



# FORGESOLAR GLARE ANALYSIS

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Project: **SGHAT**

Site configuration: **Aerodrome Business Park-Unit Q2**

Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 12:00 on 16 Sep, 2021.

## 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)	FAIL	Receptor(s) marked as ATCT receive green and/or yellow 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<sup>2</sup>  
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: 58723.9717



**PV Array(s)**

**Name:** Panel Array 1

**Axis tracking:** Fixed (no rotation)

**Tilt:** 6.0°

**Orientation:** 105.0°

**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	53.294895	-6.466739	91.90	16.95	108.85
2	53.294873	-6.466604	91.90	15.91	107.81
3	53.294084	-6.466959	91.90	15.83	107.73
4	53.294089	-6.466984	91.90	16.02	107.92
5	53.294087	-6.466993	91.90	16.07	107.97
6	53.294059	-6.467005	91.90	16.07	107.97
7	53.294072	-6.467081	91.90	16.66	108.56
8	53.294086	-6.467073	91.90	16.65	108.55
9	53.294092	-6.467104	91.90	16.89	108.79
10	53.294107	-6.467097	91.90	16.89	108.79
11	53.294090	-6.466992	91.90	16.07	107.97
12	53.294089	-6.466989	91.90	16.06	107.96
13	53.294112	-6.466979	91.90	16.06	107.96
14	53.294130	-6.467087	91.90	16.89	108.79
15	53.294145	-6.467080	91.90	16.90	108.80
16	53.294127	-6.466972	91.90	16.06	107.96
17	53.294156	-6.466959	91.90	16.06	107.96
18	53.294173	-6.467067	91.90	16.90	108.80
19	53.294188	-6.467061	91.90	16.90	108.80
20	53.294171	-6.466953	91.90	16.06	107.96
21	53.294199	-6.466940	91.90	16.07	107.97
22	53.294216	-6.467047	91.90	16.90	108.80
23	53.294231	-6.467041	91.90	16.90	108.80
24	53.294214	-6.466933	91.90	16.07	107.97
25	53.294234	-6.466924	91.90	16.07	107.97
26	53.294251	-6.467032	91.90	16.91	108.81
27	53.294266	-6.467025	91.90	16.91	108.81
28	53.294249	-6.466917	91.90	16.07	107.97
29	53.294268	-6.466909	91.90	16.08	107.98
30	53.294286	-6.467016	91.90	16.91	108.81
31	53.294301	-6.467010	91.90	16.91	108.81
32	53.294283	-6.466902	91.90	16.08	107.98
33	53.294303	-6.466893	91.90	16.08	107.98
34	53.294320	-6.467001	91.90	16.91	108.81
35	53.294336	-6.466994	91.90	16.91	108.81
36	53.294318	-6.466886	91.90	16.08	107.98
37	53.294338	-6.466877	91.90	16.08	107.98
38	53.294355	-6.466985	91.90	16.92	108.82
39	53.294370	-6.466978	91.90	16.92	108.82
40	53.294353	-6.466870	91.90	16.08	107.98
41	53.294372	-6.466862	91.90	16.09	107.99
42	53.294390	-6.466969	91.90	16.92	108.82
43	53.294405	-6.466963	91.90	16.92	108.82
44	53.294387	-6.466855	91.90	16.09	107.99
45	53.294407	-6.466846	91.90	16.09	107.99
46	53.294425	-6.466954	91.90	16.92	108.82
47	53.294440	-6.466947	91.90	16.92	108.82
48	53.294422	-6.466839	91.90	16.09	107.99
49	53.294442	-6.466830	91.90	16.09	107.99
50	53.294459	-6.466938	91.90	16.92	108.82
51	53.294474	-6.466931	91.90	16.92	108.82
52	53.294457	-6.466823	91.90	16.09	107.99
53	53.294467	-6.466819	91.90	16.10	108.00
54	53.294462	-6.466789	91.90	15.87	107.77
55	53.294480	-6.466781	91.90	15.87	107.77
56	53.294485	-6.466813	91.90	16.12	108.02
57	53.294477	-6.466817	91.90	16.11	108.01

