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Maffra Solar Farm

Glint and Glare Assessment

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Glint and Glare Assessment

Prepared for
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moir
landscape architecture

Moir Landscape Architecture Pty Ltd
Studio 1, 88 Fern Street
PO Box 111, Islington NSW 2296
admin@moirla.com.au

Ph.(02) 4965 3500
www.moirla.com.au
ACN: 097 558 908
ABN: 48 097 558 908

Executive Summary

Moir Landscape Architecture (Moir LA) have been engaged by NGH to provide a glint and glare assessment of the proposed Maffra Solar Farm (the Project). The report will accompany the planning permit application respectively prepared for the Project.

The Project is located on the Maffra-Briagolong Road in 3km north east direction of the town of Maffra in the Local Government Area of Wellington. The subject land is approximately 12 ha in area and is identified as Maffra-Briagolong Road 3860, Lot 13 TP23981.

The Glint and Glare Assessment has been prepared in accordance with the '*State of Victoria Department of Environment, Land, Water and Planning 2019: Solar Energy Facilities Design and Development Guidelines'* (the Guidelines).

In accordance with the Guidelines, the following has been assessed:

- Assessment of residential dwellings within 1 km of the proposed solar array that have a line of sight.
- All roads and rail lines within 1 km of the proposed solar array
- Aviation receptors within 5km of the proposed solar array.

Moir LA have undertaken this glint and glare assessment utilising the Solar Glare Hazard Analysis Tool (SGHAT). The SGHAT is used to evaluate glare resulting from solar farms at different receptors, based on proximity, orientation and specifications of the PV modules.

A total of 17 free standing dwellings were identified within 1 km of the Project.
Based on the desktop assessment no potential "Yellow" glare were investigated for residential receptors.

Four (4) route receptors were identified as part of the assessment. Based on glare assessment no potential "Yellow" glare were investigated for route receptors from the Project.

It is important to reiterate the assessment is based on a worst case scenario and does not take into account weather conditions, intervening elements such as vegetation and built structures.

Principles for mitigation in accordance with to reduce potential glare have been included in this report in accordance with the Solar Energy Facilities Design and Development Guideline (DELWP) .

1.0 Introduction

1.1 The purpose of this report

Moir Landscape Architecture (Moir LA) have been engaged by NGH to provide a glint and glare assessment of the Project. The report will accompany the planning permit application respectively prepared for the Project.

The Glint and Glare Assessment has been prepared in accordance with the Guidelines.

Glint is generally defined as a momentary flash of bright light while glare can be defined as continuous source of excessive brightness proportionate to ambient lighting (FAA, 2021).

While glint and glare impacts can be relatively uncommon, it is important to model and assess these impacts to ensure any potential significant impact is avoided or mitigated appropriately (DELWP 2019). Assessment needs to be undertaken to ensure that sensitive visual receptors such as road users, surrounding rail network, nearby buildings, air traffic controllers and pilots are not impacted by the proposed development (ForgeSolar, 2022).

1.2 Glint and glare key principles

The key principles for ensuring the Project can be undertaken whilst maintaining an acceptable level of amenity are outlined in the Guideline as follows:

1. **Solar panels and associated buildings and infrastructure should be sited to reduce the likely impacts of glint and glare.**

2. **Solar panels and other infrastructure should be constructed of materials and / or treated to minimise glint and glare.**

3. **Solar Panels and associated buildings should be adjusted to avoid relative glare risks.**

4. **If large scale solar energy development is likely to exceed the relevant criteria for glare and standards for glint, mitigation strategies should be adopted.**

1.3 Assessment requirements

Table 1 provides an outline of the assessment requirements for the glint and glare report and where these have been addressed in the report.

Report Structure	
Requirements for Glint and Glare Assessment:	**Addressed in report:**
A description of the proposed PV panels indicating: *- the axis of rotation and maximum tilt angle* *- the light absorption efficiency and / or refractive index values at different angles.* *- whether any backtracking is proposed and the time and duration of these operations.*	**Refer to:** **Section 3.0: Project Overview**
Results of the glint and glare analysis for each assessable receiver	**Refer to:** **Section 4.0: Residential Receptors** **Section 5.0: Road and Rail Receptors** **Section 6.0: Aviation Receptors**
Identification of existing vegetation or built structures and a quantitative assessment of whether these features would eliminate or reduce the modelled impacts.	**Refer to Summary Tables**
A justification for excluding any modelled glare results because they would be insignificant due to the size, position and luminance of the glare source or high ambient luminance.	**Section 2.2**
Details of strategies to either avoid or mitigate impacts including re-siting or sizing the project, altering the tracking patterns, implementing vegetation screening, or entering neighbour agreements with landowners if all other measures have been exhausted.	**Refer to:** **Section 8.0: Mitigation Recommendations**

Table 1 Overview of Report Structure

2.0 Study Method

2.1 Overview of Study Method

The Glint and Glare Assessment has been prepared in accordance with the Guideline developed by DELWP 2019. The objective of the assessment to demonstrate that glint and glare would not pose a significant risk to road and route and aviation receptors and that nuisance from glare is minimised for residential locations in accordance with the objectives outlines in the Guidelines.

Refer to Section 4.0
Residential Receptors

Assess all residential dwellings within 1 km of the proposed solar array that have a line of sight.

Refer to Section 5.0
Road and Rail Receptors

Assess all roads and rail lines within 1 km of the proposed solar array.

Refer to Section 6.0
Aviation Receptors

Assess all air traffic control towers and take off / landing approaches to any runway or landing strip within 5 km of the proposed solar array.

Refer to Section 7.0
Performance Objectives

Summary of the assessment with reference to performance objectives.

Refer to Section 8.0
Mitigation Recommendations

Overview of proposed strategies to either avoid or mitigate impacts.

2.2 Assessment Methodology

Moir LA have undertaken this glint and glare assessment utilising SGHAT developed by Sandia National Laboratories. The SGHAT is used to evaluate glare resulting from solar farms at different receptors, based on proximity, orientation and specifications of the PV modules. This tool is recognised by the Australian Government Civil Aviation Safety Authority (CASA).

SGHAT is used to indicate the nature of glare that can be expected at each potential receptor. Glare can be broadly classified into three categories and presented by the following three colours:

- **Green Glare:** Low potential for temporary after-image
- **Yellow Glare:** Potential for temporary after-image
- **Red Glare:** Retinal burn, not expected for PV.

Note: The main focus of this assessment is the yellow glare. Red glare is not expected for PV and green glare is low potential to cause after image and deemed negligible. (HO,2011)

The glare analysis tool used to assess the glint and glare hazard was run at a simulation interval of one minute, based on the reflectivity of solar rays off PV modules which typically lasts for at least one minute.

Modelling for the solar farms in the SGHAT tool is based on the following factors:

- Position of the sun over time with respect to the location of the proposed solar farm.
- Assessment is based on a worst case scenario assuming clear weather all year round, (ie. no consideration of cloud coverage).
- Tracking axis tilt, tracking axis orientation and properties of the PV modules.
- Potential to screen the impact by surrounding topography.

