare or resemblance to aeronautical lights. The CAA can require such lights to be extinguished or screened.
- Article 222 prohibits intentionally dazzling or distracting pilots with directed lights.

These provisions reinforce the requirement that solar developments must not pose a safety hazard to aircraft through glint or glare.

Summary
Across UK and international guidance, several consistent themes emerge:

- The visual and safety impacts of glint and glare must be considered during planning.
- Aviation receptors, particularly ATC towers and final approach paths, are critical in assessing risk.
- Mitigation, siting, and orientation of panels play a major role in managing potential reflections.
- Geometric modelling and, where necessary, real-world testing are valid methods of assessment.

The methodology applied in this report aligns with these principles and references the most authoritative sources, including FAA and CAA recommendations.

4.0 GLINT AND GLARE

There are Numerous published studies that have been conducted to evaluate the type and intensity of solar reflections—specifically glint and glare—from various surfaces, including solar panels and glass. The findings from these studies, particularly those relevant to aviation safety, are summarised below and are considered applicable to this assessment.

Types of Solar Reflections

Reflections from solar panels can be categorised as either specular or diffuse, depending on the surface characteristics:

- Specular Reflection: Light is reflected in a specific, predictable direction, similar to a mirror.
- Diffuse Reflection: Light is scattered in multiple directions, resulting in a softer, less focused reflection.

As solar panels typically have flat, smooth surfaces, the majority of light they reflect is specular in nature.

The FAA guidance document (2010) includes a figure illustrating this distinction, highlighting how flat solar panel surfaces tend to redirect sunlight directionally, potentially making them more relevant for glint and glare analysis.

Key Research Studies

1- Riley & Olson (2011) – “A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems”

This study analysed glare from a fixed-tilt (25°) PV system near Las Vegas, Nevada. Using ocular safety metrics, it compared the potential glare experienced by aviators with that of reflections from still water. Key findings include:

- The reflectivity of solar panels varies with the angle of incidence, peaking at angles near 90°, with values ranging from approximately 5% to 30%.
- The glare potential of PV systems is comparable to smooth water.
- Materials such as white concrete, snow, and structural glass exhibit higher reflectivity than flat-plate PV panels.

These conclusions suggest that while glare is possible, the relative intensity is not significantly greater than reflections already present in the aviation environment.

2- FAA Guidance (2010) – “Technical Guidance for Evaluating Selected Solar Technologies on Airports”

The FAA’s 2010 guidance includes a comparative diagram of reflectivity levels for different materials, including solar panels, glass, water, and metal. It reinforces the understanding that:

- Most solar panel reflections are **specular** in nature.
- **Solar panels reflect less light than standard glass, snow, or steel**, and produce reflectivity levels similar to still water.
- The guidance does not differentiate between specular and diffuse reflections in its numerical reflectivity values, though the physical characteristics are discussed.

3- SunPower Technical Notification (2009)

SunPower Corporation issued a technical bulletin aimed at raising awareness of the glare potential of PV systems. It included a comparison of the reflectivity of solar panels with various materials such as:

- Smooth water
- Standard glass
- Polished steel

Findings align with those of Riley & Olson and the FAA, showing that solar panels have lower reflectivity than many common natural and man-made materials. The document also notes that SunPower has developed solar PV installations at or near airports and Air Force bases, all of which have received FAA or Department of Defense (DoD) clearance as posing “No Hazard to Air Navigation.”

Developers are encouraged to engage with stakeholders, including airport authorities, during the planning stages of solar projects to address any potential concerns related to glint and glare.

Summary of Findings

- Solar panel reflections are predominantly specular, with intensity depending on sun angle, panel tilt, and environmental conditions.
- Reflectivity of PV systems is typically lower than that of standard glass, polished metals, or snow, and comparable to water.
- Field experience and studies show that, with proper siting and evaluation, solar installations do not typically present a hazard to aviation.
- Engagement with aviation stakeholders and site-specific assessments remain critical to ensuring safety.

5.0 METHODOLOGY

Guidance regarding the interaction between solar developments and aviation activity exists both in the UK issued by the Civil Aviation Authority (CAA) and in the USA, where it is provided by the Federal Aviation Administration (FAA). The UK CAA guidance is relatively high-level and does not set out a prescribed methodology for assessment.

In response, MEE has reviewed current guidance and available research and concluded that the use of the Solar Glare Hazard Analysis Tool (SGHAT), developed by Sandia National Laboratories, aligns with national and international policies and guidelines on glint and glare. This includes considerations for residential properties, roads, railways, and aviation-related activities.

Accordingly, ForgeSolar software built using the Solar Glare Hazard Analysis Tool (SGHAT) technology and licensed from Sandia National Laboratories has been used for the purposes of this analysis.

Glint and glare are defined as follows:

- **Glint** – A brief flash of bright light, typically experienced by moving receptors or originating from moving reflective surfaces.

- **Glare** – A sustained source of bright light, generally affecting static receptors or resulting from large reflective surfaces.

The assessment process is structured as follows:

- **Identification of Receptors**
  Identify relevant receptors in the vicinity of the proposed solar development. These may include aviation-related structures, residential dwellings, transport infrastructure, and other sensitive locations.

- **Geometric Reflection Analysis**
  Perform geometric calculations to assess the potential for direct solar reflections from the proposed solar panels toward the identified receptors.

- **Panel Visibility Assessment**
  Assess whether the solar panels are visible from each receptor location. If the panels are not visible, then reflections—and therefore impacts—are not possible.

- **Timing of Reflections**
  Where reflections are predicted, determine the time(s) at which they may occur throughout the year.

- **Sun Position Consideration**
  Evaluate the alignment of both the reflected sunlight and the direct sun path in relation to each receptor's position.

- **Impact Determination**
  Based on the above considerations, assess whether the predicted reflections are likely to result in a significant detrimental impact, following the criteria outlined in Appendix D.

6.0 PROPOSED DEVELOPMENT

The below figure shows the proposed paddle court development with a set of Panels located on the Eastern side of the building with a total area of 55 m^2. Facing 30 degrees to the south. The PV has been incorporated in Glare analysis model accordingly as illustrated in Appendix A.

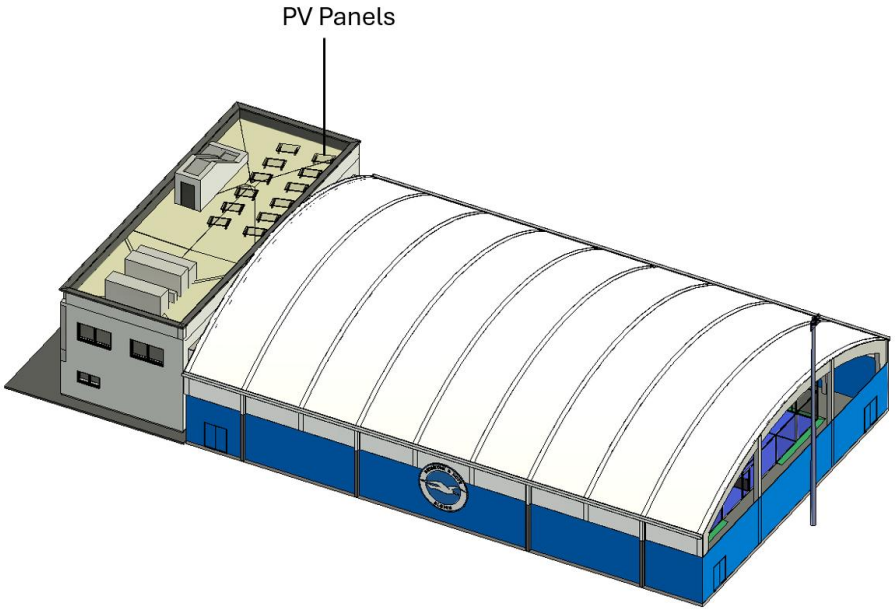


Figure 1: Padel Court PV Panels

The figure below shows the location of the Padel Court building within the campus.

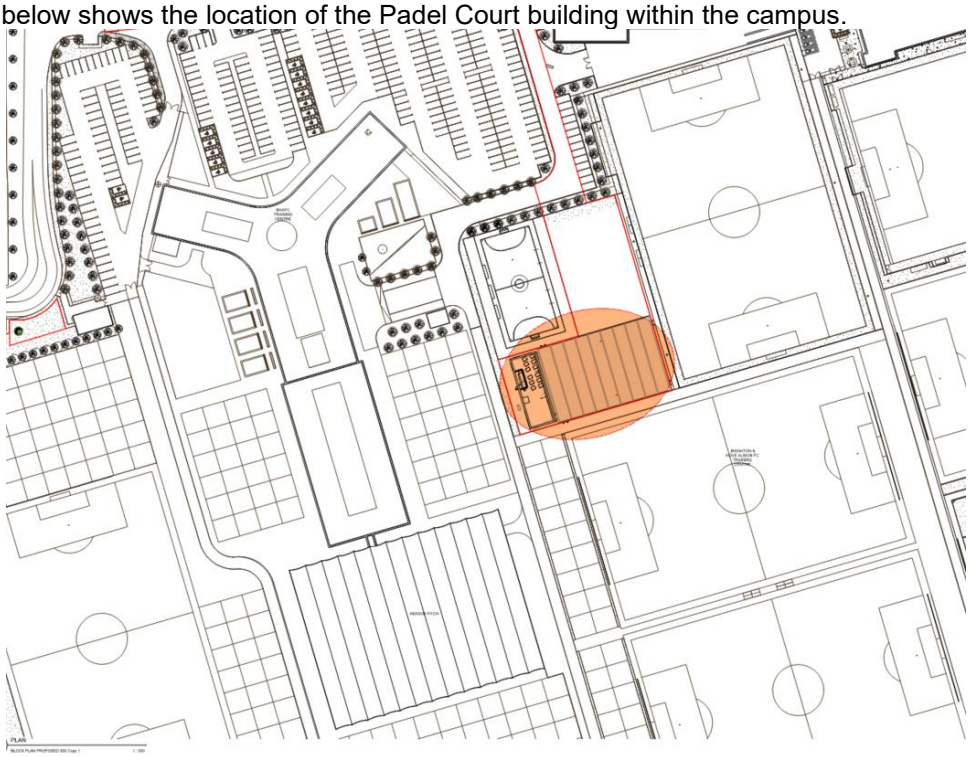


Figure 2: the location of the Padel Court building within the campus

The figure below illustrates the relative location of the Padel Court in relation to Brighton City Airport.