**Name:** Panel Array 2  
**Axis tracking:** Fixed (no rotation)  
**Tilt:** 6.0°  
**Orientation:** 105.0°  
**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	53.294968	-6.467189	91.90	16.80	108.70
2	53.294948	-6.467069	91.90	15.86	107.76
3	53.294160	-6.467425	91.90	15.83	107.73
4	53.294165	-6.467454	91.90	16.01	107.91
5	53.294542	-6.467284	91.90	16.05	107.95
6	53.294561	-6.467276	91.90	16.05	107.95
7	53.294537	-6.467256	91.90	15.83	107.73
8	53.294556	-6.467248	91.90	15.83	107.73
9	53.294656	-6.467233	91.90	16.06	107.96
10	53.294664	-6.467281	91.90	16.44	108.34
11	53.294679	-6.467274	91.90	16.44	108.34
12	53.294671	-6.467226	91.90	16.06	107.96
13	53.294717	-6.467205	91.90	16.07	107.97
14	53.294724	-6.467253	91.90	16.45	108.35
15	53.294739	-6.467246	91.90	16.45	108.35
16	53.294732	-6.467199	91.90	16.07	107.97
17	53.294760	-6.467186	91.90	16.07	107.97
18	53.294768	-6.467233	91.90	16.45	108.35
19	53.294783	-6.467227	91.90	16.45	108.35
20	53.294775	-6.467179	91.90	16.07	107.97
21	53.294795	-6.467170	91.90	16.08	107.98
22	53.294802	-6.467218	91.90	16.45	108.35
23	53.294817	-6.467211	91.90	16.45	108.35
24	53.294810	-6.467163	91.90	16.08	107.98
25	53.294829	-6.467154	91.90	16.08	107.98
26	53.294837	-6.467202	91.90	16.45	108.35
27	53.294852	-6.467195	91.90	16.46	108.36
28	53.294844	-6.467148	91.90	16.08	107.98
29	53.294873	-6.467135	91.90	16.08	107.98
30	53.294881	-6.467183	91.90	16.46	108.36
31	53.294895	-6.467176	91.90	16.46	108.36
32	53.294888	-6.467128	91.90	16.09	107.99
33	53.294923	-6.467112	91.90	16.09	107.99
34	53.294938	-6.467203	91.90	16.80	108.70
35	53.294968	-6.467189	91.90	16.80	108.70

## Flight Path Receptor(s)

**Name:** Baldonnell 04 Runway

**Description:** None

**Threshold height:** 15 m

**Direction:** 42.0°

**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	53.293853	-6.453457	98.20	15.20	113.40
Two-mile	53.272306	-6.485749	152.40	129.70	282.10

**Name:** Baldonnell 10 Runway

**Description:** None

**Threshold height:** 15 m

**Direction:** 101.6°

**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	53.304625	-6.468289	86.30	15.30	101.60
Two-mile	53.310419	-6.515747	73.70	196.50	270.20

**Name:** Baldonnell 22 Runway

**Description:** None

**Threshold height:** 15 m

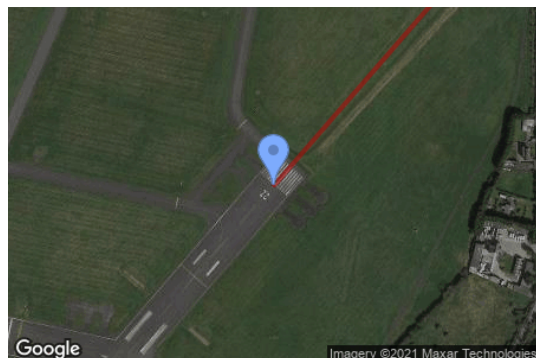
**Direction:** 222.0°

**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	53.303267	-6.439792	93.40	15.20	108.60
Two-mile	53.325072	-6.407981	62.40	214.90	277.30

