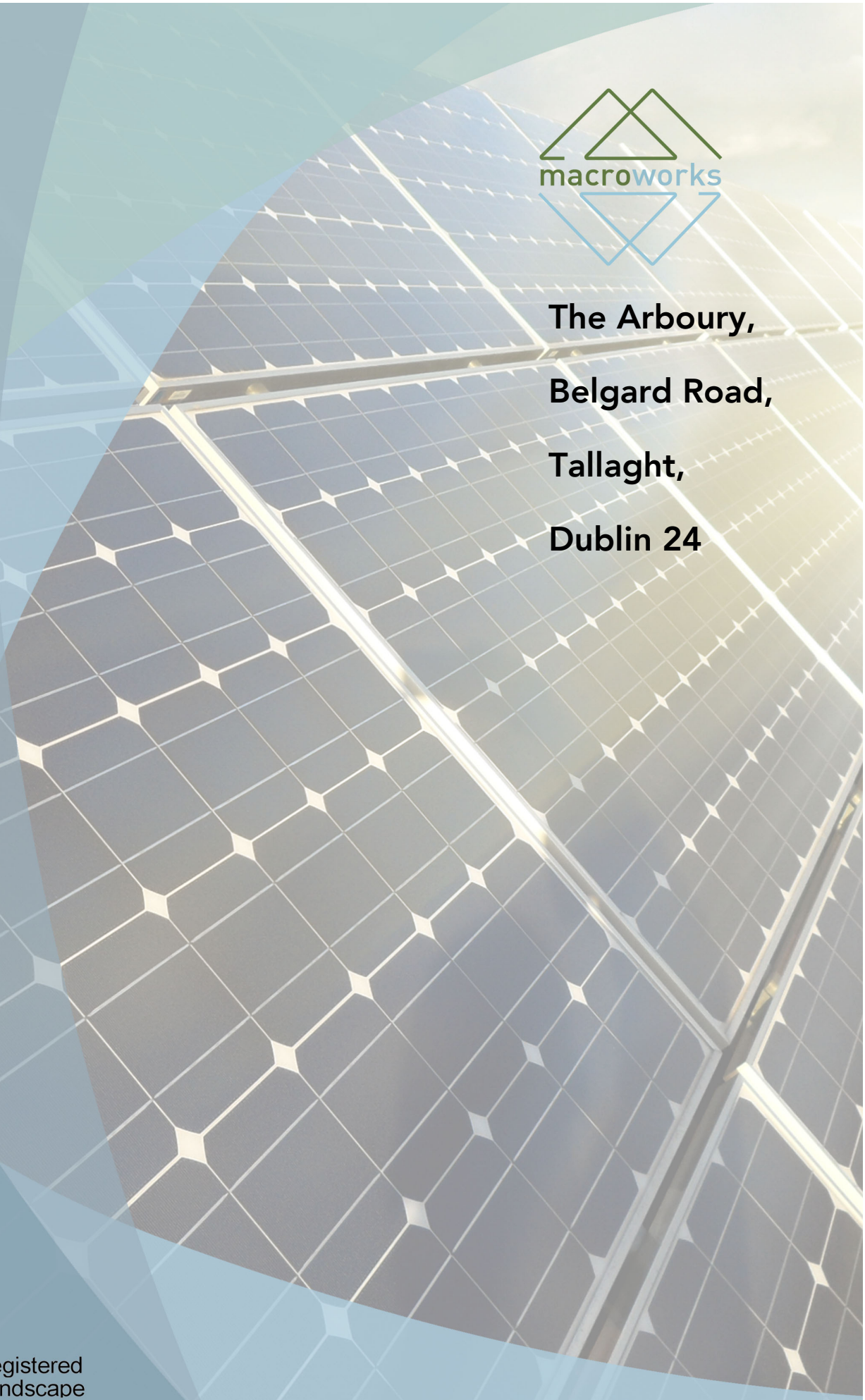
GLINT AND GLARE ASSESSMENT



macroworks

The Arboury,

Belgard Road,

Tallaght,

Dublin 24

Registered Landscape Architect

March 2022

GLINT AND GLARE STUDY

Executive Summary

The proposal for a roof mounted photovoltaic solar panel installation on the roofs of the proposed development at the former ABB Site on Belgard Road, Tallaght, Dublin 24, was assessed to determine whether it has the potential to cause any glint or glare on aviation receptors. The air traffic control tower and the flight approach paths to the runways at Casement Aerodrome were identified for analysis. The assessment also includes an analysis for the helipad at Tallaght hospital.