2.3 Modelling Assumptions

The glare and glint impact is calculated utilising the geographic location, elevation, position of the sun and other vector calculations including module orientation, reflective environment and visual factors. Sun position is determined at every one (1) minute interval through out the year.

Although the SGHAT is an extensive tool to understand the impacts of potential glare, it does not consider backtracking procedures in relation to the PV array tracking system, weather conditions, separation between PV modules and existing surrounding vegetation (if present) between the Project and a sensitive receiver.

Single axis tracking PV panels capable of rotating to a maximum of 60° have been considered for this analysis. The trackers are oriented north south with a maximum pitch distance of 6.8 metres.

The glint and glare effects of PV panels depends on the scale and type of infrastructure, the prominence and topography of the site relative to the surrounding environment, and any proposed screening measures to reduce visibility of the site.

Section 3.0 provides an overview of the PV panel parameters used for the assessment.

2.4 Backtracking Operations

A single axis horizontal tracking system can be configured to do a 'backtracking' technique, which implies that when the sun is low in the sky in the morning or evening, the tracking system can adjust the panels to maximise solar capture while minimising overshadowing.

ForgeSolar uses a simplified model of backtracking. Single-axis trackers follow the movement of the sun as it moves east to west throughout the day. Yields are maximized, and light reflection is minimised when panels are directly facing the sun. In times when the sun is not in the tracking range, we assume that the panels instantaneously revert to their resting angle of 0° (flat). Due to this, glare from the backtracking mechanism will be more conservatively simulated and at times of sunset and sunrise, when the sun is at a lower angle relative to the array, glare impacts will be more noticeable.

Variable angles of incidence of the sun relative to the panels may occur when the tracking system is performing a backtracking operation, and this variation is somewhat represented by SGHAT software in its recent update of 2022. Instant (Legacy) backtracking function within the SGHAT tool considers the worst case scenario. Therefore, using the 'resting angle' option is modelled to determine several backtracking positions. This function simulates the impression of the panels returning to a predefined angle after the maximum tilt angle has been attained and

It is important to note that 'resting angle modelling' is not a realistic representation of how a backtracking technique would work in actuality but on the other hand, gives some idea of the potential glare consequences of shifting the PV panels away from the sun after the maximum tilt is reached.

The following parameters have been considered to simulate a typical backtracking process for the proposed development:

- A maximum tracking angle of 60° is considered to indicate a full rotational range of 120°.
- To simulate 'backtracking', 'resting angle' determined as 45°, assuming the PV modules move directly to 45° once maximum tilt of 60° is reached and represents a worst case scenario.
- To simulate glare experienced mid tracking, an angle of 22° is considered assuming the PV modules move from the resting angle prior to arriving at the stowing angle.
- Night time angle (stowing angle after dark) of 5° is considered assuming the PV modules move directly to 5° once maximum tilt of 60° is reached and represents a worst case scenario.

3.0 Project Overview

3.1 Site Context

The Project is located on the Maffra-Briagolong Road in 3km to the north east direction of the Maffra town in the Local Government Area of Wellington. The subject land is approximately 12.20 ha in area and is identified as Maffra-Briagolong Road 3860, Lot 13 TP23981. (Refer to Figure 1).

Figure 1 Project Site Context (Map Source: Google Earth, 2021)

3.2 Solar Panel Specifications

Each module consists of P type Mono-crystalline cell type with a 2.0 mm, anti-reflection coated semi-tempered glass set in an anodised aluminium alloy frame (Suzhou Talesun Solar Technologies Co., Ltd. 2021).

To attain optimum solar energy collection, the project modelling has utilised a maximum rotational range of 120°. The tracking tilt angle upon which the panels rotate is considered 0.34 degrees to match the average ground slope of the Site for each PV area. The panels are fixed on a tubular frame with a single axis tracking procedure. The panels will have a maximum height not exceeding 5.15 m when facing at the highest angle.

Refer to **Figure 2** for typical panel dimensions utilised for this assessment.

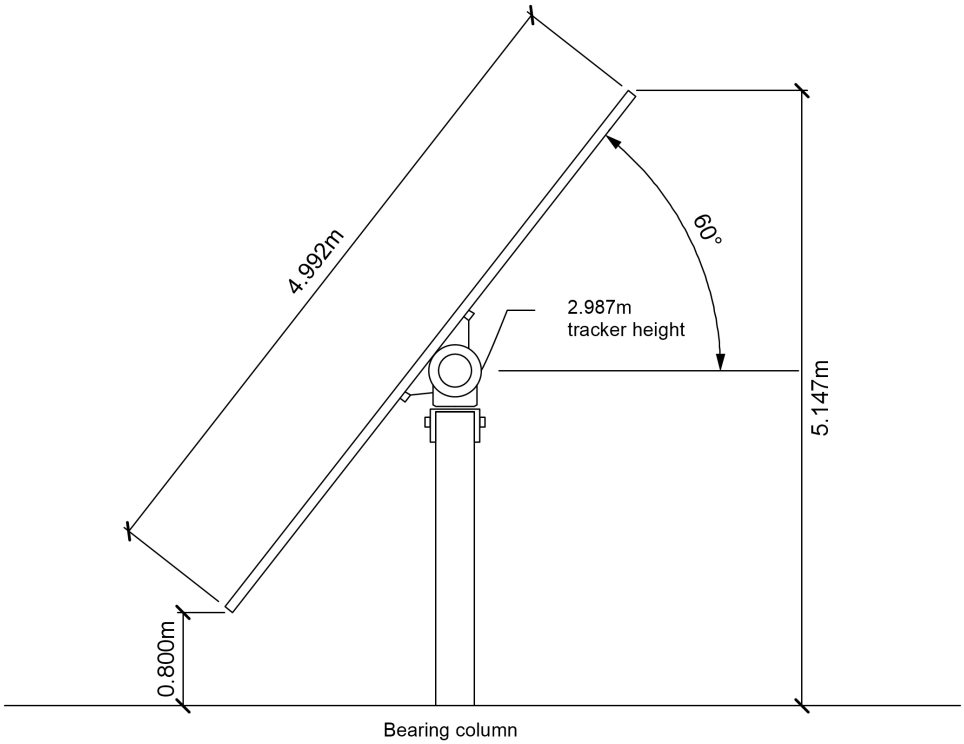

Figure 2 PV Parameters utilised for this assessment (provided by client)

General Solar PV system inputs:			
Input Data	**Units**	**Value**	**Comments**
Time Zone	UTC	+10	VIC time Zone
Orientation of Array	Degrees	0	Rows aligned in north-south directions
PV Surface materials	-	Smooth Glass with Anti-Reflective Coating	Provided by the Client
Mounting Type	-	Single Axis Tracking	As per tracker data sheet
Single Axis Tracking Parameters			
Axis Orientation	Degrees	0	Panels orientated north south
Axis Tilt	Degrees	0.34	Elevation of tracking axis. Average ground slope is approximately 0.34 degrees (Google Earth)
Module Offset angle	Degrees	0	Facing upwards Panels rotate during operation
Max tracking angle	Degrees	±60° (Range of 120°)	Panels following the Sun
Resting angle	Degrees	0°, 22°, 45°, 5°	Panels following the Sun, to represent backtracking and after dark stowing angles
Height	Metres	5.15	Provided by the Client

Table 2. Summary of modelling parameters

3.3 Array layout

A single axis tracking system follows the sun's trajectory and rotates the panels across east to west. There will be an estimated 12,000 modules mounted on a north/south axis to slowly track movement of the sun. The rows of modules will be spaced approximately 6.8m apart to ensure no shading occurs and allows for ease of access for maintenance purposes.