**Name:** Baldonnel 28 Runway

**Description:** None

**Threshold height:** 15 m

**Direction:** 281.6°

**Glide slope:** 3.0°

**Pilot view restricted?** Yes

**Vertical view:** 30.0°

**Azimuthal view:** 50.0°

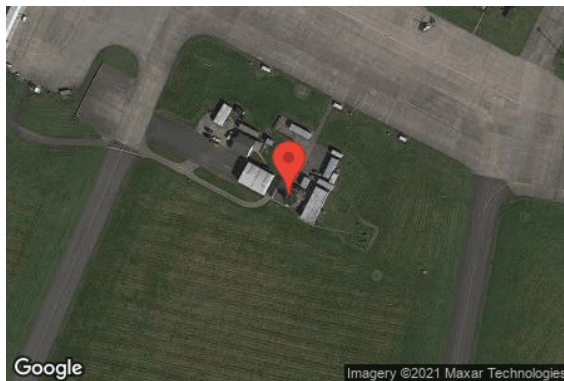


Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301694	-6.445155	96.10	15.20	111.30
Two-mile	53.295880	-6.397707	107.60	172.40	280.00

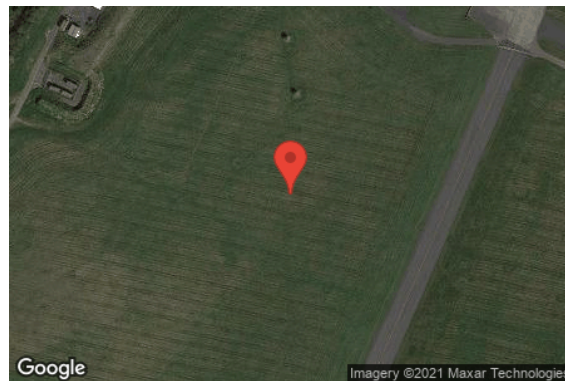
## Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305525	-6.441821	90.00	9.00
2-ATCT	2	53.305009	-6.445142	92.30	28.00
3-ATCT	3	53.298162	-6.455575	94.60	25.00

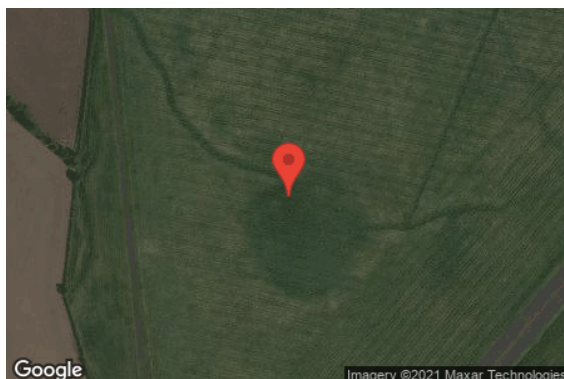
Map image of 1-ATCT



Map image of 2-ATCT



Map image of 3-ATCT





# GLARE ANALYSIS RESULTS

## Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Array 1	6.0	105.0	8,312	0	-
Panel Array 2	6.0	105.0	8,168	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Baldonnel 04 Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 22 Runway	4589	0
Baldonnel 28 Runway	6841	0
1-ATCT	1487	0
2-ATCT	1646	0
3-ATCT	1917	0

## Results for: Panel Array 1

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 04 Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 22 Runway	2283	0
Baldonnel 28 Runway	3472	0
1-ATCT	743	0
2-ATCT	837	0
3-ATCT	977	0