An in-depth analysis of this proposed photovoltaic panel installation with regard to the indicated aviation receptors has predicted that there is no potential for hazardous effects upon aircraft approaching Casement Aerodrome. Analysis showed no theoretical potential for glint and glare at the air traffic control tower at Casement Aerodrome as a result of the proposed roof mounted installation of photovoltaic panels.

Furthermore, an analysis was undertaken to assess potential impacts on helicopters using the helipad at Tallaght hospital. The analysis results indicate that hazardous impacts are highly unlikely.

1 INTRODUCTION

Macro Works Ltd. were commissioned to undertake a glint and glare assessment for a proposed roof mounted photovoltaic (PV) panel installation on the roof of a proposed development (The Arboury) at the former ABB Site on Belgard Road, Tallaght, Dublin 24 (Figure 1 refers). PV arrays are proposed on the roofs of Block B and Block C only. The PV panels will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun).

Figure 1: Extract from Drawing No.: 2113 – Drawing BIM Name: PE19150-CWO-ZZ-13-DR-A-2113, a plan view of the of the proposed development showing PV arrays on Block B and Block C.

2 STATEMENT OF AUTHORITY

Macro Works' relevant experience includes nineteen years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments. Macro Works has assessed the effects of glint and glare for many solar development sites throughout Ireland to date.

3 METHODOLOGY

The process for dealing with aviation receptors is as follows:

1. The Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) is used to determine if any of these aviation receptors has the potential to theoretically experience glint or glare. This tool also calculates the intensity of such reflectance and whether it is acceptable by FAA standards.
2. SGHAT does not account for terrain screening or screening provided by surface elements such as existing vegetation or buildings, therefore the results of the SGHAT may need to be considered, in conjunction with an assessment of existing intervening screening that may be present, to establish if reflectance can actually be experienced at the receptors.
3. Finally, if necessary, additional assessment is undertaken using Macro Works' bespoke model which would into account any screening provided by any proposed mitigation measures.

4 GUIDANCE

Guidance has been prepared by the Federal Aviation Authority[1] to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. SGHAT was developed in conjunction with the FAA in harmony with this guidance and is commonly regarded as the accepted industry standard by aviation authorities internationally when considering the glint and glare effects upon aviation related receptors.

4.1 FEDERAL AVIATION AUTHORITY

Within the FAA's interim policy, a 'Review of Solar Energy System Projects on Federally Obligated Airports'[2] it states:

> *"To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a ''no objection'' to a Notice of Proposed Construction Form 7460–1, the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:*

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[1] Harris, Miller, Miller & Hanson Inc.. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Available at: https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

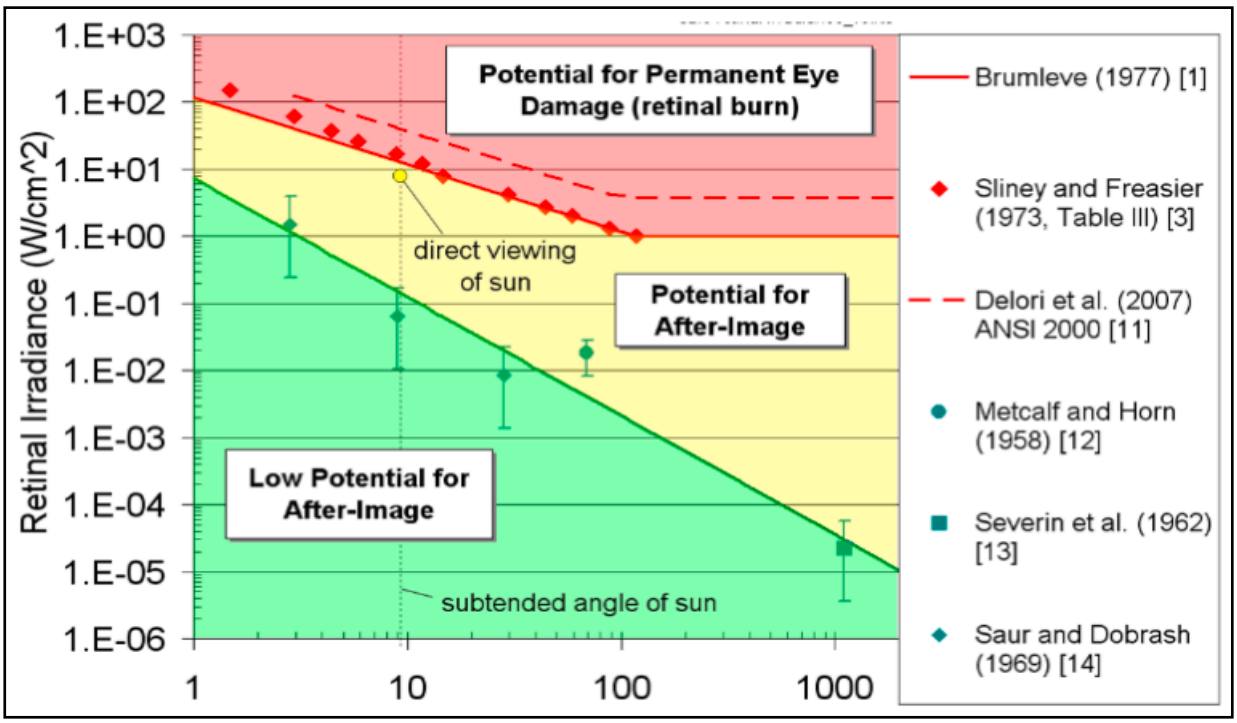
[2] Federal Aviation Administration (FAA). (2013). Department of Transportation - Federal Aviation Administration. *Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Vol 78 (No 205), 63276-63279.