For the purposes of this report maximum possible coverage of the panels across the site has been considered. Refer **Figure 3** for PV array areas

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PV Array Areas for Assessment

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Figure 3 PV Array Areas (Map Source: Google Earth, 2021)

4.0 Residential Receptors

4.1 Overview of methodology

Table 4 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on residential receptors

Glint and Glare Requirements - Residential Receivers		
Scope	**Methodology**	**Performance Objective**
All residential viewpoints within 1km of the proposed solar array that have a line of sight. Representative viewpoints may be used for residential receivers that are clustered together.	**Analysis of the daily and yearly glare impacts in minutes.** **All residential receivers must be assessed at a height of 1.5 m above ground level.**	**If glare is geometrically possible then measures should be taken to eliminate or reduce to an acceptable level, the occurrence of glare through design, orientation, landscaping or other screening measures**
Note: Modeling for residential receptors is calculated on a receptor height of 1.5 m AGL.		

Table 4. Residential Receptors Assessment Requirements (DELWP 2019)

Impact rating and performance objectives for glare impacts to residential dwellings			
Major Impact	**Moderate Impact**	**Low Impact**	**No Impact**
Significant amount of glare that should be avoided	*Implement mitigation measures to reduce impacts as far as practicable*	*No mitigation required*	*No mitigation required*

Table 5. Residential receptor impact rating and performance objectives (DELWP 2019)

4.2 Residential Receptors

A desktop assessment determined 17 free standing Observation Point (OP) receptors with a line of sight to the project within 1,000 m of the Project. (Refer to Figure 4 and Table 6)

Figure 4 Residential Receptors (Map Source: Google Earth, 2021)

Dwelling	Location	Elevation	Distance to the nearest solar panel	Yellow Glare (Hours Per Year):	Recommended Mitigation Measures
OP 01	602 MAFFRA-BRIAGOLONG ROAD MAFFRA 3860	59m	0.99km	0	Not Required.
OP 02	602B MAFFRA-BRIAGOLONG ROAD MAFFRA 3860	65m	0.71km	0	Not Required.
OP 03	85 MCCUBBINS ROAD MAFFRA 3860	62m	0.93km	0	Not Required.
OP 04	138 THREE CHAIN ROAD MAFFRA 3860	59m	1.00km	0	Not Required.
OP 05	116 THREE CHAIN ROAD MAFFRA 3860	56m	0.99km	0	Not Required.
OP 06	94 THREE CHAIN ROAD MAFFRA 3860	52m	0.98km	0	Not Required.
OP 07	90 THREE CHAIN ROAD MAFFRA 3860	55m	0.97km	0	Not Required.
OP 08	62B SANDY CREEK ROAD MAFFRA 3860	60m	0.86km	0	Not Required.
OP 09	62A SANDY CREEK ROAD MAFFRA 3860	55m	0.99km	0	Not Required.
OP 10	26 SANDY CREEK ROAD MAFFRA 3860	61m	0.91km	0	Not Required.
OP 11	40 SANDY CREEK ROAD MAFFRA 3860	61m	0.96m	0	Not Required.
OP 12	57 SANDY CREEK ROAD MAFFRA 3860	58m	1.00km	0	Not Required.
OP 13	427 SANDY CREEK ROAD MAFFRA 3860	57m	0.96km	0	Not Required.
OP 14	20 SANDY CREEK ROAD MAFFRA 3860	53m	0.75km	0	Not Required.
OP 15	345 MAFFRA-BRIAGOLONG ROAD MAFFRA 3860	56m	0.67km	0	Not Required.
OP 16	5 SANDY CREEK ROAD MAFFRA 3860	52m	0.81km	0	Not Required.
OP 17	301 MAFFRA-BRIAGOLONG ROAD MAFFRA 3860	52m	0.94km	0	Not Required.

Table 6. Residential receptor assessment results

Based on the desktop assessment no potential “Yellow” glare was investigated for residential receptors.

Assessment indicates potential “Green” glare for OP03, OP04, OP05, OP06, and OP07. ‘Green Glare’ has been recognised as having a low potential for an after Image. Further analysis of the outputs presented data to prove glare at above mentioned receptors will likely be less than 10 hours per year. Desktop analysis of the dwellings using aerial imagery indicates existing vegetation along the west and north west of the Project will likely filter potential glare experienced from the Project at receptor locations.

Therefore, no additional mitigation measures have been recommended for dwelling receptors surrounding the Project. The time of day glare likely to be experienced is provided for each receptor in **Appendix A**.

5.0 Road and Rail Receptors

5.1 Overview of Methodology

Table 7 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on road and railway line receptors.

Glint and Glare Requirements - Road & Rail		
Scope	**Methodology**	**Performance Objective**
All roads and rail lines within 1 km of the proposed solar array.	**Solar glare analysis to identify whether glint and glare are geometrically possible within the forward looking eyeline of motorists and rail operators.**	**If glare is geometrically possible then measures should be taken to eliminate the occurrence of glare. Alternatively, the applicant must demonstrate that glare would not significantly impede the safe operation of vehicles or the interpretation of signals and signage.**
Note: Modeling for road receptors is calculated on a maximum height of 2.4 m AGL - representative of the eye level for truck drivers (Source: Austroads Ltd. 2021).		
Modeling for rail lines is based a representative eye height of 3 m AGL to represent the eye level of train drivers (Source: Transport Asset Standards Authority 2020).		

Table 7. Road and Rail Receptor Assessment Requirements (DELWP 2019)

5.2 Road and Rail Receptors

A desktop assessment determined no rail lines located within 1 km of the Project and total of 4 road receptors within 1 km of the development footprint. These have been shown on Figure 5.

- Brewers Hill Road
- Maffra-Briagolong Road
- McCubbins Road
- Sandy Creek Road

Figure 5 Rail Line and Road Receptors (Map Source: Google Earth, 2021)

5.3 Results of Glint and Glare Assessment - Road and Rail

4 route receptors were identified as part of the assessment.

Table 8 provides an overview of the annual glare experienced along the route receptors.

Based on the desktop assessment no potential "Yellow" glare were identified for any of the route receptors. Assessment of the outputs indicates McCubbins Road will likely experience 1.9 hours of potential 'Green' Glare per year which is recognised as having a low potential for an after image.

Detailed glare impact outputs for each route is provided in **Appendix A**.

Road / Rail Receptor:	Approximate Distance to the Project:	Elevation:	Yellow Glare (Hours Per Year):	Existing screening factors:	Mitigation Recommendations:
Brewers Hill Road	0.63km	50m	0	Not Required.	Not Required.
Maffra-Briagolong Road	0.04km	60m	0	Not Required.	Not Required.
McCubbins Road	0.40km	71m	0	Not Required.	Not Required.
Sandy Creek Road	0.75km	52m	0	Not Required.	Not Required.