### Flight Path: Baldonnel 04 Runway

0 minutes of yellow glare

0 minutes of green glare

## Flight Path: Baldonnell 10 Runway

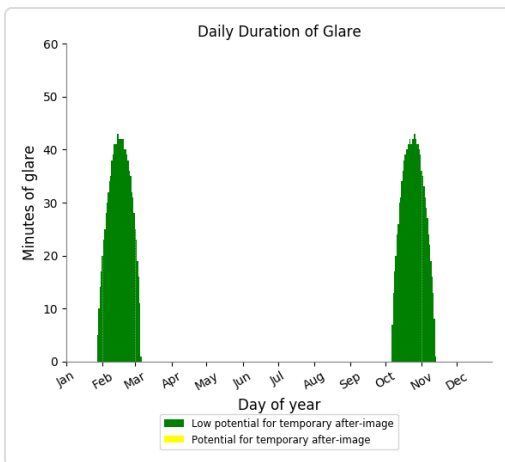
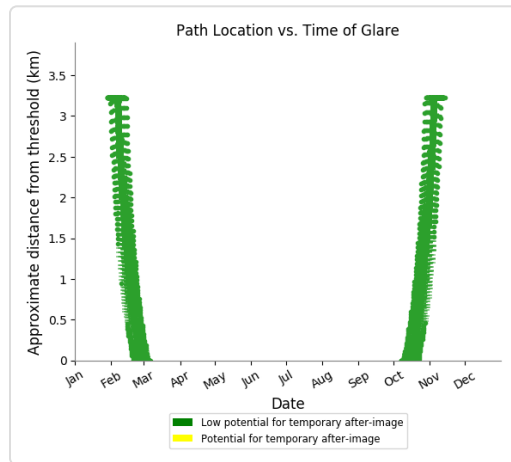
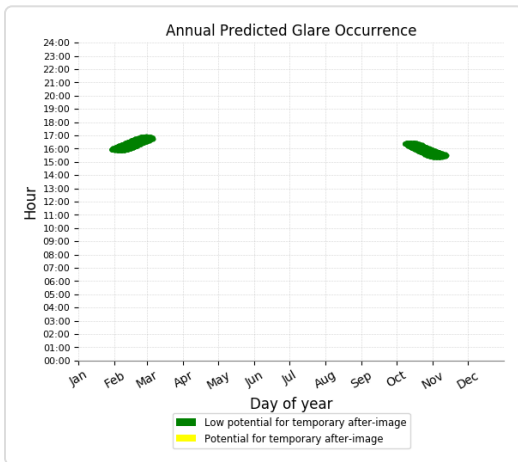
0 minutes of yellow glare

0 minutes of green glare

## Flight Path: Baldonnell 22 Runway

0 minutes of yellow glare

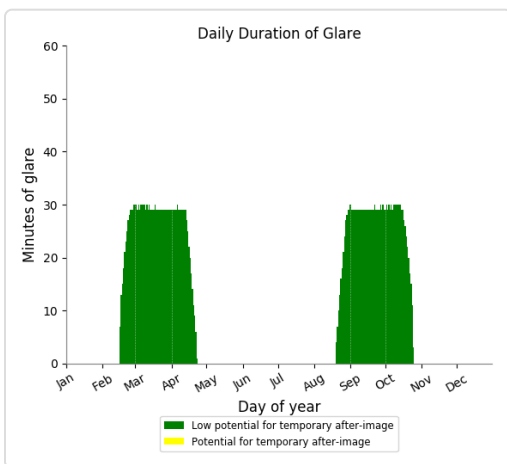
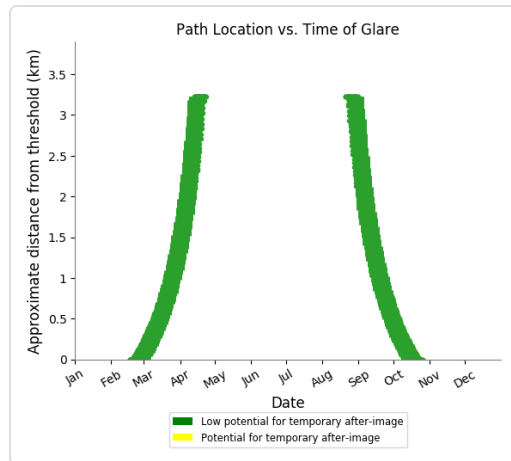
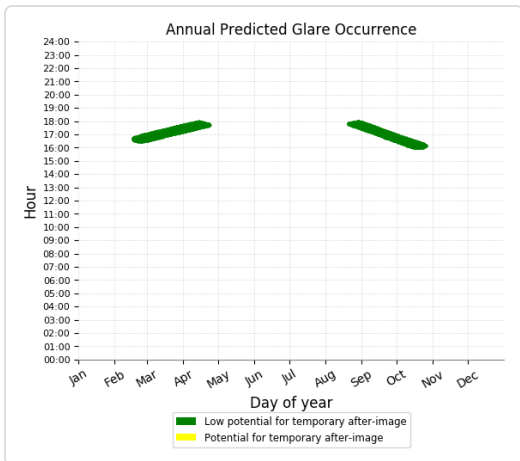
2283 minutes of green glare