- *No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab, and*
- *No potential for glare or ''low potential for after-image'' (shown in green in Figure 1* [Figure 2 refers]*) along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath."*

In summary, glare at an ATCT is not acceptable but glare with a *''low potential for after-image''* is acceptable along final approach paths to runways.

4.2 SOLAR GLARE HAZARD ANALYSIS TOOL

The SGHAT was designed to determine whether a proposed solar energy project would result in the potential for ocular impact as depicted on the Solar Glare Hazard Analysis Plot (Figure 2 refers). SGHAT analyses ocular impact over the entire calendar year in one minute intervals from when the sun rises above the horizon until the sun sets below the horizon. One of the principal outputs from the SGHAT report is a glare plot per receptor that indicates the time of day and days per year that glare has the potential to occur. SGHAT plot classifies the intensity of ocular impact as either Green Glare, Yellow Glare or Red Glare. These colour classifications are equivalent to the FAA's definitions regarding the level of ocular impact e.g. 'Green Glare' in the SGHAT is synonymous to the FAA's *''low potential for after-image','* and so forth. The various correlations are illustrated on the Solar Glare Hazard Analysis Plot**.**



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

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

Figure 2: Figure 1 from the FAA Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports

5 IDENTIFICATION OF STANDARD RECEPTORS

Casement Aerodrome is located approximately 4.7km to the northwest (heading of 289 degrees) of the proposed PV panels (Figure 3 refers) thus warrants inclusion in this assessment. There are four runway approaches at Casement Aerodrome; 10,28, 04 and 22. The Air Traffic Control Tower (ATCT) at Casement Aerodrome is 9m Above Ground Level (AGL) and will be referenced as '1-ATCT' in this report.

Figure 3: Aerial view (Google Earth Pro) showing the location of the PV panels (red pin) relative to the identified aviation receptor (yellow pin).

6 RESULTS

6.1 RUNWAY APPROACHES

The SGHAT results are contained in Appendix A and show that of the four runway approaches analysed, one has the theoretical potential to receive glare (runway 04). In in this instance SGHAT calculated the potential glare to be '*Green Glare*'. SGHATs '*Green Glare*' classification regarding the intensity of the potential glare is synonymous with FAA's *'low potential for temporary after image'*. *'Green Glare'* / glare with a *'low potential for temporary after image,'* regardless of the number of minutes per year, is considered by the FAA to be an **acceptable level of reflectance effect for runway approaches**.

6.2 AIR TRAFFIC CONTROL TOWERS

The SGHAT results are contained in Appendix A and show **no theoretical potential for glare at the ATCT in Casement Aerodrome.**

7 ADDITIONAL AVIATION RECEPTORS - HELIPAD

There is a helipad within the grounds of Tallaght hospital which is situated approximately 0.5km to the west (heading 264 degrees) of the proposed PV panels (Figure 4 refers). There is no category for helipads within the FAA guidance and these are generally not assessed as a standard aviation receptor. However, in the interest of undertaking a thorough assessment this helipad has been included for analysis in this assessment.

Figure 4: Aerial view (Google Earth Pro) showing the approximate location of the proposed development (red pin) relative to the identified aviation receptor (yellow pin).

In the absence of specific flight path information for the helicopters that land and take off from this helipad, and given the potential random trajectory of helicopter destination and arrival flights for Tallaght hospital, it was deemed appropriate to analyse receptor points at multiple height intervals above the helipad. It is intended that these will serve for the evaluation of a wide variety of flight scenarios to and from the helipad.