Table 8. Road & Rail receptor assessment results

6.0 Aviation Receptors

6.1 Overview of Methodology

Table 9 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on aviation receptors.

Glint and Glare Requirements - Aviation Receptors		
Scope	**Methodology**	**Performance Objective**
All air traffic control towers and take off / landing approaches to any runway or landing strip within 5km of the proposed solar array.	**Solar glare analysis that is worst case in all scenarios accounting for all aircraft using the airport (e.g. gliders, helicopters etc).**	**Any glint and glare should be avoided unless the aerodrome operator agrees that the impact would not be material (e.g. occurs at times when there are no flights or would not pose a safety risk to airport operations).**
Note: Modeling for Flight Path receptors is calculated on a threshold crossing height of 50ft (15m) in 2 mile (3.21km) point ground elevation and the ±50 degree azimuthal and 30 degree vertical viewing angle representative of the pilot field view from cockpit. (Source: Rogers, 2015)		

Table 9. Aviation Receptor Assessment Requirements (DELWP 2019)

6.2 Aviation Receptors

A desktop assessment identified no landing strips within 5 km of the development footprint.

7.0 Performance Objectives

7.1 Summary of assessment results

7.1.1 Residence Receptors

Table 5 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on residence receptors. The assessment undertaken by Moir LA has been summarised below:

No dwellings have been assessed as having a potential 'Yellow' glare

It is important to reiterate the assessment is based on a worst case scenario and does not take into account weather conditions, intervening elements such as existing vegetation and built structures.

Assessment indicates that there will be minor potential "Green" glare for OP03, OP04, OP05, OP06, and OP07 which is recognised as having a low potential for an after image. Additionally, assessment indicates glare at these locations is within the acceptable level being less than 10 hours per year.

Detailed assessment of aerial imagery indicates existing vegetation around the Project which will likely filter glare from the Project. Therefore no additional mitigation measures are deemed necessary.

The time of day glare likely to be experienced is provided for each receptor in **Appendix A.**

7.1.2 Road and Rail Receptors

Table 7 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on Road receptors. The assessment undertaken by Moir LA has been summarised below:

No road receptors have been assessed as having a potential 'Yellow' glare

It is important to reiterate the assessment is based on a worst case scenario and does not take into account weather conditions, intervening elements such as existing vegetation.

Assessment of the outputs indicates that McCubines Road experienced 1.9 hours of the potential 'Green' Glare per year which is recognised as having a low potential for an after image.

Detailed glare impact outputs for McCubines Road are provided in **Appendix A**.

8.0 Mitigation Measures

Mitigation measures requirements were investigated to reduce the potential Impacts. An overview of these investigations has been provided in the assessment tables in **Sections 4.0 - 6.0.**

An effective method for reducing the potential glare impact at residential receptors, road and rail receptors is to implement screen planting along the project boundary or as applicable at affected viewpoints.

Detailed assessment of outputs indicates no “Yellow glare” from the Project. Analysis of aerial imagery revealed existing vegetation surrounding the Project. This existing vegetation will filter potential glare impacts for surrounding receptors. Therefore no additional mitigation measures have been recommended.

The extent of existing vegetation has been illustrated in **Figure 6.**

Figure 6 Mitigation Principles (Map Source: Google Earth, 2021)

9.0 Conclusion

The purpose of this report is to identify potential glint and glare impacts from the Project on the surrounding residential receptors (within1,000 m of the Project), road and rail Receptors (within 1,000 m of the Project) and aviation receptors (within 5,000 m of the Project).

Based on the assumptions and aforementioned parameters in this report, potential to experience glare has been assessed for 17 dwellings and 4 road Receptors. Detailed assessment revealed no potential “Yellow” glare for any of the dwelling, road and rail receptors. No aviation receptors were identified within 5km of the Project.

Desktop analysis of aerial imagery indicates existing vegetation surrounding the Project which will intervene and likely fragment any glare impacts further. Therefore no additional mitigation measures have been recommended.

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Appendix A

FORGESOLAR GLARE ANALYSIS

Project: **2239 MAFFRA SOLAR FARM**
Site configuration: **MAFFRA SOLAR FARM**

Client: NGH

Created 15 Sep, 2022
Updated 15 Sep, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 75794.13406
Category 10 MW to 100 MW
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
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	SA tracking	SA tracking	766	12.8	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	113	1.9	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	149	2.5	0	0.0
OP 4	174	2.9	0	0.0
OP 5	174	2.9	0	0.0
OP 6	105	1.8	0	0.0
OP 7	51	0.8	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.34°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Rated power: -
Panel material: Smooth glass with 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	-37.935714	146.995103	59.89	5.15	65.04
2	-37.936000	146.995781	59.14	5.15	64.29
3	-37.937606	146.996428	58.17	5.15	63.32
4	-37.937322	146.994103	62.08	5.15	67.23
5	-37.931878	146.991947	68.28	5.15	73.43
6	-37.932361	146.995997	57.56	5.15	62.71
7	-37.933053	146.996439	59.45	5.15	64.60
8	-37.933517	146.996403	59.34	5.15	64.49
9	-37.933056	146.995544	58.03	5.15	63.18
10	-37.933000	146.994497	59.19	5.15	64.34

Route Receptors

Name: Brewers Hill Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942576	146.989655	52.23	2.40	54.63
2	-37.942716	146.991028	51.82	2.40	54.22
3	-37.942991	146.993491	49.00	2.40	51.40
4	-37.943147	146.994741	49.17	2.40	51.57
5	-37.943355	146.996452	51.99	2.40	54.39
6	-37.943592	146.998474	52.56	2.40	54.96
7	-37.943879	147.001012	53.58	2.40	55.98
8	-37.944142	147.003136	53.32	2.40	55.72
9	-37.944455	147.006033	54.96	2.40	57.36

Name: Maffra-Briagolong Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.921442	146.998193	51.69	2.40	54.09
2	-37.922999	146.997184	55.27	2.40	57.67
3	-37.924590	146.996423	58.63	2.40	61.03
4	-37.925005	146.996176	58.99	2.40	61.39
5	-37.925411	146.995639	60.41	2.40	62.81
6	-37.926046	146.994266	69.88	2.40	72.28
7	-37.926323	146.993557	73.71	2.40	76.11
8	-37.926878	146.992817	75.87	2.40	78.27
9	-37.927555	146.992366	77.31	2.40	79.71
10	-37.928160	146.992200	77.68	2.40	80.08
11	-37.929243	146.991926	75.57	2.40	77.97
12	-37.930479	146.991695	71.65	2.40	74.05
13	-37.931665	146.991561	68.92	2.40	71.32
14	-37.932867	146.991341	66.13	2.40	68.53
15	-37.934001	146.991149	63.59	2.40	65.99
16	-37.935187	146.990935	60.13	2.40	62.53
17	-37.936654	146.990662	59.49	2.40	61.89
18	-37.938172	146.990367	55.29	2.40	57.69
19	-37.941124	146.989820	54.13	2.40	56.53
20	-37.942516	146.989579	52.40	2.40	54.80
21	-37.944776	146.989166	51.51	2.40	53.91