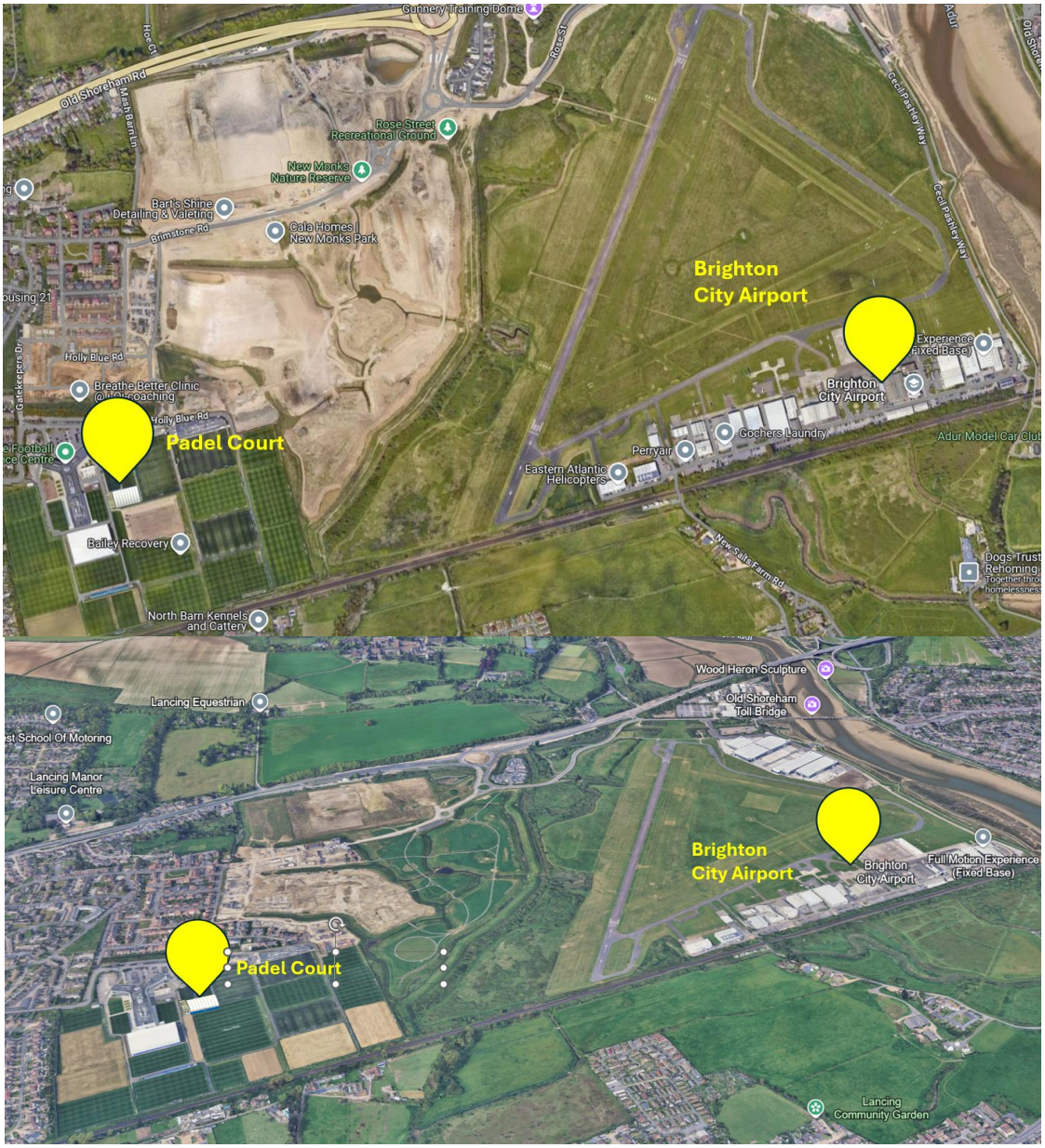


Figure 3: The relative location of the Padel Court in relation to Brighton City Airport.

6.1 Sun path

The figure below displays the Sun Path Diagram for Brighton.

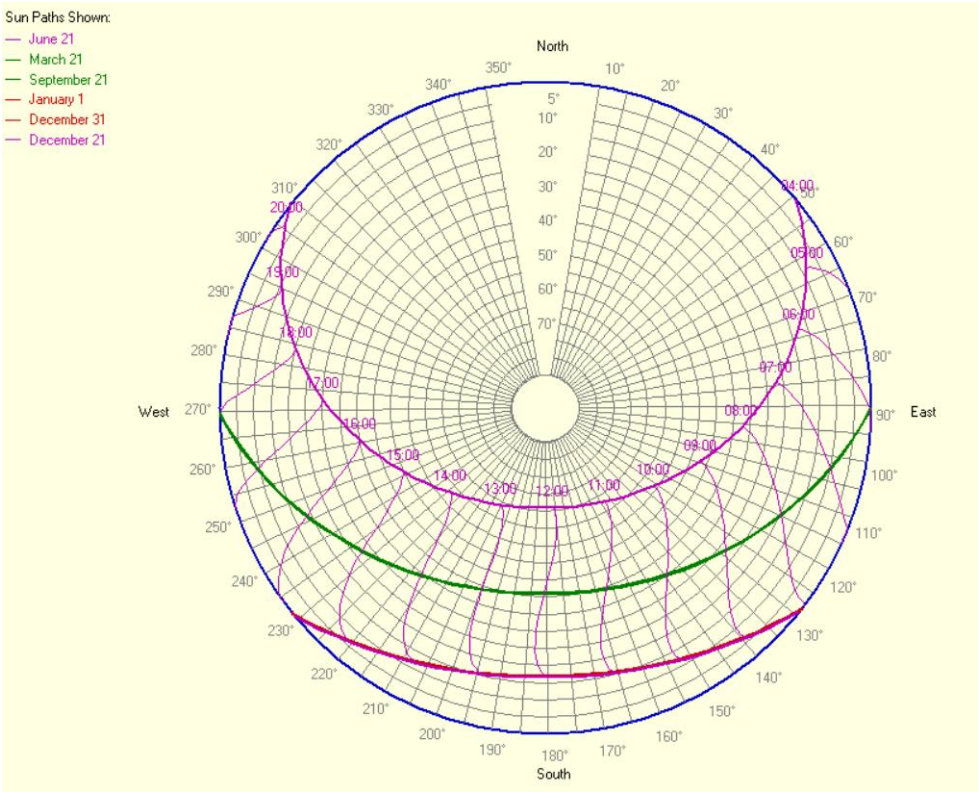


Figure 4: Brighton Sun path

The figure below illustrates the annual solar sunrise and sunset times, solar azimuth angles, and total sunlit hours for Brighton.

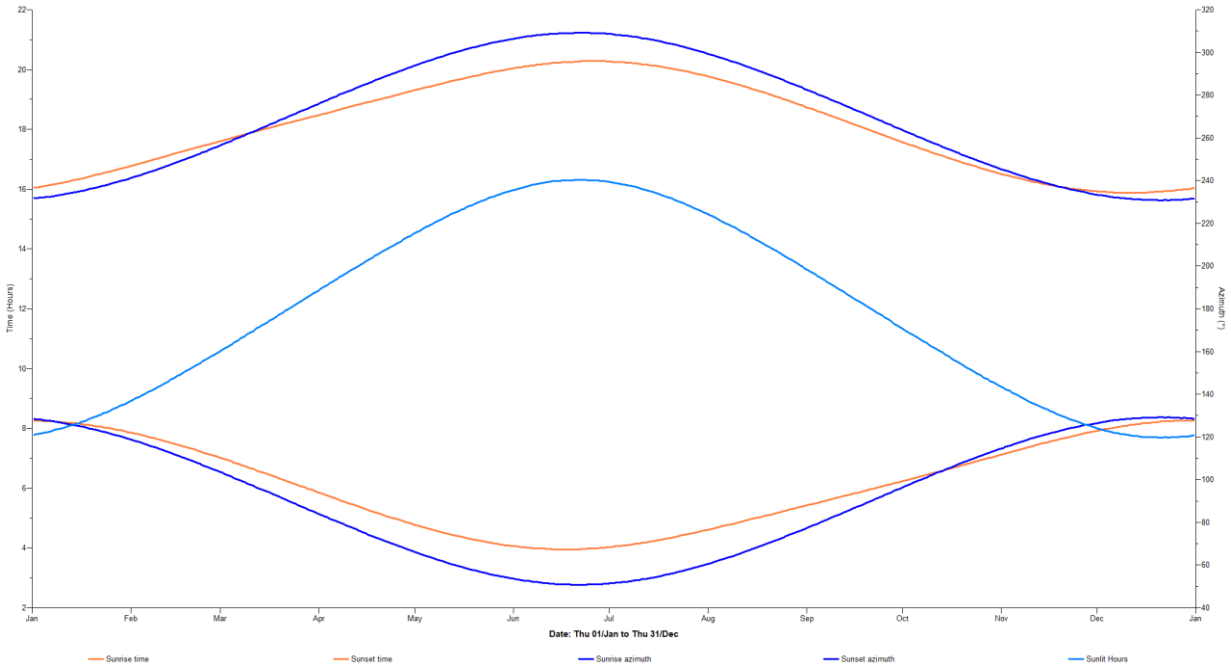


Figure 5: Brighton Sunrise, Sunset Azimuth and Sunlit hours profiles

The figure below shows the north direction and the relative position of the sun during the summer solstice.