The SGHAT software was utilised to undertake this analysis. Using the SGHAT software, Observation Points (OP) were places at representative selection of four different heights at 100m intervals above the helipad surface; 0m, 100m, 200m and 300m.

While the use of Observation Points for assessing a helipad are not included for in the FAA guidance, for the purpose of this assessment, it was assumed, as a worst-case scenario, that a similar hazard intensity classification would apply to helicopters at these Observation Points as would apply to passenger aircraft approaching a runway.

7.1 HELIPAD ANALYSIS RESULTS

The SGHAT results for the Observation Points above the helipad at Tallaght hospital are contained in Appendix B and show that three of the four Observation Points (OP2, OP3 and OP4) have the theoretical potential to receive glare. In all instances SGHAT calculated the potential glare to be '*Green Glare*'. SGHATs '*Green Glare*' classification regarding the intensity of the potential glare is synonymous with FAA's *'low potential for temporary after image'*. **For this reason it is deemed highly unlikely for there to be any potential for hazardous impacts on helicopters approaching the helipad at Tallaght hospital**.

8 OVERALL CONCLUSION

From the analysis and discussions contained herein, it is considered that there will not be any hazardous glint and glare effects upon the aviation receptors identified as a result of the proposed roof mounted solar PV panels.

APPENDIX A:

SGHAT RESULTS – RUNWAYS APPROACHES AND AIR TRAFFIC CONTROL TOWERS (ATCT)

FORGESOLAR GLARE ANALYSIS

Project: **SGHAT_IRE**
Site configuration: **Belgard Road-temp-0**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 10:10 on 25 Mar, 2022.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

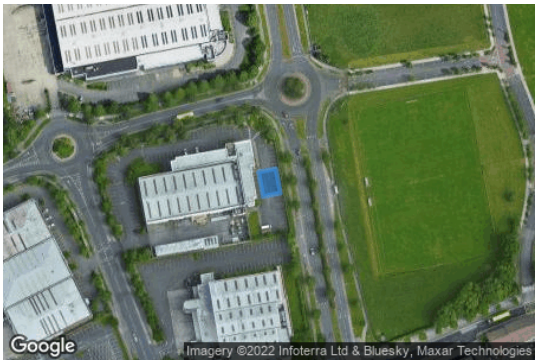
DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 66678.11293
Methodology: V2

PV Array(s)

Name: Block B
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 161.0°
Rated power: -
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	53.290227	-6.369266	99.50	31.78	131.28
2	53.290244	-6.369109	99.50	31.78	131.28
3	53.290111	-6.369067	99.50	31.78	131.28
4	53.290093	-6.369225	99.50	31.78	131.28
5	53.290227	-6.369266	99.50	31.78	131.28

Name: Block C
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 161.0°
Rated power: -
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	53.290185	-6.368603	99.50	28.35	127.85
2	53.290203	-6.368446	99.50	28.35	127.85
3	53.290070	-6.368404	99.50	28.35	127.85
4	53.290053	-6.368561	99.50	28.35	127.85
5	53.290185	-6.368603	99.50	28.35	127.85

Flight Path Receptor(s)

Name: Casement 04 Runway
Description: None
Threshold height: 15 m
Direction: 41.3°
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	53.293830	-6.453465	98.30	15.20	113.50
Two-mile	53.272113	-6.485435	154.40	127.80	282.20

Name: Casement 10 Runway
Description: None
Threshold height: 15 m
Direction: 101.8°
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	53.304622	-6.468287	86.30	15.30	101.60
Two-mile	53.310549	-6.515700	73.60	196.60	270.20

Name: Casement 22 Runway
Description: None
Threshold height: 15 m
Direction: 220.9°
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	53.303267	-6.439788	93.40	15.20	108.60
Two-mile	53.325107	-6.408047	62.50	214.80	277.30

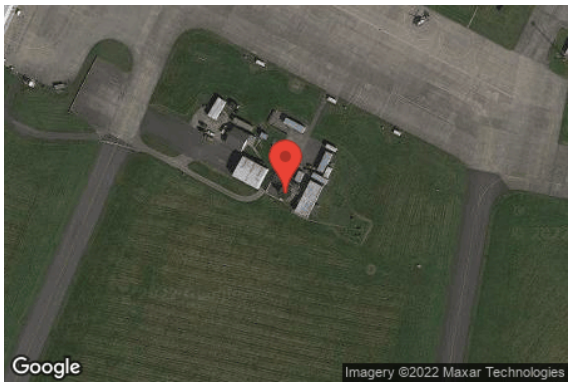
Name: Casement 28 Runway
Description: None
Threshold height: 15 m
Direction: 281.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301696	-6.445153	96.10	15.20	111.30
Two-mile	53.295759	-6.397747	106.20	173.80	280.00