Name: McCubbins Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.928287	146.991910	76.89	2.40	79.29
2	-37.927881	146.989077	61.90	2.40	64.30
3	-37.927610	146.986803	60.62	2.40	63.02
4	-37.927229	146.983981	65.40	2.40	67.80
5	-37.926883	146.981204	70.93	2.40	73.33
6	-37.926612	146.978994	70.62	2.40	73.02

Name: Sandy Creek Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942838	146.989343	51.80	2.40	54.20
2	-37.942631	146.987799	51.54	2.40	53.94
3	-37.942500	146.986693	54.49	2.40	56.89
4	-37.942309	146.985202	59.30	2.40	61.70
5	-37.942115	146.983754	57.52	2.40	59.92
6	-37.941895	146.982059	49.42	2.40	51.82

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.925465	147.002955	59.57	1.50
OP 2	2	-37.926187	146.997710	65.00	1.50
OP 3	3	-37.929060	146.980945	61.70	1.50
OP 4	4	-37.931186	146.979830	58.51	1.50
OP 5	5	-37.931643	146.980227	56.16	1.50
OP 6	6	-37.932514	146.980329	52.37	1.50
OP 7	7	-37.934262	146.981245	54.49	1.50
OP 8	8	-37.939161	146.984592	59.75	1.50
OP 9	9	-37.940667	146.983305	54.99	1.50
OP 10	10	-37.941361	146.985150	60.93	1.50
OP 11	11	-37.942004	146.984614	60.63	1.50
OP 12	12	-37.942613	146.983906	57.42	1.50
OP 13	13	-37.942757	146.985547	57.11	1.50
OP 14	14	-37.941852	146.987843	52.72	1.50
OP 15	15	-37.940701	146.987789	55.70	1.50
OP 16	16	-37.943154	146.988683	51.94	1.50
OP 17	17	-37.944508	146.988554	51.70	1.50

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	SA tracking	SA tracking	766	12.8	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	113	1.9	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	149	2.5	0	0.0
OP 4	174	2.9	0	0.0
OP 5	174	2.9	0	0.0
OP 6	105	1.8	0	0.0
OP 7	51	0.8	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

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

Receptor results ordered by category of glare

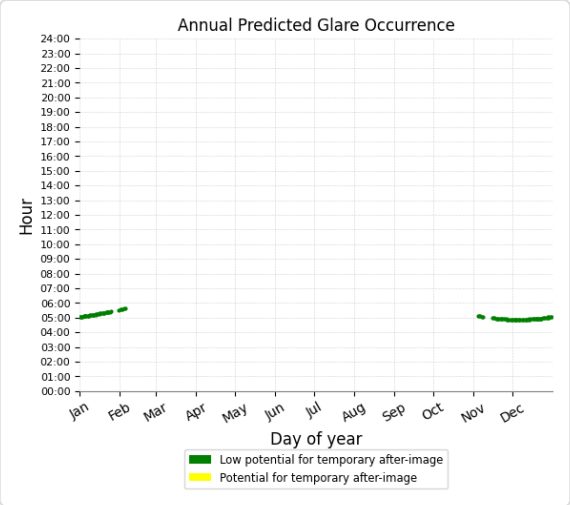
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
McCubbins Road	113	1.9	0	0.0
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 3	149	2.5	0	0.0
OP 4	174	2.9	0	0.0
OP 5	174	2.9	0	0.0
OP 6	105	1.8	0	0.0
OP 7	51	0.8	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