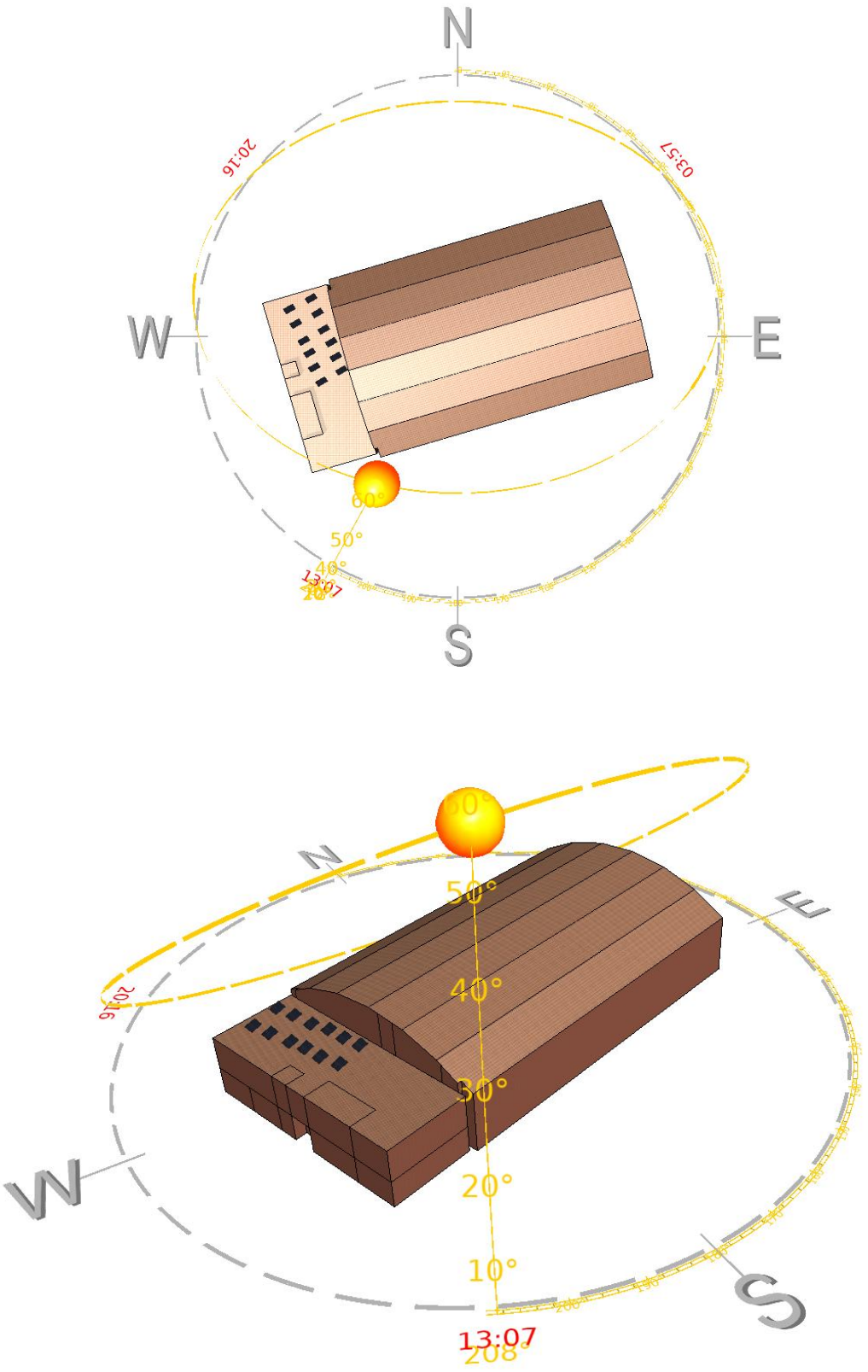


Figure 6: Brighton Padel Court sun path 21st of June 15:00

7.0 BRIGHTON CITY AIRPORT DETAILS

Brighton City Airport (formerly known as Shoreham Airport) is one of the world's oldest commercial airports, with the first recorded flight dating back to 1910. Today, it continues to play a significant role in British aviation, serving as a major hub for pilot training, pleasure flights, and private jet and helicopter charters. It is recognised as one of the busiest and most notable general aviation airfields in the United Kingdom.

The ICAO Airport layout from 2021 shows 4 runways as follows

1- Runway 02/20 Asphalt (1036x 18 m)

2- Runway 02/20 Grass (602 x32)

3- Runway 06/24 Grass (799x25 m)

4- Runway 13/31 Grass (408 x18 m)

The Air Traffic Control (ATC) Tower is located on the main building approximately 200 m south runway 06/24.