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305496	-6.441790	93.50	9.00

Map image of 1-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Block B	15.0	161.0	94	0	-
Block C	15.0	161.0	84	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Casement 04 Runway	178	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

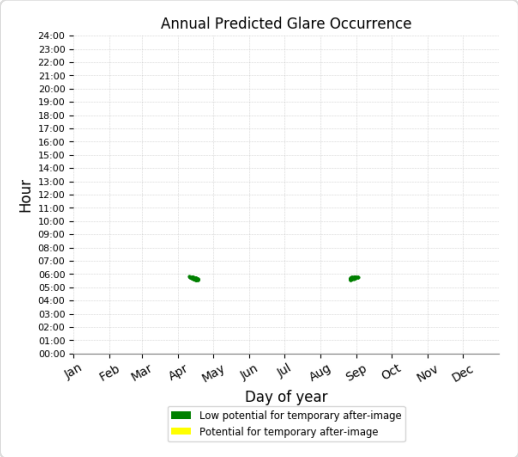
Results for: Block B

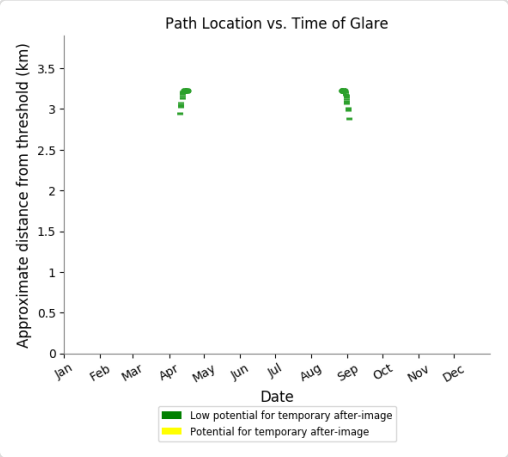
Casement 04 Runway	94	0

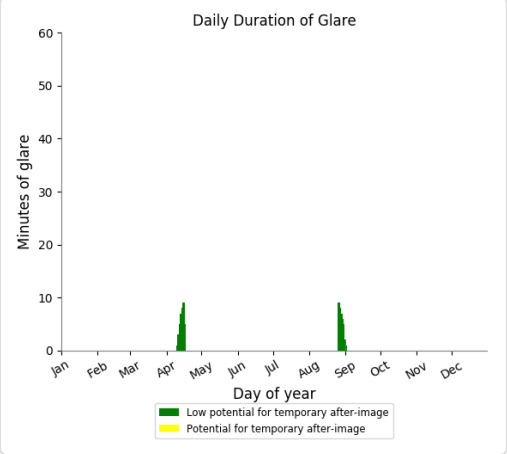
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
94 minutes of green glare







Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

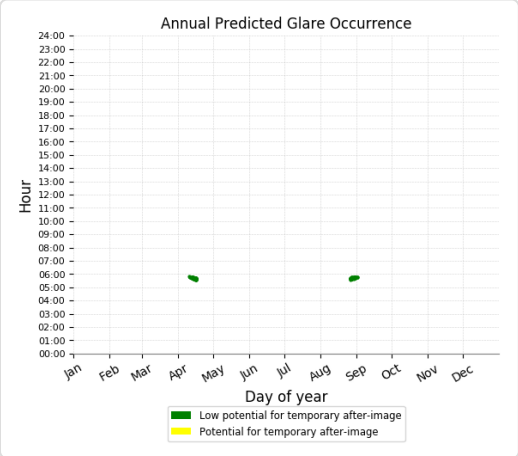
0 minutes of yellow glare
0 minutes of green glare