## Flight Path: Baldonnell 28 Runway

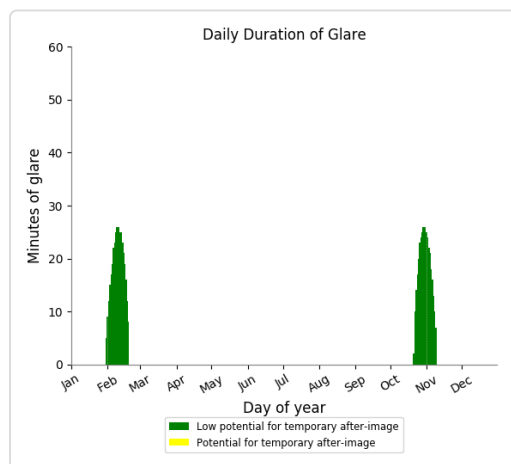
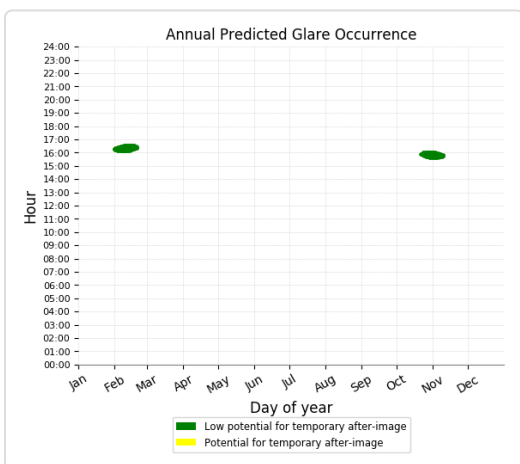
0 minutes of yellow glare

3472 minutes of green glare



### Point Receptor: 1-ATCT

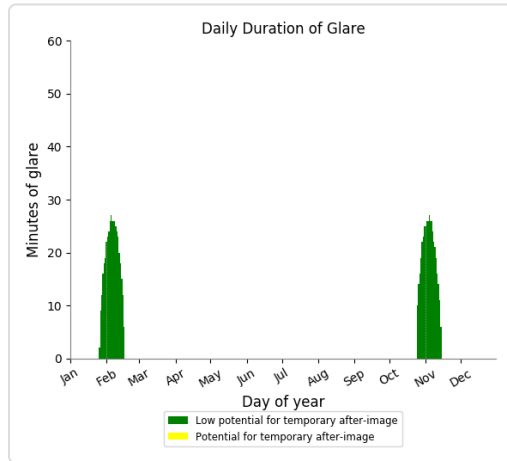
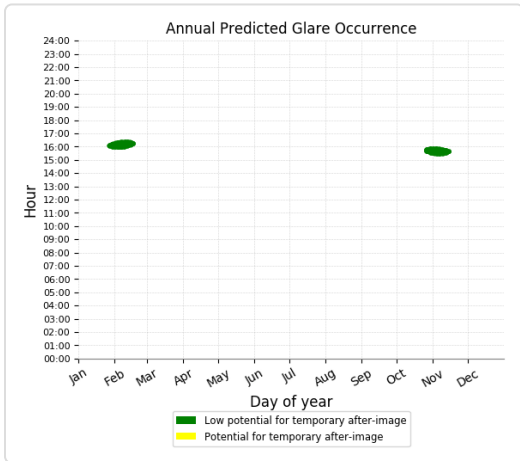
0 minutes of yellow glare  
743 minutes of green glare