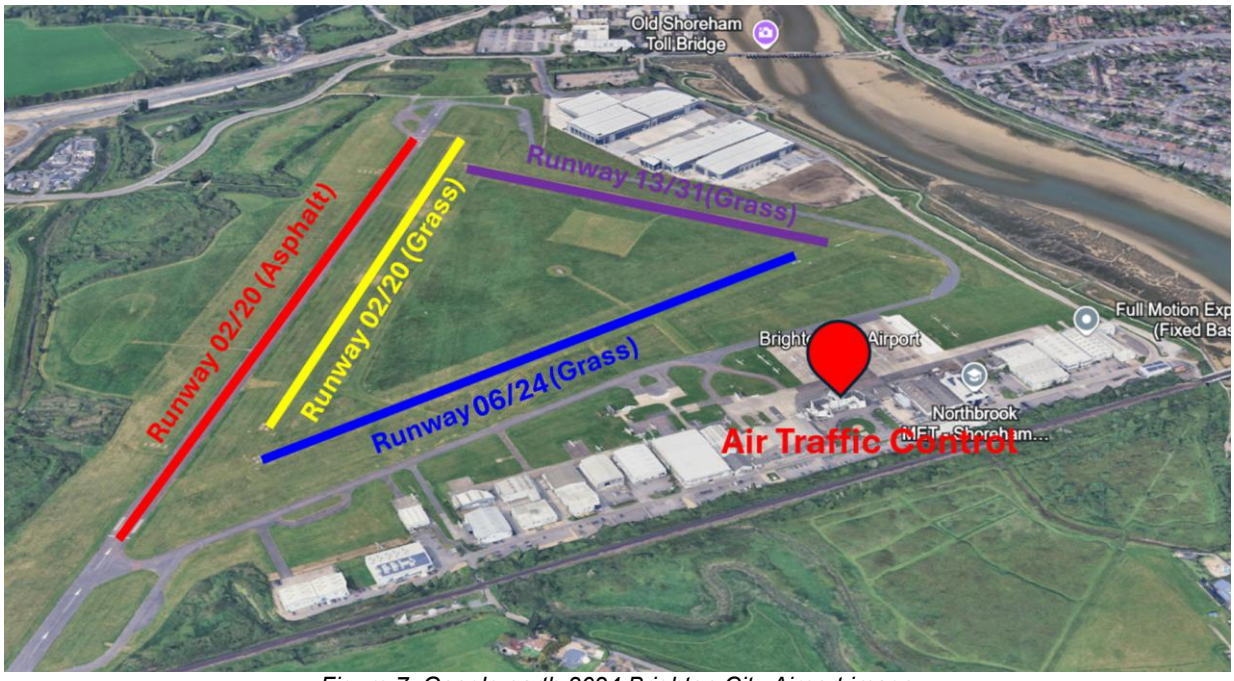


Figure 7: Google earth 2024 Brighton City Airport image

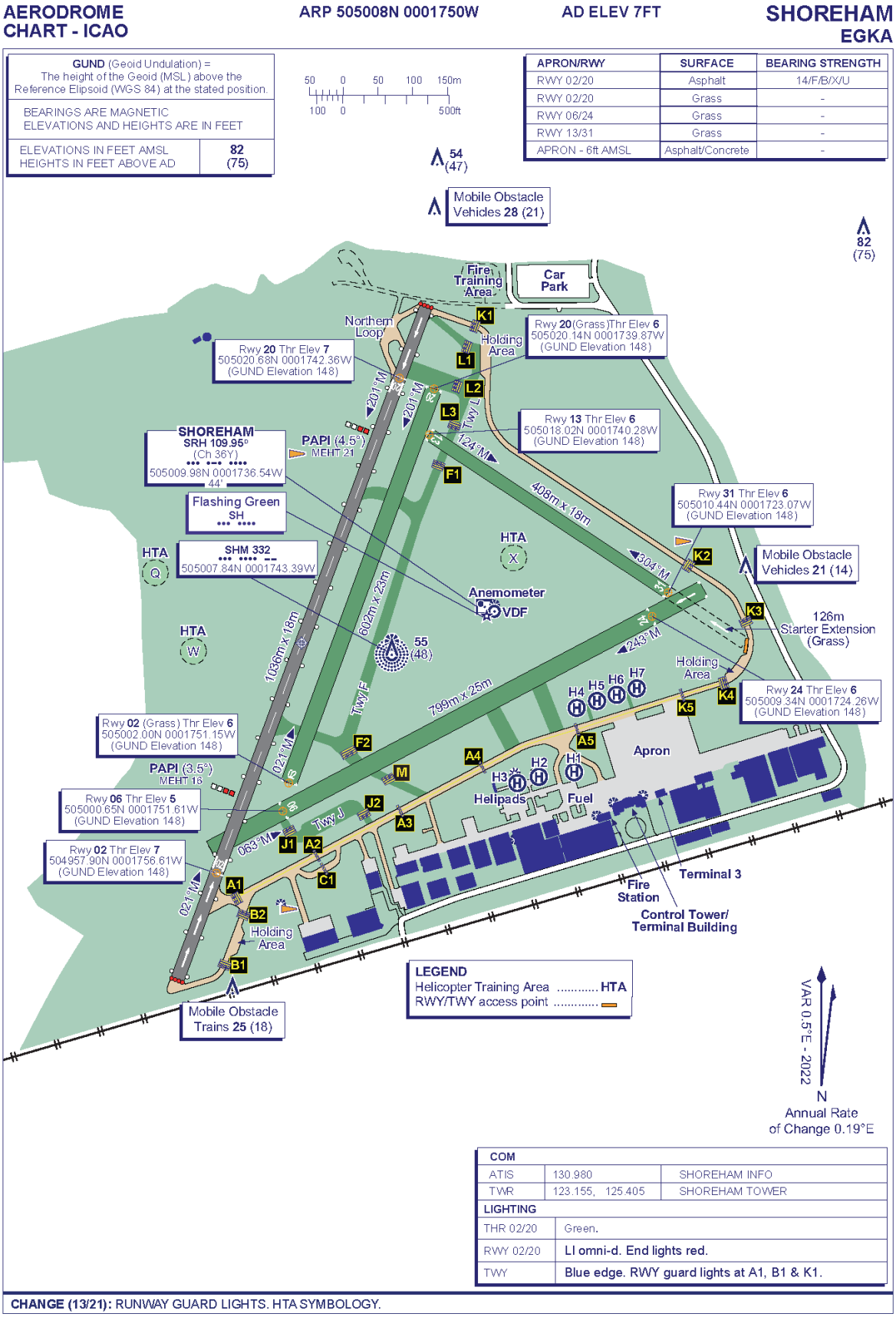


Figure 8: ICAO Brighton City Airport 2021 layout

8.0 POTENTIAL CRITICAL RECEPTORS

A glint and glare assessment has been conducted for all aircraft approach paths associated with the aerodromes included in this report. Receptor locations (i.e., aircraft positions) have been defined along the extended runways centreline, beginning at a point 50 feet above the runway threshold and extending outward to a distance of 2 miles (3.2 km).

The assessment methodology focuses on determining whether solar reflections may be experienced by aircraft during approach considered one of the most critical phases of flight. Aircraft heights at each receptor point have been calculated based on a standard 3-degree descent angle relative to the runway threshold elevation unless otherwise stated by the Airport. For Runways 02/20, the following is glidepath angle provided by the airport:

- Runway 20: glidepath angle 4.5 degrees
- Runway 02: glidepath angle: 3.5 degrees



Figure 9: Airport Critical receptors

The below figure illustrates the assessed 2-mile approach paths (shown in yellow) for each runway bearing:



Figure 10: Runway threshold and 2 miles approaches

As per the information provided by Brighton Airport Safeguarding officer, since the completion of this report, a new touchdown point has been promulgated into the AIP for runway 06. Therefore, this new runway touchdown point needs to be considered not the previous touchdown point.

The coordinates for Runway 06 new threshold are provided per the below extract:

Runway 06 New Threshold position
N50 50 03.49 W000 17 42.66



Figure 11: Runway 06 new threshold

The new threshold for runway 06 has been incorporated in the study.

The figure below shows the Air Traffic Control (ATC) tower situated above the main building of Brighton City Airport.



Figure 12: Air traffic Control

The assessment involved general aviation aircraft performing both left-hand and right-hand circuits (Fixed wing airplane training Circuits) around Runway 02/20, the longest runway at the aerodrome.

When light aircraft arrive at or depart from an aerodrome, they follow a standard flight pattern. A typical circuit is illustrated in the figure below.

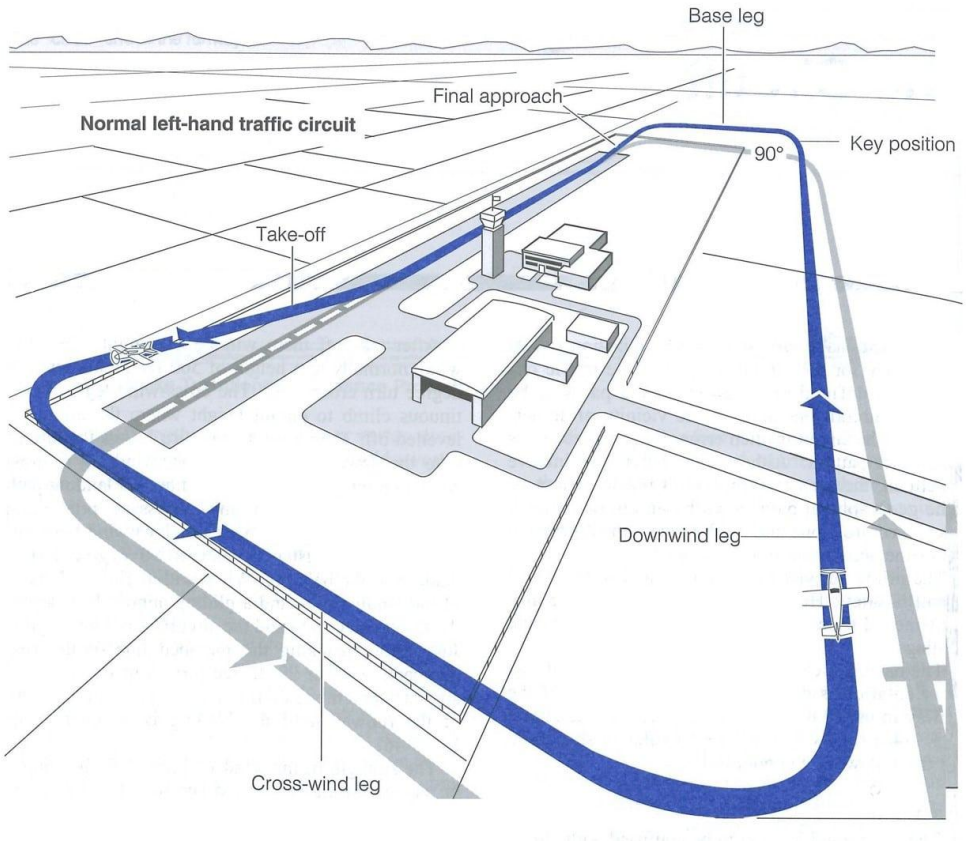


Figure 13: Typical Circuit

The way flight circuits are flown can vary significantly between airports, pilots, and aircraft types. For this assessment, the modelled circuit incorporates the following characteristics:

- Circuit altitude: 251.8 meters above the lowest runway threshold
- Circuit path: Originates and terminates at the longest runway 02/20 Asphalt with the following glidepath:
    - Runway 20: glidepath angle 4.5 degrees
    - Runway 02: glidepath angle: 3.5 degrees

- Base leg altitude: Aircraft are assumed to be at maximum 251.8 meters above mean sea level (AMSL) and descends to achieve the glidepath angle for runway 02 and 20

According to information provided by Brighton Airport, the Left and Right circuits (fixed wing airplane training circuits) have been modelled as illustrated in the figure below. The modelling approach has been updated from individual points to complete routes to more efficiently assess the potential for glare across the entire circuit.

Other runways circuits will be within the domain of the identified circuit range

Further details on Routes Modelling are provided in Appendix A.