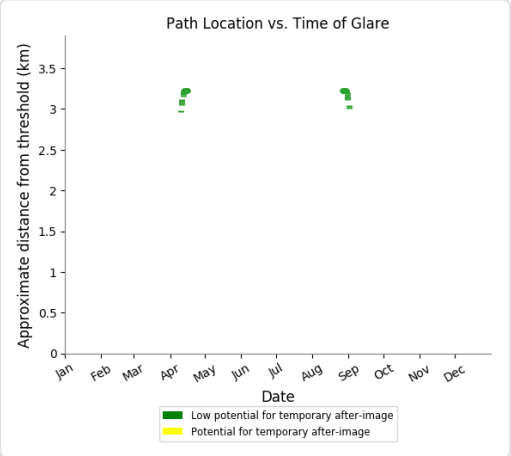
Results for: Block C

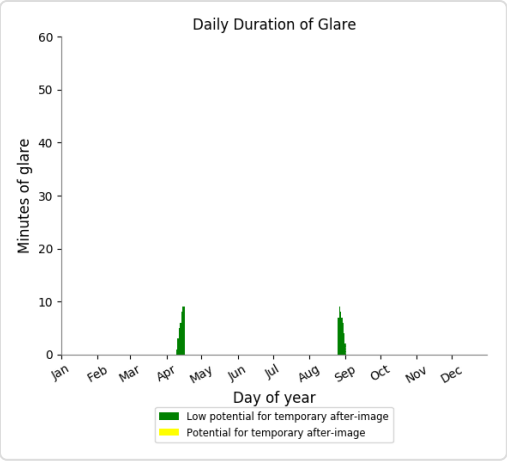
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	84	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	0	0
1-ATCT	0	0

Flight Path: Casement 04 Runway

0 minutes of yellow glare
84 minutes of green glare







Flight Path: Casement 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 22 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
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.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
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.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

APPENDIX B:

SGHAT RESULTS - HELIPAD

FORGESOLAR GLARE ANALYSIS

Project: **Tallagh Hospital - Helipad**
Site configuration: **Belgard Road**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 16:17 on 02 Mar, 2022.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

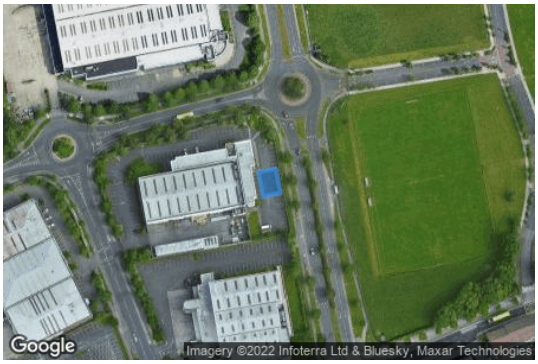
DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 65565.9959
Methodology: V2

PV Array(s)

Name: Block B
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 161.0°
Rated power: -
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	53.290227	-6.369266	99.50	31.78	131.28
2	53.290244	-6.369109	99.50	31.78	131.28
3	53.290111	-6.369067	99.50	31.78	131.28
4	53.290093	-6.369225	99.50	31.78	131.28
5	53.290227	-6.369266	99.50	31.78	131.28

Name: Block C
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 161.0°
Rated power: -
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	53.290185	-6.368603	99.50	28.35	127.85
2	53.290203	-6.368446	99.50	28.35	127.85
3	53.290070	-6.368404	99.50	28.35	127.85
4	53.290053	-6.368561	99.50	28.35	127.85
5	53.290185	-6.368603	99.50	28.35	127.85

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.289501	-6.376776	104.60	0.00
OP 2	2	53.289501	-6.376776	104.60	100.00
OP 3	3	53.289501	-6.376776	104.60	200.00
OP 4	4	53.289501	-6.376776	104.60	300.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Block B	15.0	161.0	1,916	0	-
Block C	15.0	161.0	1,716	0	-

Total annual glare received by each receptor

OP 1	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 2	934	0
OP 3	1279	0
OP 4	1419	0

Results for: Block B

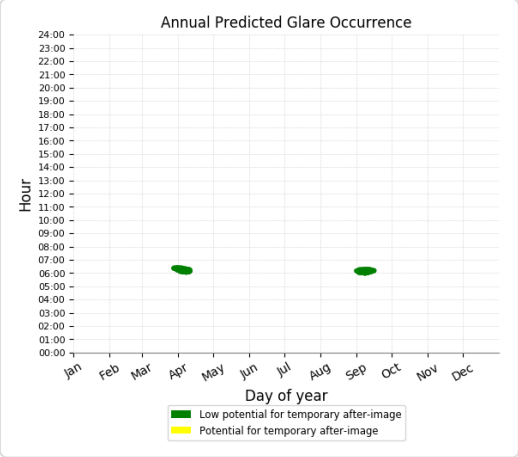
Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	520	0
OP 3	660	0
OP 4	736	0

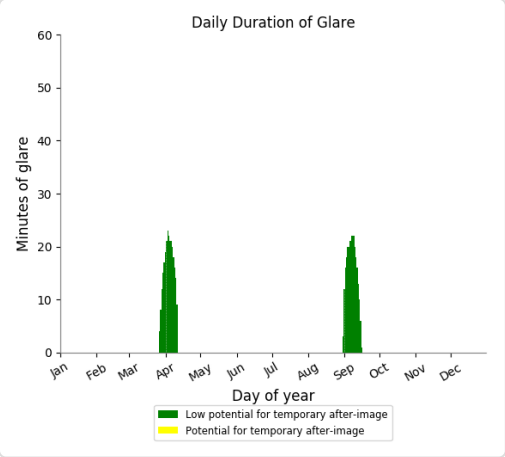
Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