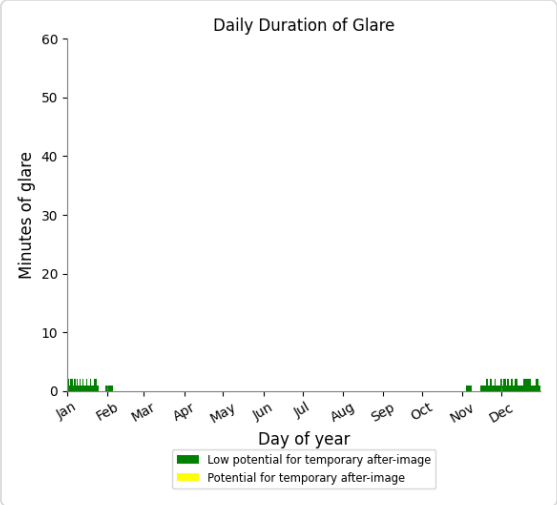
PV array 1 and McCubbins Road

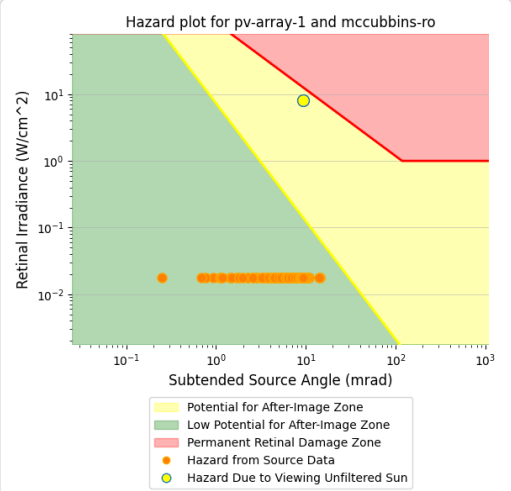
Receptor type: Route

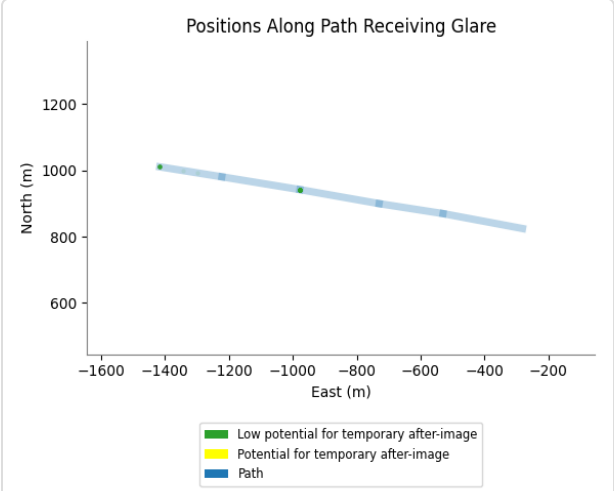
0 minutes of yellow glare

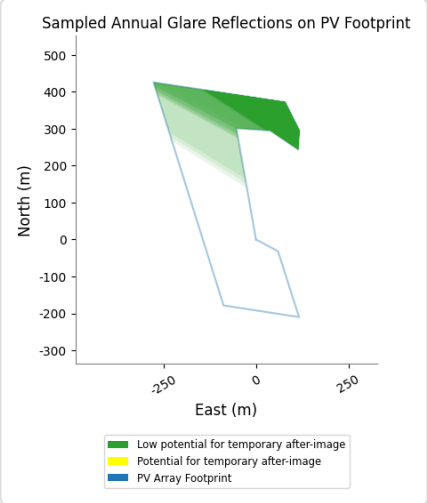
113 minutes of green glare











PV array 1 and Brewers Hill Road

Receptor type: Route

No glare found

PV array 1 and Maffra-Briagolong Road

Receptor type: Route

No glare found

PV array 1 and Sandy Creek Road

Receptor type: Route

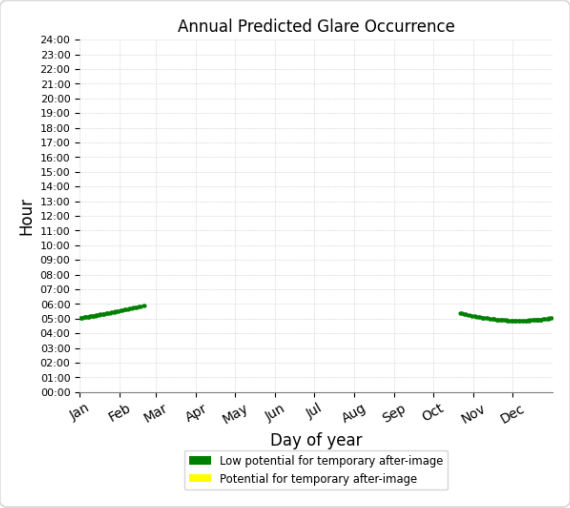
No glare found

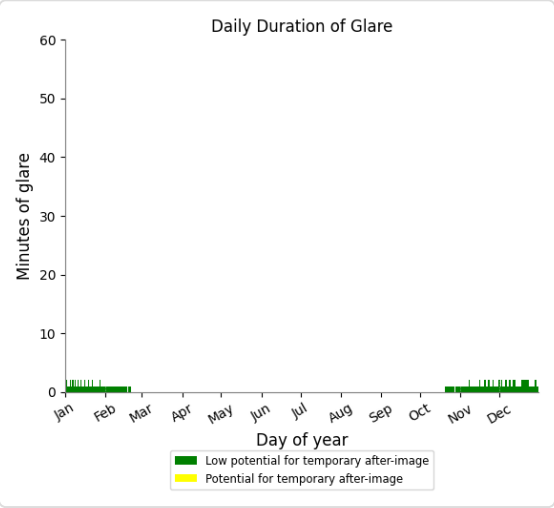
PV array 1 and OP 3

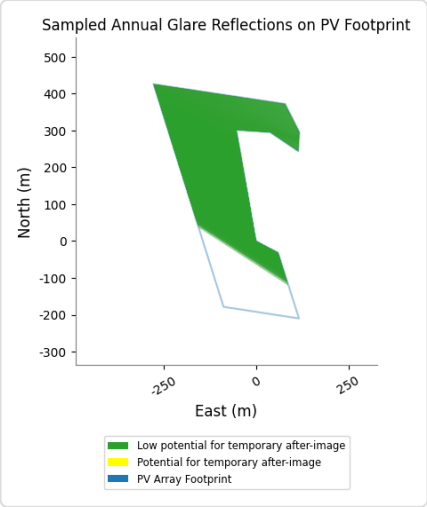
Receptor type: Observation Point

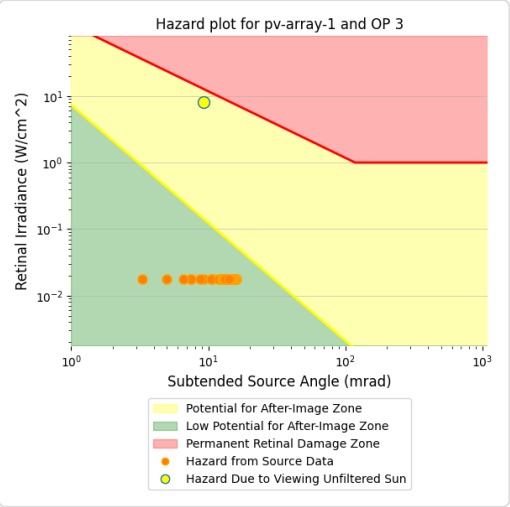
0 minutes of yellow glare

149 minutes of green glare



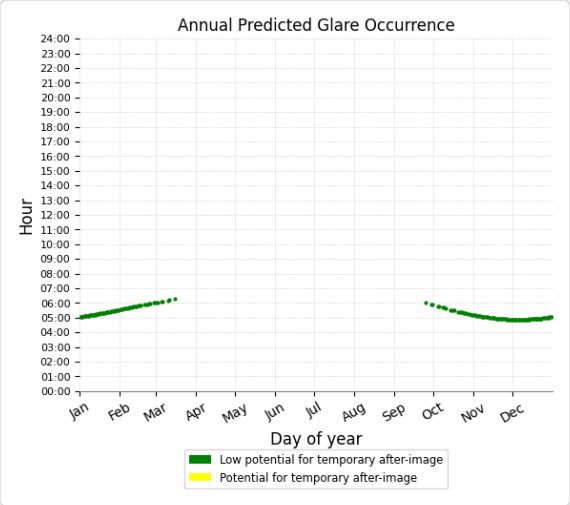


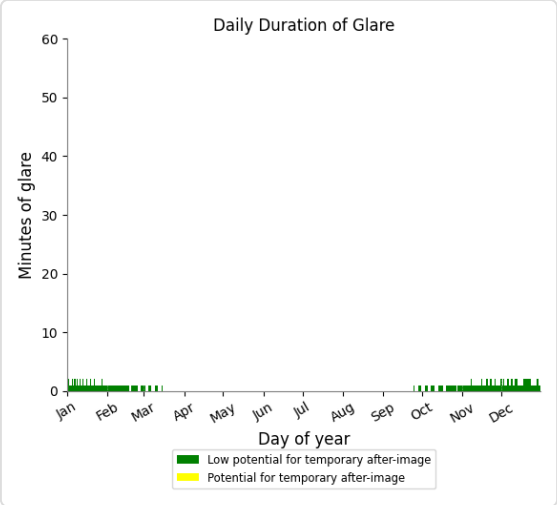


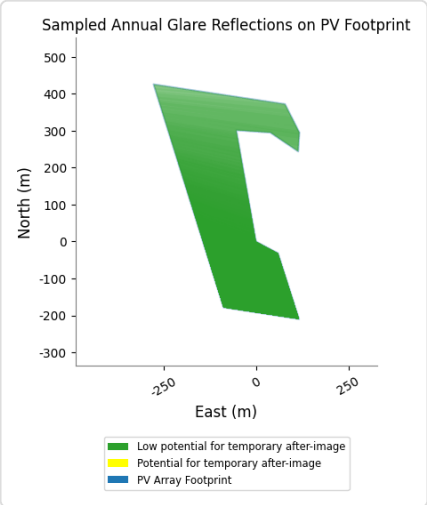


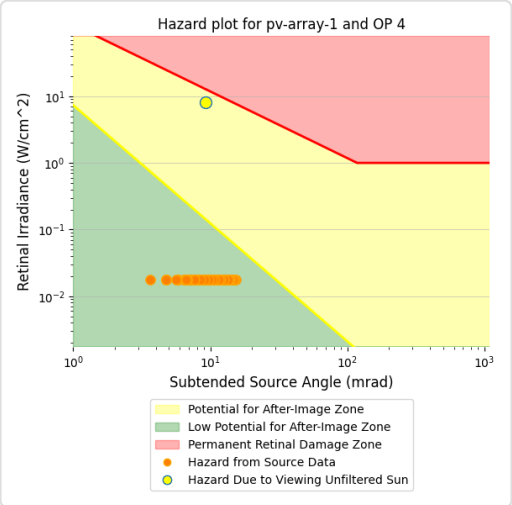
PV array 1 and OP 4

Receptor type: Observation Point
0 minutes of yellow glare
174 minutes of green glare