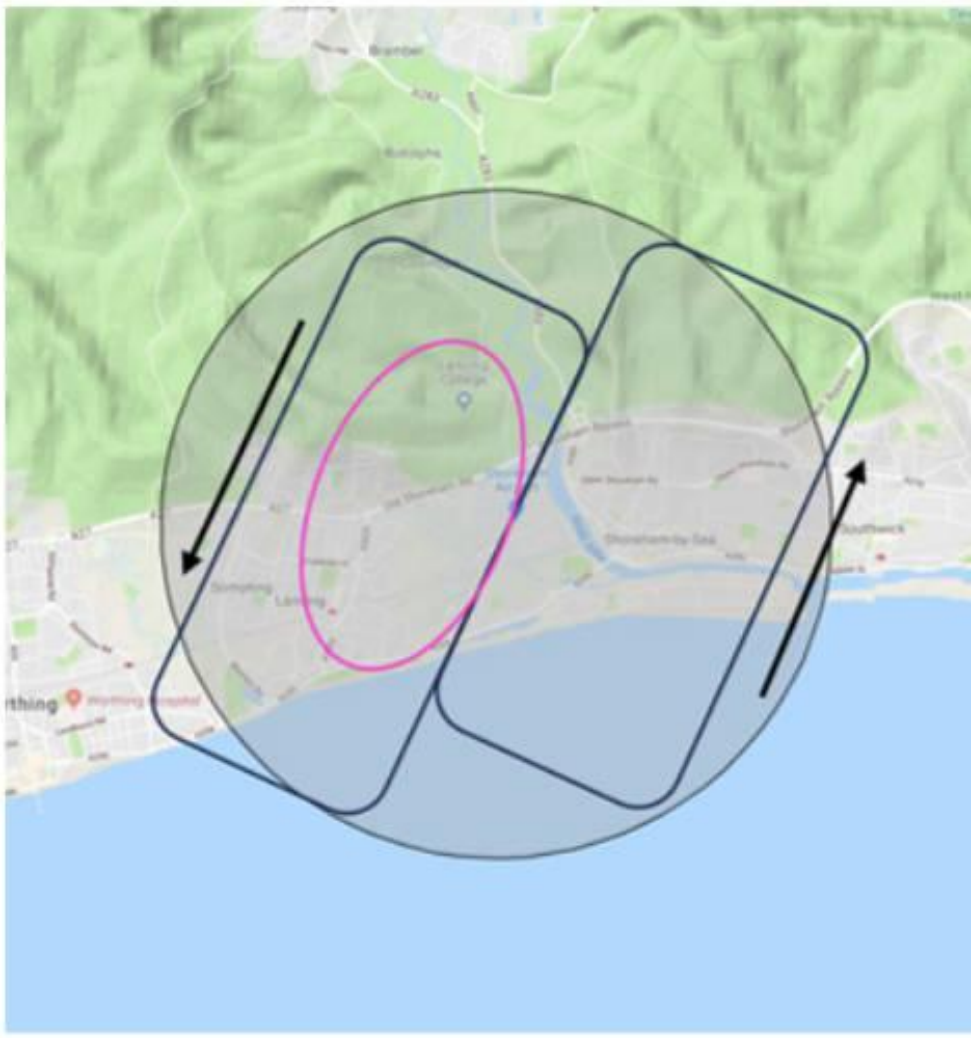


Figure 14: left- and right-hand fixed wing airplane training circuits (source Brighton Airport safeguarding officers)

8.1 Helipad Circuit Path

The figure below illustrates the helicopter training route. As shown, the helicopter will reach a maximum altitude of 600 ft QNH within the Aerodrome Traffic Zone (ATZ), and up to 800 ft QNH between the A27 and the railway during the downwind leg.

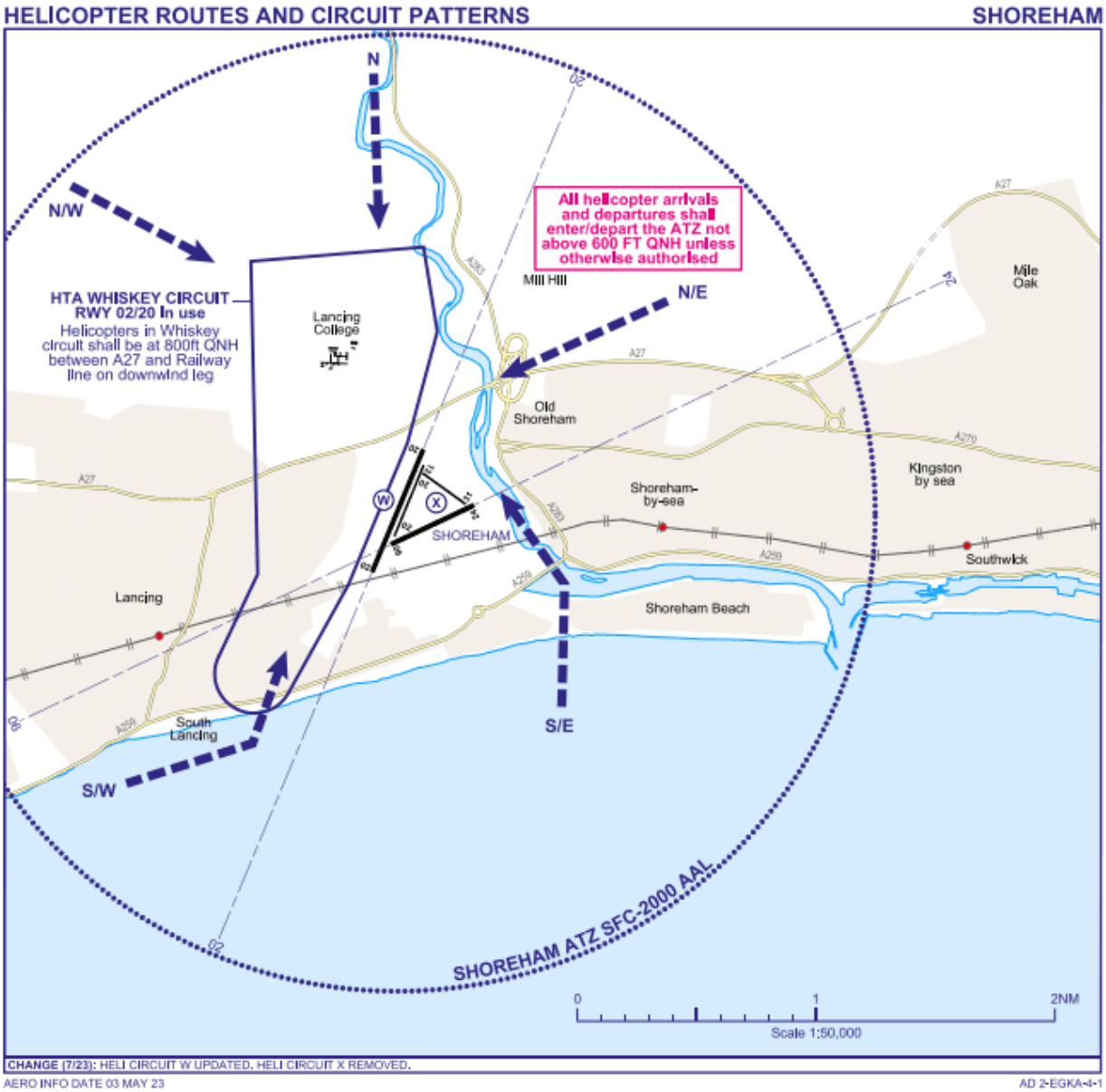


Figure 15: Helicopter Training Route

No other critical receptors have been identified in the vicinity of the Padel Court building.

9.0 RESULTS

The ForgeSolar model has been used to assess the potential for glare reflections. Intensity calculations have been conducted in accordance with the Sandia National Laboratories methodology, specifically targeting aviation receptors. This approach is commonly applied to evaluate the potential glare impact from solar photovoltaic developments located on or near aerodromes.

The intensity model estimates the expected glare intensity and its potential to cause visual after-effects, such as after-images or more severe visual impairments. The model's glare classification system, including associated designations and colour coding, is presented in the table below:

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

Figure 16: Glare Impact Categories

Receptor	Reflection possible towards the receptor		Glare Type	Comment
	am	pm		
ATC Tower	No		N/A	No solar reflections are geometrically possible; therefore, no impact is expected.
Runway 02 (Asphalt)	No		N/A	-
Runway 20 (Asphalt)	No		N/A	-
Runway 02(Grass)	No		N/A	-
Runway 20 (Grass)	No		N/A	-
Runway 13 (Grass)	No		N/A	-
Runway 31 (Grass)	No	Yes (36.5 hrs)	Low Potential	Solar reflections are predicted to reach a maximum intensity classified as *low potential for temporary after-image*, occurring for a total of 2,199 minutes annually, with a maximum duration of up to 20 minutes on any single day.
Runway 06 (Grass)	No		N/A	-
Runway 24 (Grass)	No		N/A	-

Receptor	Reflection possible towards the receptor		Glare Type	Comment
	am	pm		
Left Circuit	Yes (45.1 hrs)	No	Low Potential	Solar reflections are predicted to reach a maximum intensity classified as *low potential for temporary after-image*, occurring for a total of 2704 minutes annually, with a maximum duration of up to 22 minutes on any single day.
Right Circuit	No		N/A	-
Helicopter Training Route	Yes (112.7 hrs)	No	Low Potential	Solar reflections are predicted to reach a maximum intensity classified as *low potential for temporary after-image*, occurring for a total of 6,762 minutes annually, with a maximum duration of up to 35 minutes on any single day.

Table 1: Glare Analysis Summary

ATC Tower

Modelling results indicate that solar reflections from the proposed development toward the Air Traffic Control (ATC) tower are not geometrically possible.

As such, no impacts are anticipated for ATC personnel, and no mitigation measures are required.

Runways Approach

The modelling indicates no glare potential for the following runway approaches.