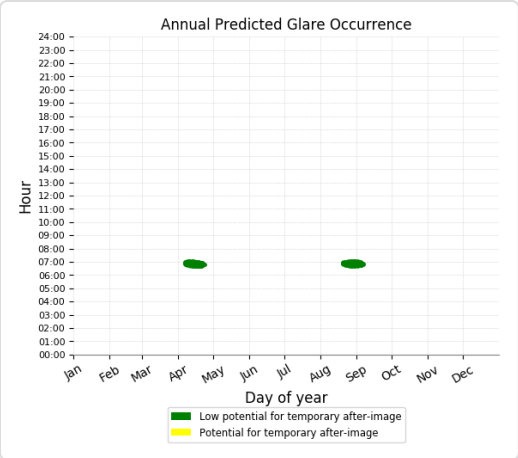
0 minutes of yellow glare
520 minutes of green glare

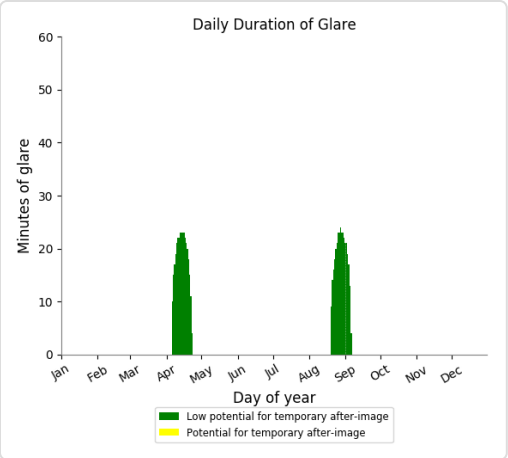




Point Receptor: OP 3

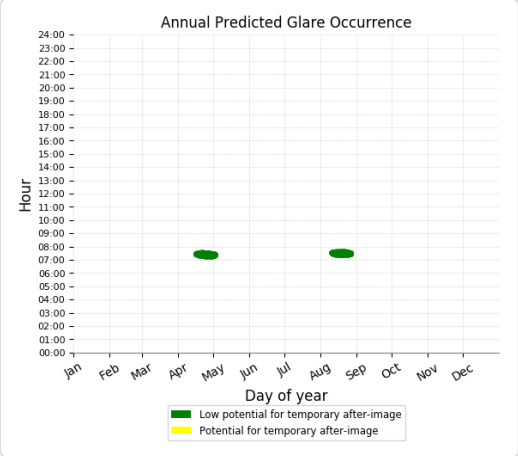
0 minutes of yellow glare
660 minutes of green glare

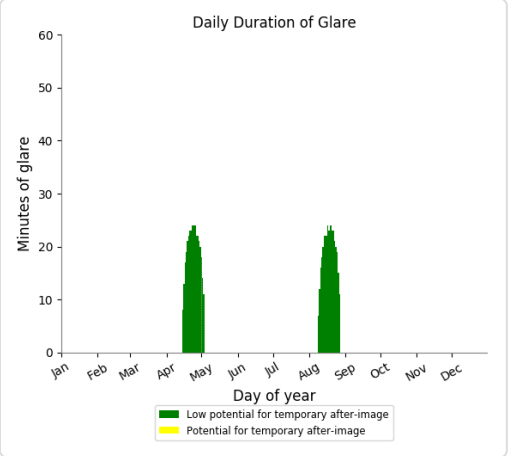




Point Receptor: OP 4

0 minutes of yellow glare
736 minutes of green glare





Results for: Block C

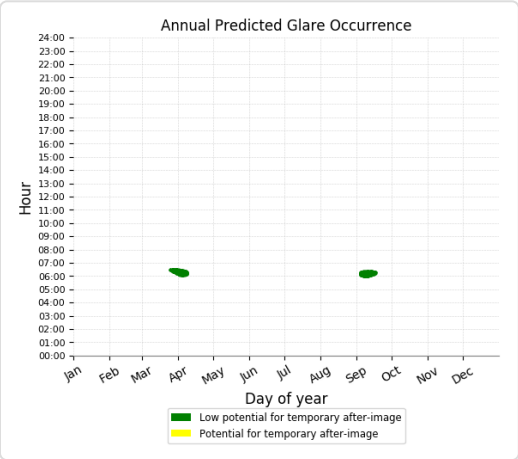
Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	414	0
OP 3	619	0
OP 4	683	0