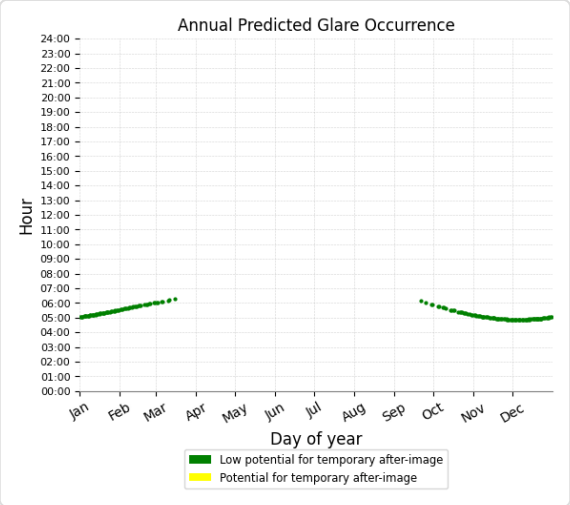


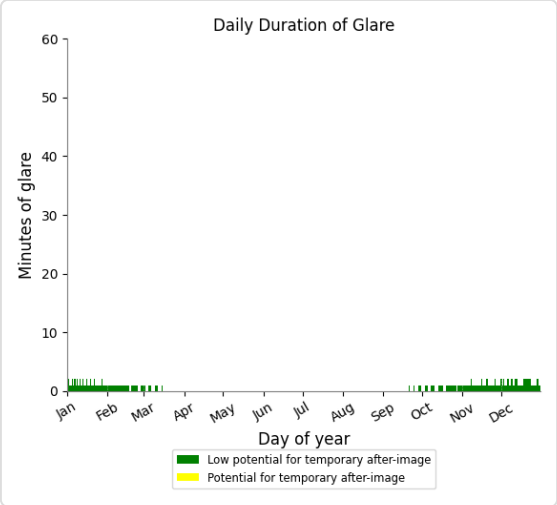


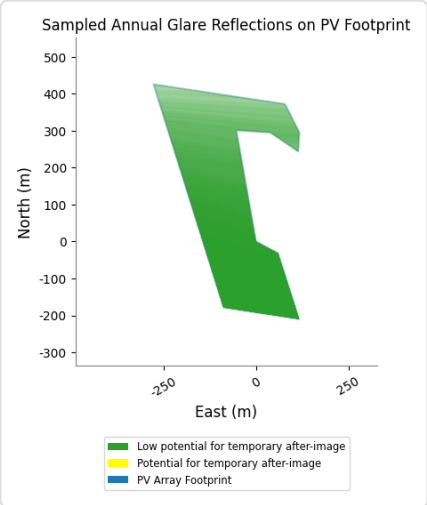


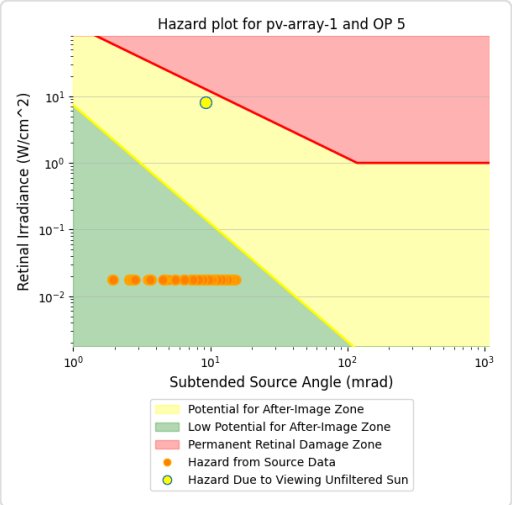
PV array 1 and OP 5

Receptor type: Observation Point
0 minutes of yellow glare
174 minutes of green glare