### Point Receptor: 2-ATCT

0 minutes of yellow glare

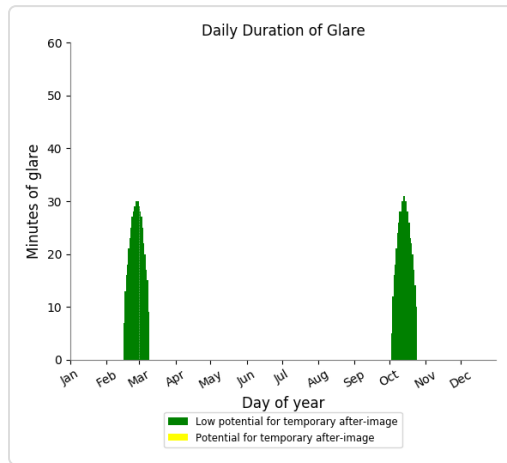
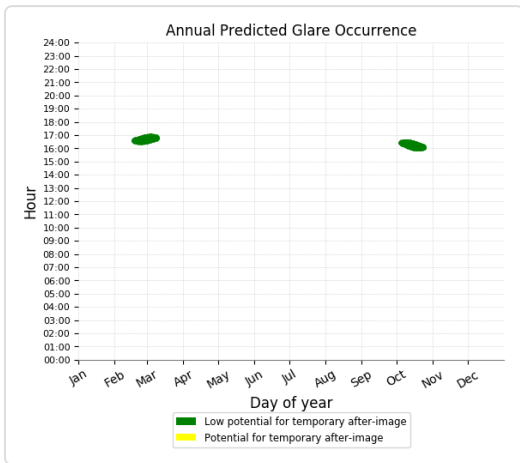
837 minutes of green glare



### Point Receptor: 3-ATCT

0 minutes of yellow glare

977 minutes of green glare



## Results for: Panel Array 2

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 04 Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 22 Runway	2306	0
Baldonnel 28 Runway	3369	0
1-ATCT	744	0
2-ATCT	809	0
3-ATCT	940	0

## Flight Path: Baldonnell 04 Runway

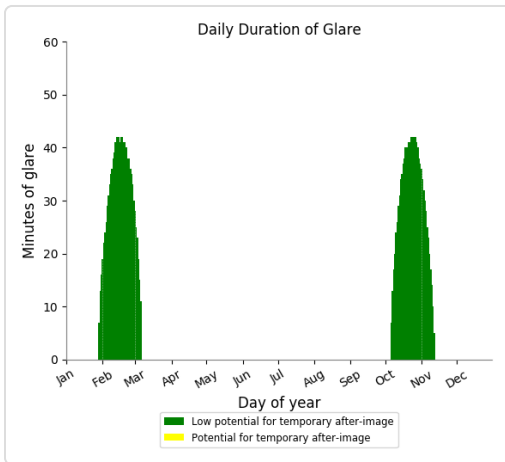
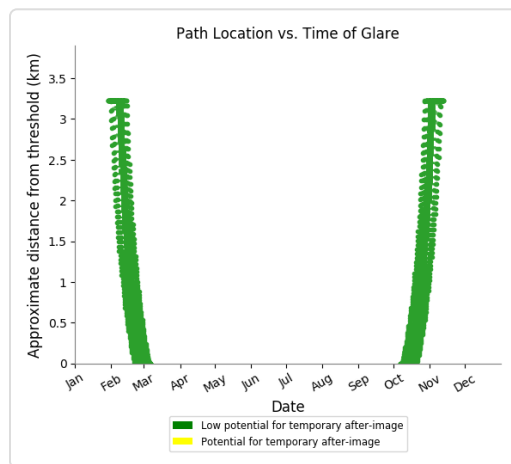
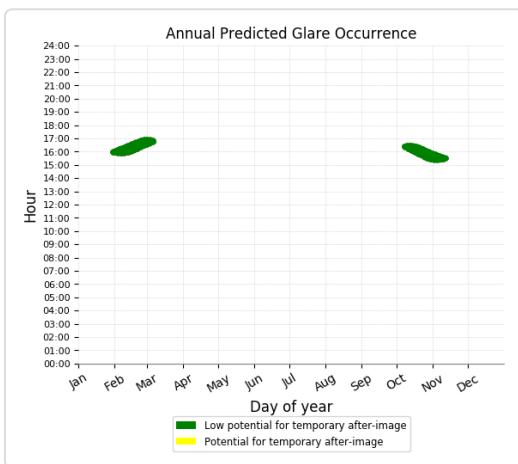
0 minutes of yellow glare  
0 minutes of green glare