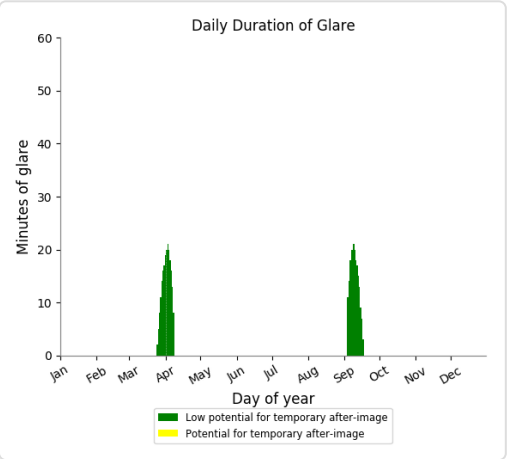
Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

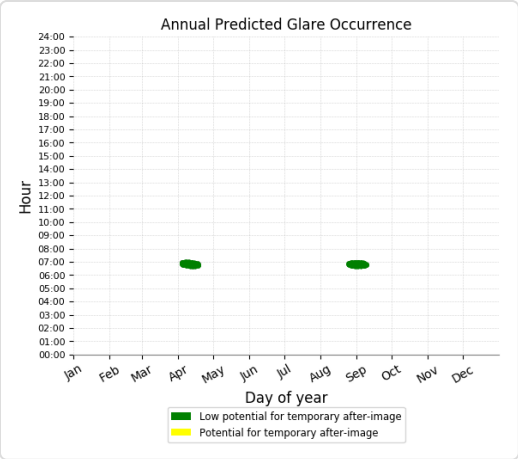
0 minutes of yellow glare
414 minutes of green glare

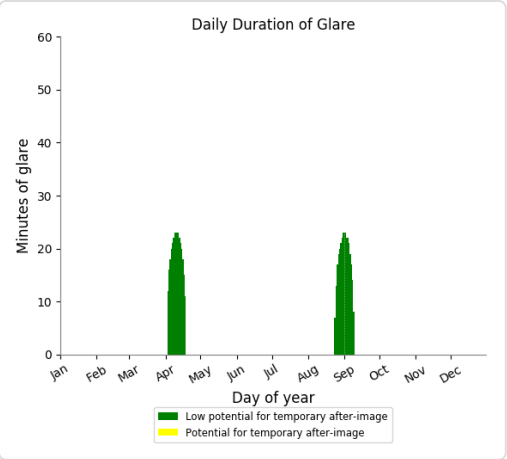




Point Receptor: OP 3

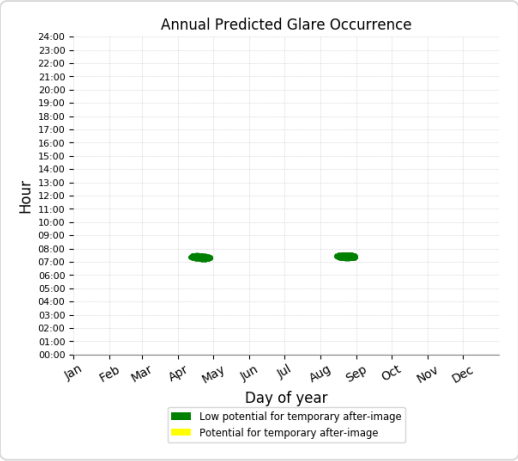
0 minutes of yellow glare
619 minutes of green glare

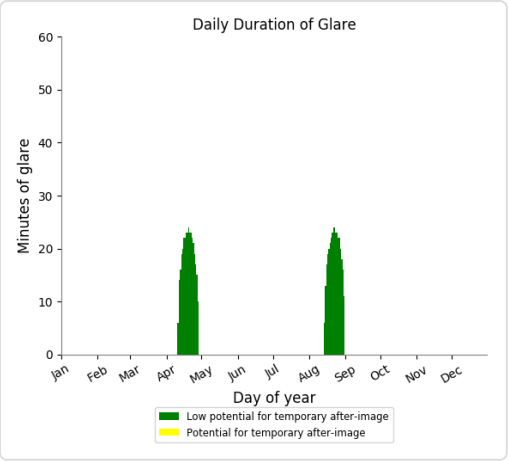




Point Receptor: OP 4

0 minutes of yellow glare
683 minutes of green glare





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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
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.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
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.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.