1- Runway 02 (Asphalt) and Runway 20 (Asphalt)
2- Runway 02 (Grass) and Runway 20 (Grass)
3- Runway 06 (Grass) and Runway 24 (Grass)
4- Runway 13 (Grass)

For Runway 31 (Grass), The PV array is expected to produce the following glare effects:

- 2,199 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 20 minutes on any single day which is acceptable.
- 0 minutes of "yellow" glare with potential to cause temporary after-image

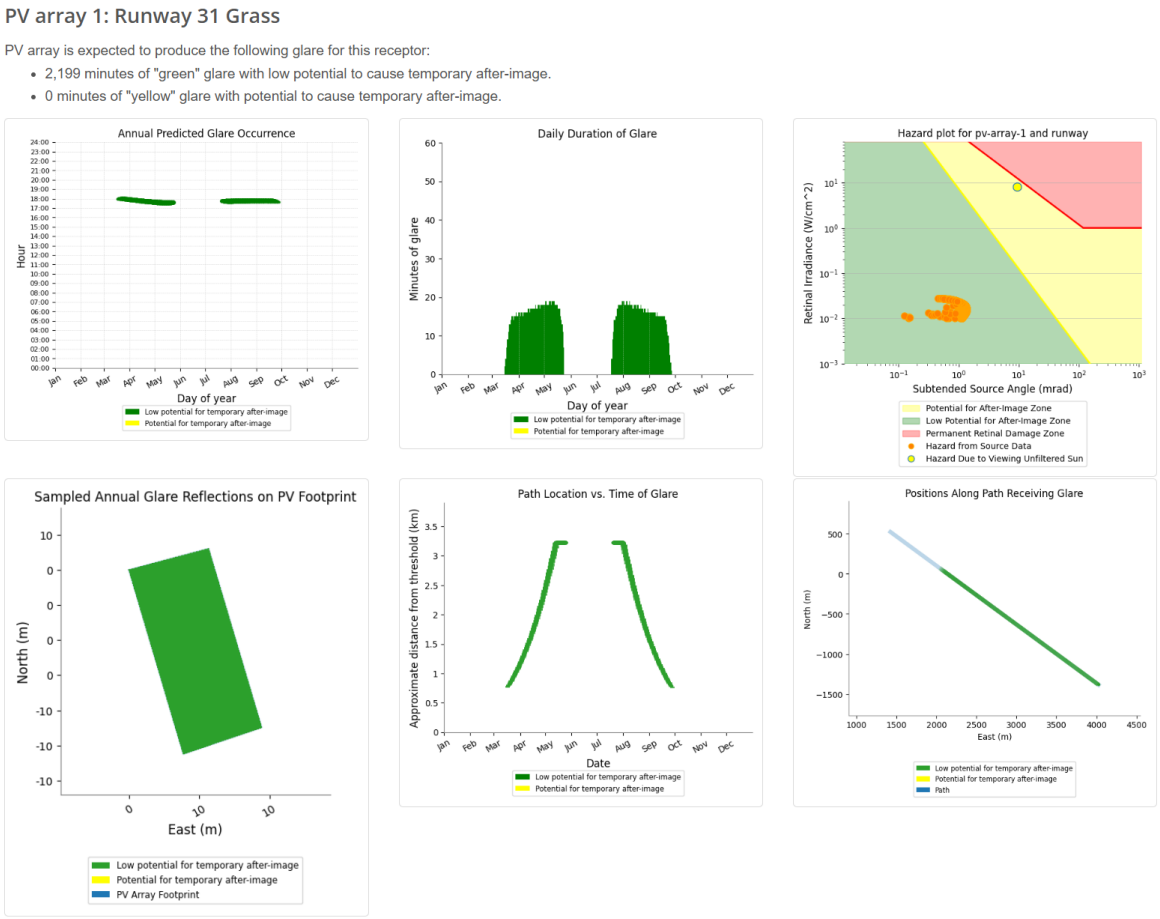


Figure 17: Glare analysis Summary plots (Runway 31 Grass)

Helicopter Circuit

The PV array is expected to produce the following glare for helicopter circuit:

- 6,762 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 35 minutes on any single day which is acceptable.

- 0 minutes of "yellow" glare with potential to cause temporary after-image.

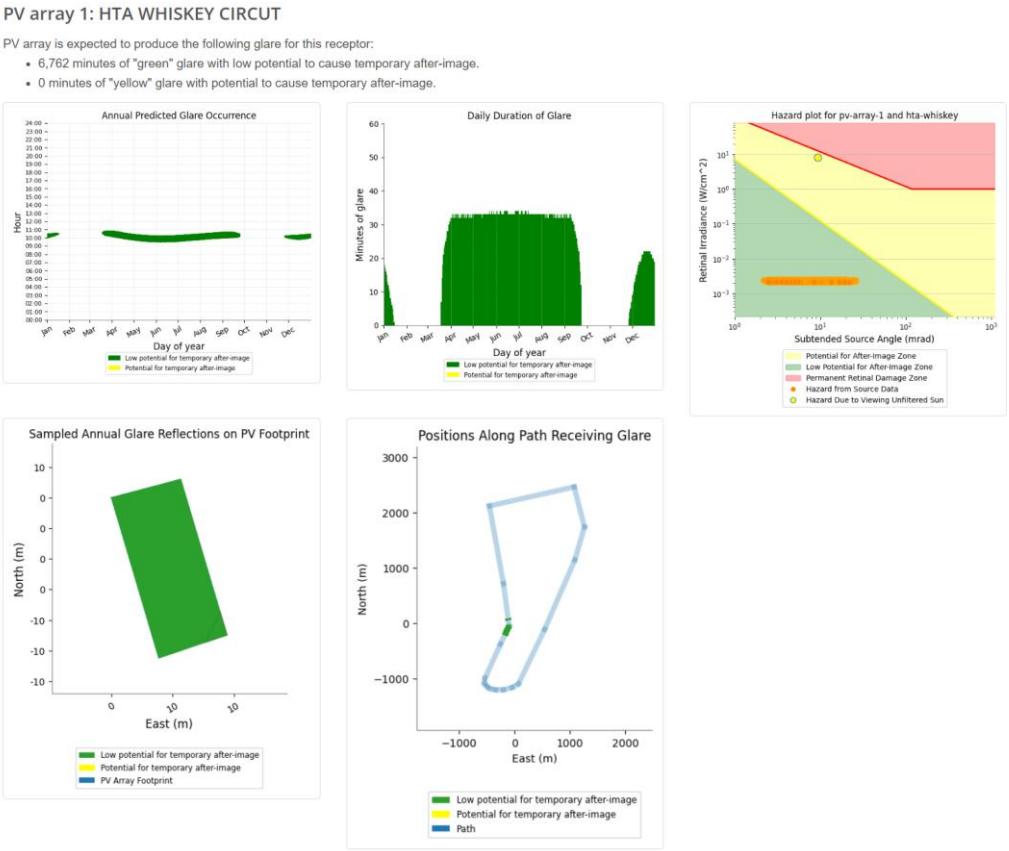


Figure 18: Glare analysis Summary plots (Helicopter Path)

Runway Left-Hand Circuit and Right-Hand Circuit

The PV array is expected to produce the following glare for left circuit:

- 2,704 minutes of "green" glare with low potential to cause temporary after-image, with a maximum duration of up to 22 minutes on any single day which is acceptable.

- 0 minutes of "yellow" glare with potential to cause temporary after-image.

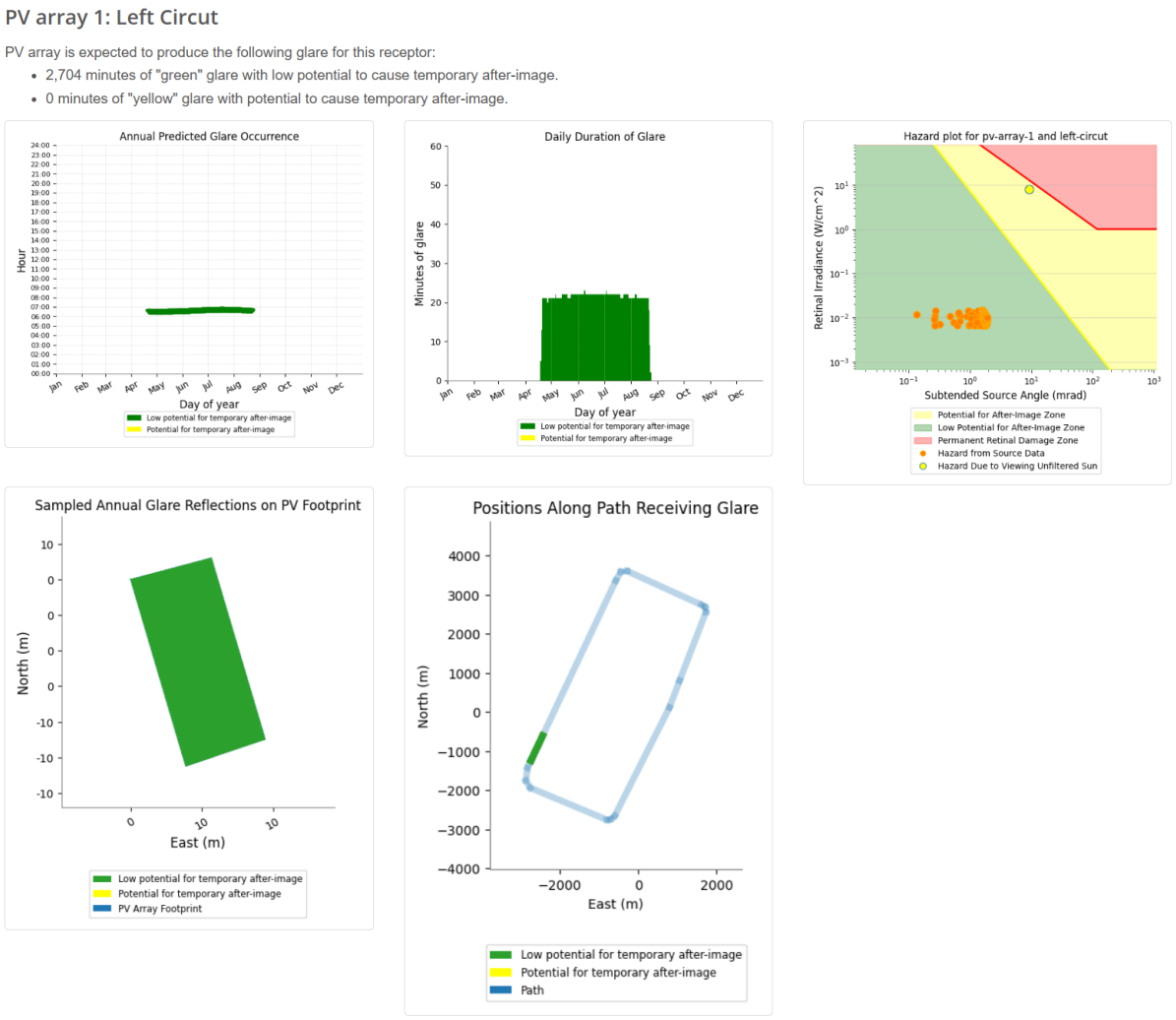


Figure 19: Glare analysis Summary plots (Left Circuit)

Modelling results indicate that no glare potential for the Runway right-hand circuit. and no mitigation is required.