## Flight Path: Baldonnell 10 Runway

0 minutes of yellow glare  
0 minutes of green glare

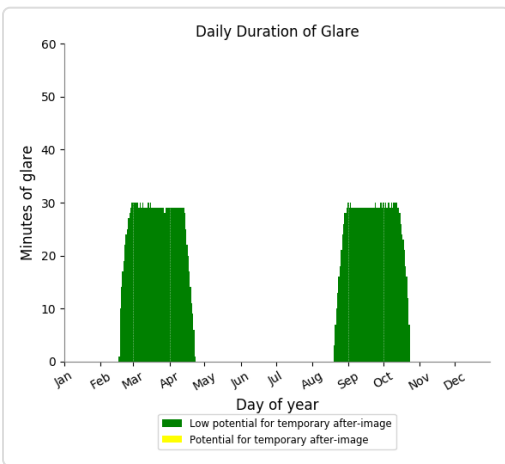
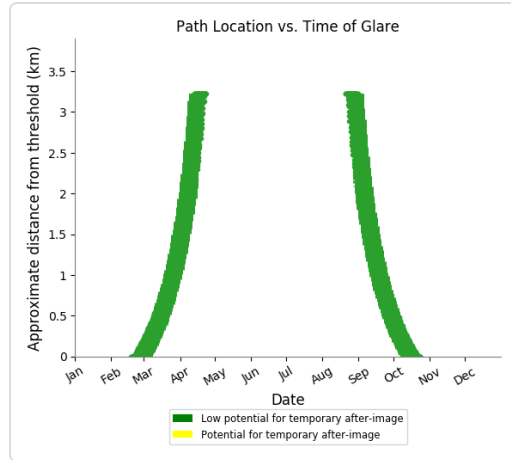
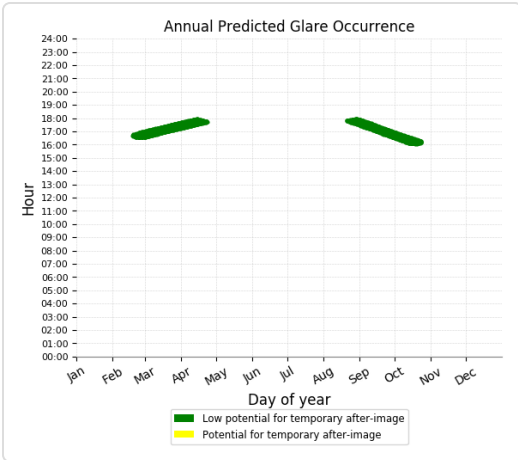
## Flight Path: Baldonnell 22 Runway

0 minutes of yellow glare  
2306 minutes of green glare



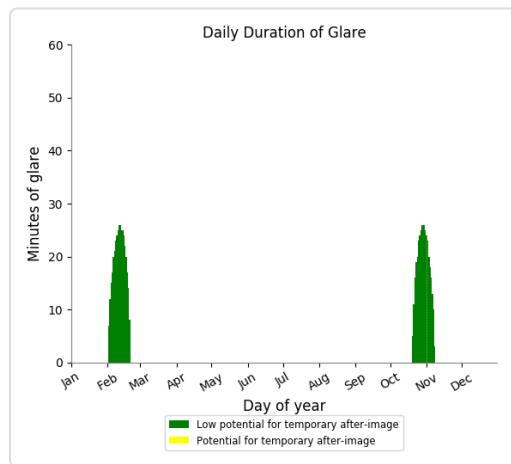
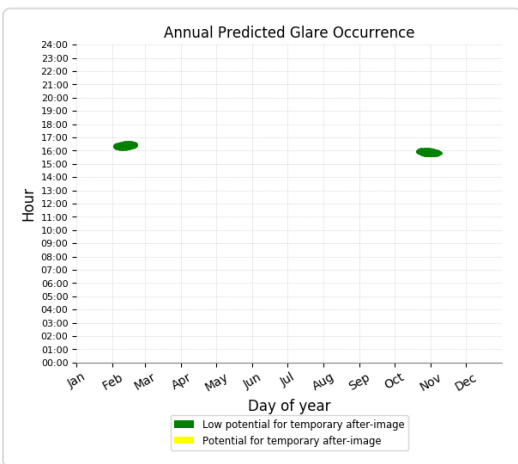
## Flight Path: Baldonnell 28 Runway