Monthly glare occurrence distribution

The Below Figure shows the Monthly glare distribution

Distinct glare per month

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	161	0	498	1706	2096	1664	1898	2031	1003	0	25	583
pv-array-1 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0

Table 2:Distinct Glare Per Month

10.0 CONCLUSIONS

No impacts are predicted for personnel in the ATC tower, and no mitigation measures are required.

No significant impacts are anticipated for pilots on approach to the assessed runways at Brighton City Airport.

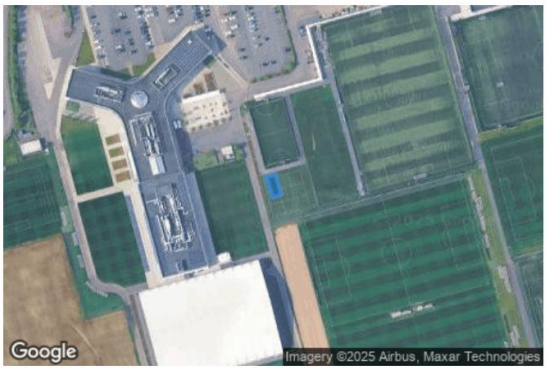
No significant impacts are anticipated for pilots on Fixed wing circuit routes and helicopter training route.

11.0 APPENDIX A: COMPONENT DATA

11.1 PV arrays

PV Arrays

Name: PV array 1
Description: Padel Court Pv Panels
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: 12.375 kW
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	50.831724	-0.310346	4.21	12.78	16.98
2	50.831606	-0.310291	4.29	12.78	17.07
3	50.831623	-0.310212	4.31	12.78	17.08
4	50.831738	-0.310265	4.19	12.78	16.97

11.2 Helicopter Circuit Path

Route Receptors

Name: HTA WHISKEY CIRCUT
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	50.853830	-0.295066	3.01	182.88	185.89
2	50.850741	-0.316781	29.81	182.88	212.69
3	50.838114	-0.313176	6.49	243.84	250.33
4	50.831229	-0.311717	4.76	243.84	248.60
5	50.828302	-0.313949	3.18	243.84	247.02
6	50.822772	-0.317897	5.09	182.88	187.97
7	50.821958	-0.318069	5.59	182.88	188.47
8	50.821470	-0.317468	5.28	182.88	188.16
9	50.821091	-0.316695	6.19	182.88	189.07
10	50.820874	-0.315236	3.98	182.88	186.86
11	50.820874	-0.313176	0.00	182.88	182.88
12	50.821253	-0.310945	0.44	182.88	183.32
13	50.821850	-0.309314	4.48	182.88	187.36
14	50.830687	-0.302619	3.47	243.84	247.31
15	50.841962	-0.294894	5.05	243.84	248.89
16	50.847327	-0.292405	2.85	182.88	185.73
17	50.853830	-0.295066	3.01	182.88	185.89

11.3 Left Circuit Fixed Wing

Name: Left Circut
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	50.838978	-0.295338	2.55	0.00	2.55
2	50.854741	-0.285789	33.35	251.80	285.15
3	50.855866	-0.286068	36.85	251.80	288.65
4	50.856380	-0.287313	36.62	251.80	288.42
5	50.864168	-0.314349	50.63	251.80	302.43
6	50.863979	-0.316710	71.37	251.80	323.17
7	50.861974	-0.318469	85.27	251.80	337.07
8	50.818938	-0.350490	3.07	251.80	254.87
9	50.815982	-0.351091	7.53	251.80	259.33
10	50.814328	-0.349503	7.19	251.80	258.99
11	50.806950	-0.321692	-0.05	195.70	195.65
12	50.807086	-0.320362	-0.10	195.70	195.60
13	50.807872	-0.318860	-0.13	195.70	195.57
14	50.832802	-0.299011	2.19	0.00	2.19
15	50.838978	-0.295338	2.55	0.00	2.55

11.4 Right Circuit Fixed Wing

Name: Right circut
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	50.838945	-0.295321	2.57	0.00	2.57
2	50.868767	-0.277739	116.96	251.80	368.76
3	50.869526	-0.276066	130.51	251.80	382.31
4	50.869553	-0.272890	144.32	251.80	396.12
5	50.860208	-0.239931	56.22	251.80	308.02
6	50.858962	-0.238214	56.78	251.80	308.58
7	50.857120	-0.238214	63.59	251.80	315.39
8	50.811456	-0.271530	-0.44	251.80	251.36
9	50.810480	-0.273590	-0.66	251.80	251.14
10	50.809721	-0.276852	-0.76	251.80	251.04
11	50.818018	-0.307751	0.00	195.70	195.70
12	50.818967	-0.308738	0.00	195.70	195.70
13	50.819564	-0.308909	0.00	195.70	195.70
14	50.832928	-0.298996	1.83	0.00	1.83
15	50.838945	-0.295321	2.57	0.00	2.57

11.5 Flight path Receptors

Flight Path Receptors

Name: Runway 02 Asphalt
Description:
Threshold height: 15 m
Direction: 25.8°
Glide slope: 3.5°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.832855	-0.298990	1.98	15.24	17.22
Two-mile	50.806816	-0.318908	-0.15	214.24	214.09

Name: Runway 02 Grass
Description:
Threshold height: 15 m
Direction: 23.5°
Glide slope: 3.5°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.834081	-0.297417	1.47	15.24	16.71
Two-mile	50.807558	-0.315664	-0.35	213.93	213.58

Name: Runway 06 Grass new
Description:
Threshold height: 15 m
Direction: 64.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.834063	-0.295658	2.01	15.24	17.25
Two-mile	50.821406	-0.336866	4.72	181.22	185.93

Name: Runway 13 Grass
Description:
Threshold height: 15 m
Direction: 124.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.838270	-0.294326	1.99	15.24	17.23
Two-mile	50.854454	-0.332309	58.43	127.48	185.91

Name: Runway 20 Asphalt
Description:
Threshold height: 15 m
Direction: 200.4°
Glide slope: 4.5°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.839023	-0.295250	2.39	15.24	17.63
Two-mile	50.866123	-0.279273	112.47	158.49	270.95

Name: Runway 20 Grass
Description:
Threshold height: 15 m
Direction: 200.9°
Glide slope: 4.5°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.838346	-0.294754	1.97	15.24	17.21
Two-mile	50.865349	-0.278373	102.44	168.09	270.53

Name: Runway 24 Grass
Description:
Threshold height: 15 m
Direction: 241.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.835865	-0.290332	1.76	15.24	17.00
Two-mile	50.849793	-0.250167	56.55	129.13	185.68

Name: Runway 31 Grass
Description:
Threshold height: 15 m
Direction: 306.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	50.836417	-0.290128	1.71	15.24	16.95
Two-mile	50.819296	-0.253193	0.00	185.64	185.64

11.6 Air traffic Control

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	50.833622	-0.290673	2.41	20.00

Map image of 1-ATCT



12.0 APPENDIX A: SOFTWARE ANALYSIS RESULTS

FORGESOLAR GLARE ANALYSIS

Project: **Brighton Padel Court**
12 (1.65 x 1) panels with total area of 19.8 m2 and capacity of 4 kW

Site configuration: **Brighton Padel Court**

Created 28 Mar, 2025
Updated 06 Aug, 2025
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 0 to 10 kW
(1,000 kW / 32,400 m^2 limit)
Site ID 156763.24548

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	30.0	180.0	11,665	194.4	0	0.0	27,850.0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
HTA WHISKEY CIRCUT	6,762	112.7	0	0.0
Left Circut	2,704	45.1	0	0.0
Right circut	0	0.0	0	0.0
Runway 02 Asphalt	0	0.0	0	0.0
Runway 02 Grass	0	0.0	0	0.0
Runway 06 Grass new	0	0.0	0	0.0
Runway 13 Grass	0	0.0	0	0.0
Runway 20 Asphalt	0	0.0	0	0.0
Runway 20 Grass	0	0.0	0	0.0
Runway 24 Grass	0	0.0	0	0.0
Runway 31 Grass	2,199	36.6	0	0.0
1-ATCT	0	0.0	0	0.0

ForgeSolar

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Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	30.0	180.0	11,655	194.2	0	0.0	27,850.0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
HTA WHISKEY CIRCUT	6,762	112.7	0	0.0
Left Circut	2,704	45.1	0	0.0
Right circut	0	0.0	0	0.0
Runway 02 Asphalt	0	0.0	0	0.0
Runway 02 Grass	0	0.0	0	0.0
Runway 06 Grass new	0	0.0	0	0.0
Runway 13 Grass	0	0.0	0	0.0
Runway 20 Asphalt	0	0.0	0	0.0
Runway 20 Grass	0	0.0	0	0.0
Runway 26 Grass	0	0.0	0	0.0
Runway 31 Grass	2,189	36.5	0	0.0
1-ATCT	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

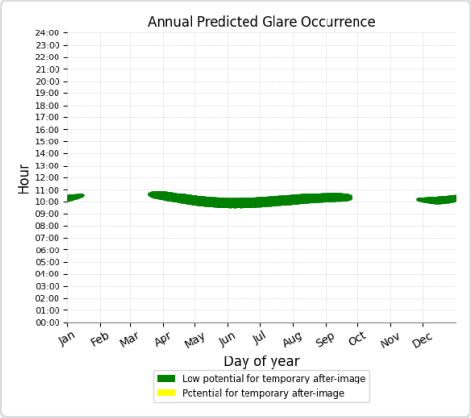
Receptor results ordered by category of glare

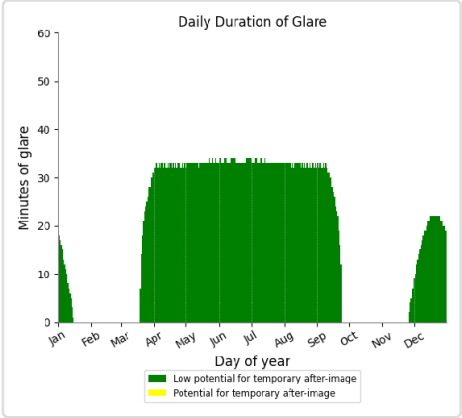
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
HTA WHISKEY CIRCUT	6,762	112.7	0	0.0
Left Circut	2,704	45.1	0	0.0
Right circut	0	0.0	0	0.0
Runway 31 Grass	2,189	36.5	0	0.0
Runway 02 Asphalt	0	0.0	0	0.0
Runway 02 Grass	0	0.0	0	0.0
Runway 06 Grass new	0	0.0	0	0.0
Runway 13 Grass	0	0.0	0	0.0
Runway 20 Asphalt	0	0.0	0	0.0
Runway 20 Grass	0	0.0	0	0.0
Runway 26 Grass	0	0.0	0	0.0
1-ATCT	0	0.0	0	0.0

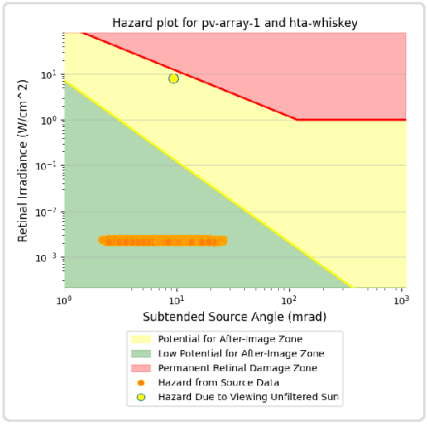
PV array 1 and Route: HTA WHISKEY CIRCUT

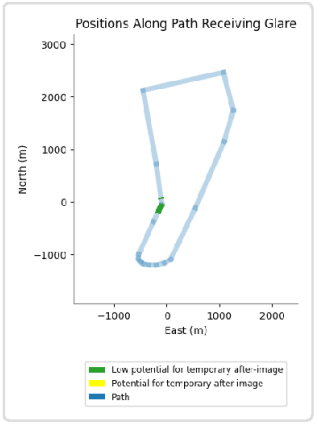
Yellow glare: none

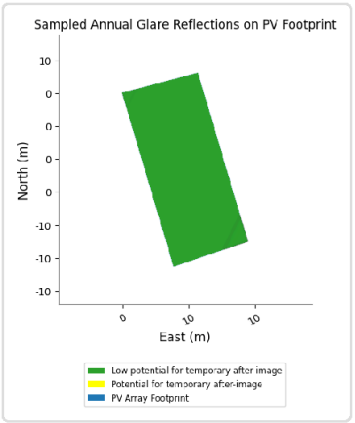
Green glare: 6,762 min.





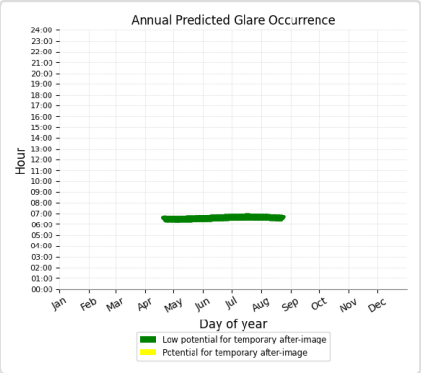


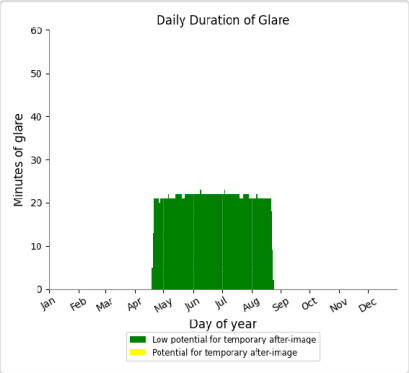


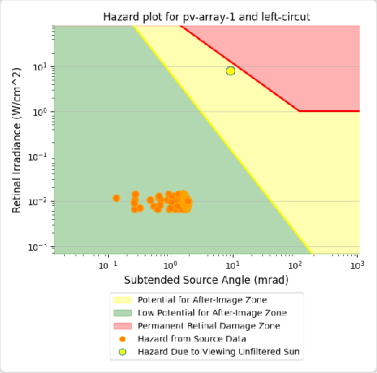


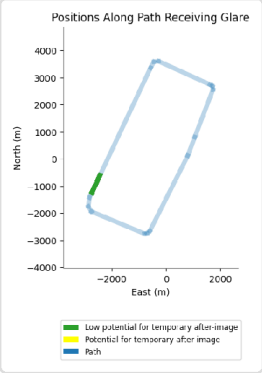
PV array 1 and Route: Left Circut

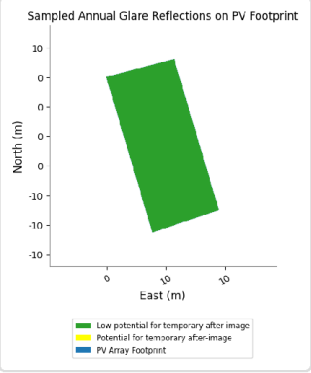
Yellow glare: none
Green glare: 2,704 min.











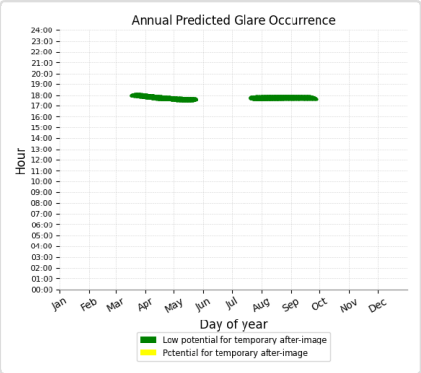
PV array 1 and Route: Right circut

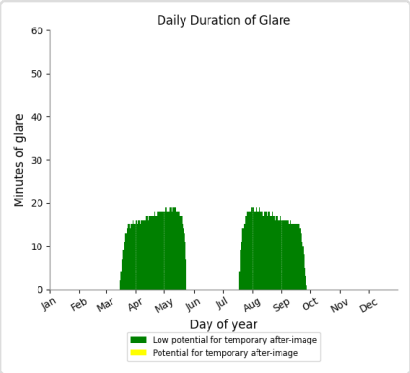
No glare found

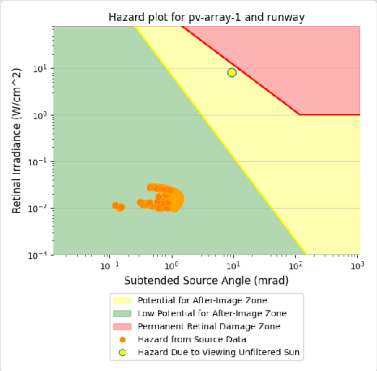
PV array 1 and FP: Runway 31 Grass

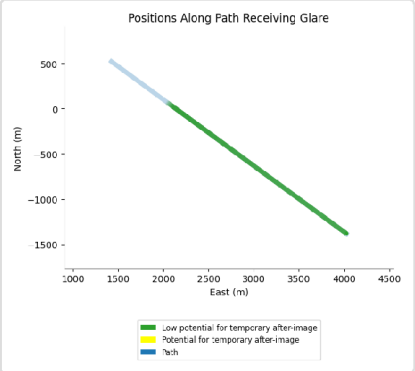
Yellow glare: none

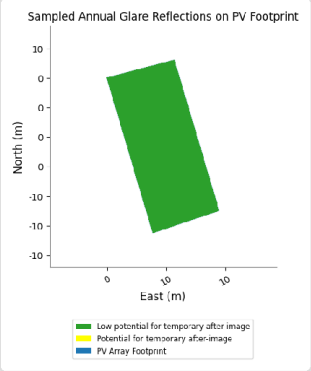
Green glare: 2,199 min.

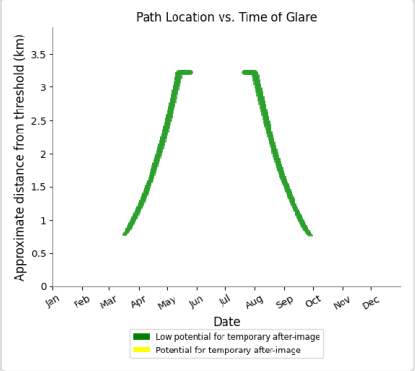












PV array 1 and FP: Runway 02 Asphalt

No glare found

PV array 1 and FP: Runway 02 Grass

No glare found

PV array 1 and FP: Runway 06 Grass new

No glare found

PV array 1 and FP: Runway 13 Grass

No glare found

PV array 1 and FP: Runway 20 Asphalt

No glare found

PV array 1 and FP: Runway 20 Grass

No glare found

PV array 1 and FP: Runway 26 Grass

No glare found

PV array 1 and 1-ATCT

No glare found

13.0 APPENDIX B: SOFTWARE ASSUMPTIONS

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
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.
Several V1 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 V1 analyses of path receptors.
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.
The analysis does not automatically 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.
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.)
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.
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.
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.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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