0 minutes of yellow glare  
3369 minutes of green glare



### Point Receptor: 1-ATCT

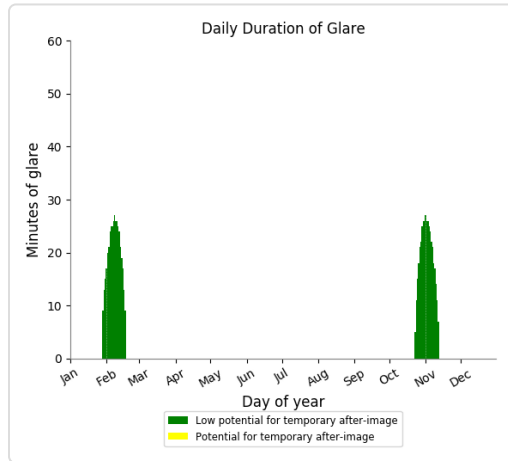
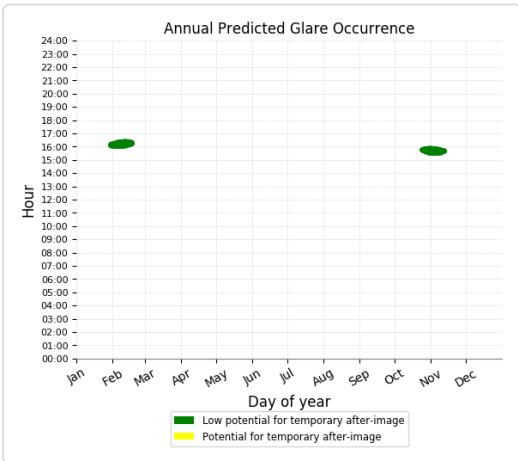
0 minutes of yellow glare  
744 minutes of green glare



### Point Receptor: 2-ATCT

0 minutes of yellow glare

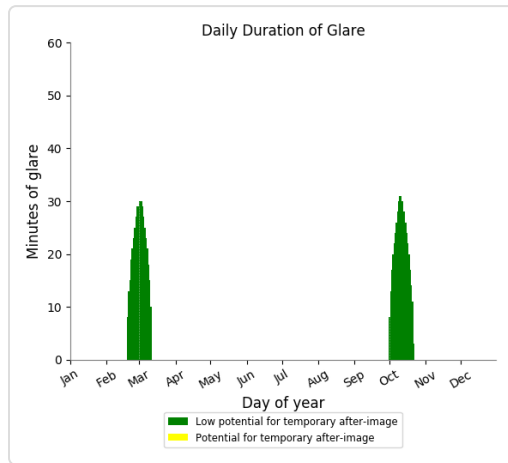
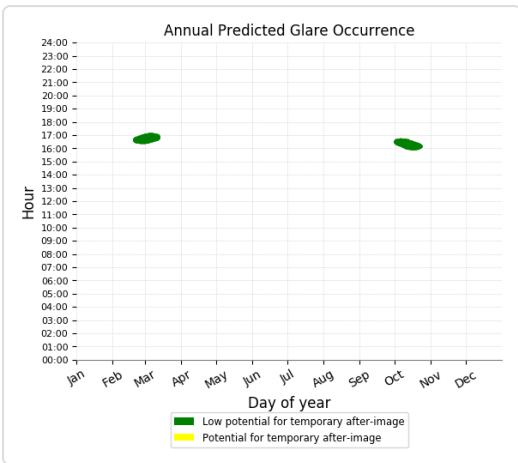
809 minutes of green glare



### Point Receptor: 3-ATCT

0 minutes of yellow glare

940 minutes of green glare



# Assumptions

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"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/](http://www.forgesolar.com/help/) for assumptions and limitations not listed here.