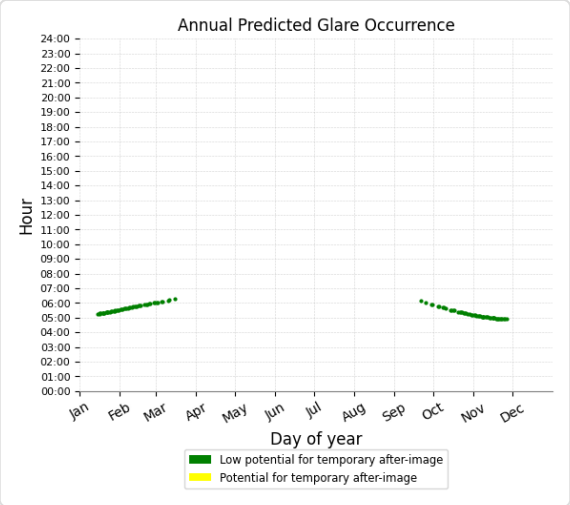


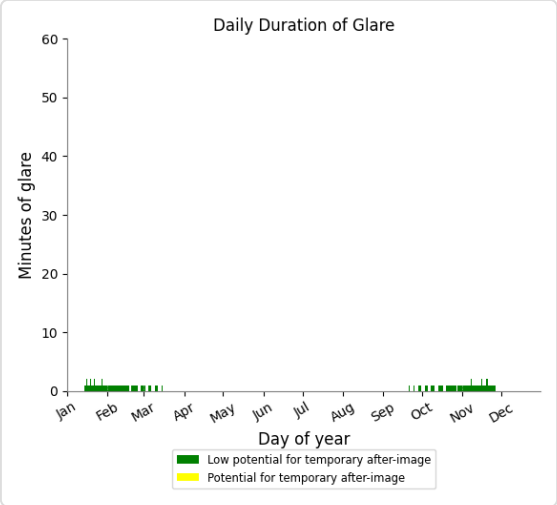


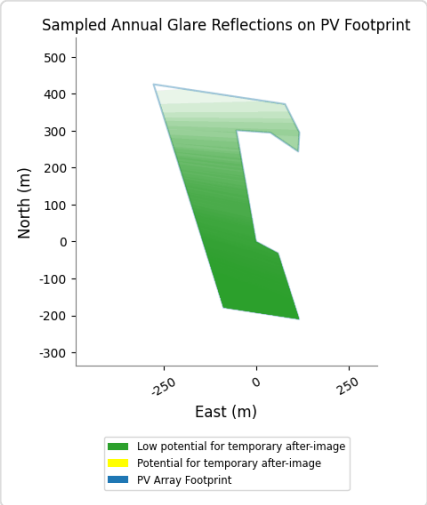


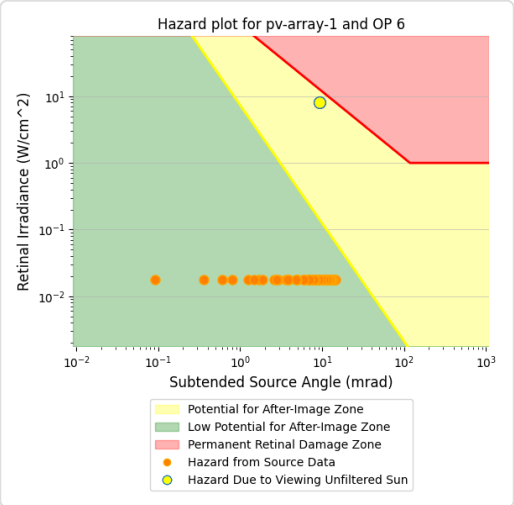
PV array 1 and OP 6

Receptor type: Observation Point
0 minutes of yellow glare
105 minutes of green glare



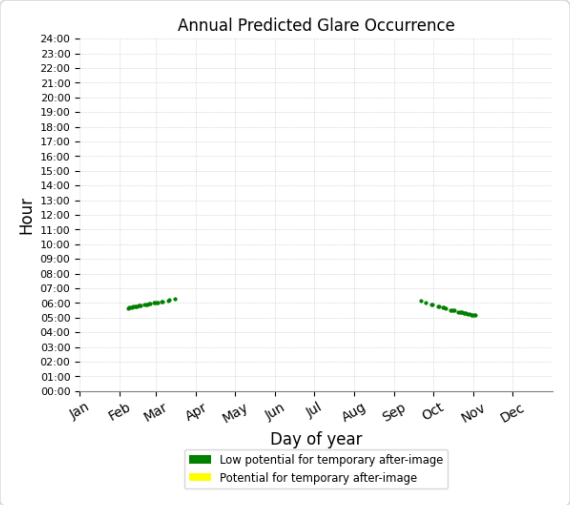


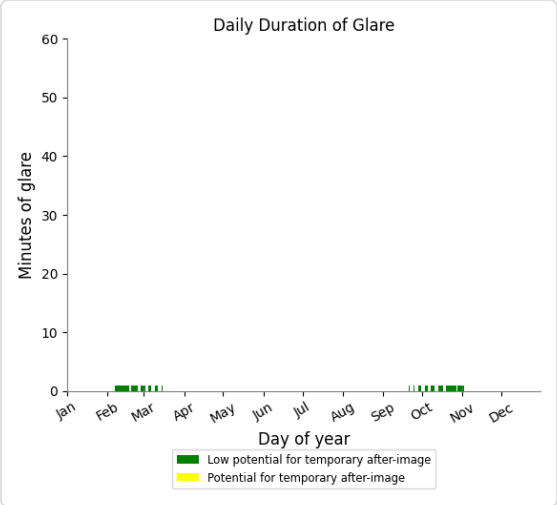


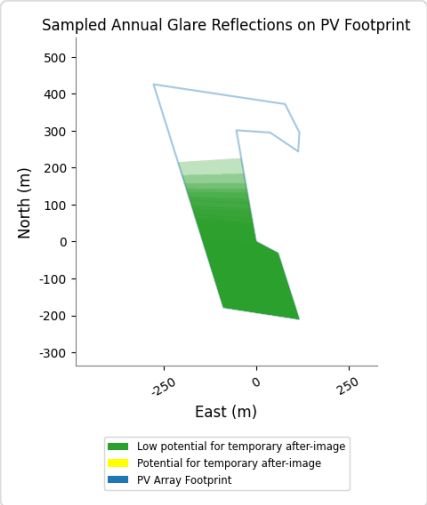


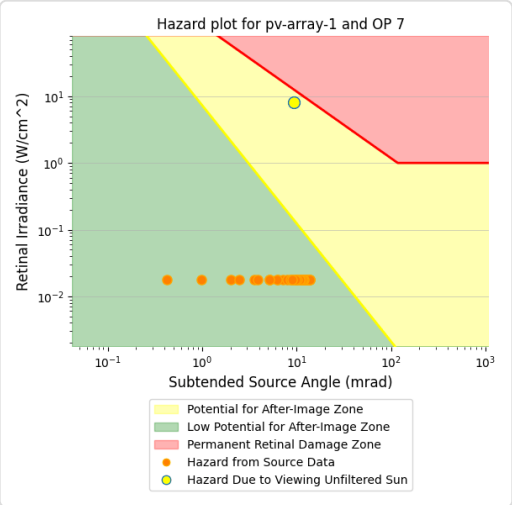
PV array 1 and OP 7

Receptor type: Observation Point
0 minutes of yellow glare
51 minutes of green glare









PV array 1 and OP 1

Receptor type: Observation Point
No glare found

PV array 1 and OP 2

Receptor type: Observation Point
No glare found

PV array 1 and OP 8

Receptor type: Observation Point
No glare found

PV array 1 and OP 9

Receptor type: Observation Point
No glare found

PV array 1 and OP 10

Receptor type: Observation Point
No glare found

PV array 1 and OP 11

Receptor type: Observation Point
No glare found

PV array 1 and OP 12

Receptor type: Observation Point
No glare found

PV array 1 and OP 13

Receptor type: Observation Point
No glare found

PV array 1 and OP 14

Receptor type: Observation Point
No glare found

PV array 1 and OP 15

Receptor type: Observation Point
No glare found

PV array 1 and OP 16

Receptor type: Observation Point
No glare found

PV array 1 and OP 17

Receptor type: Observation Point
No glare found

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

FORGESOLAR GLARE ANALYSIS

Project: **2239 MAFFRA SOLAR FARM**
Site configuration: **MAFFRA SOLAR FARM-temp-0**

Client: NGH

Created 15 Sep, 2022
Updated 15 Sep, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 75808.13406
Category 10 MW to 100 MW
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
Methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.34°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with 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	-37.935714	146.995103	59.89	5.15	65.04
2	-37.936000	146.995781	59.14	5.15	64.29
3	-37.937606	146.996428	58.17	5.15	63.32
4	-37.937322	146.994103	62.08	5.15	67.23
5	-37.931878	146.991947	68.28	5.15	73.43
6	-37.932361	146.995997	57.56	5.15	62.71
7	-37.933053	146.996439	59.45	5.15	64.60
8	-37.933517	146.996403	59.34	5.15	64.49
9	-37.933056	146.995544	58.03	5.15	63.18
10	-37.933000	146.994497	59.19	5.15	64.34

Route Receptors

Name: Brewers Hill Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942576	146.989655	52.23	2.40	54.63
2	-37.942716	146.991028	51.82	2.40	54.22
3	-37.942991	146.993491	49.00	2.40	51.40
4	-37.943147	146.994741	49.17	2.40	51.57
5	-37.943355	146.996452	51.99	2.40	54.39
6	-37.943592	146.998474	52.56	2.40	54.96
7	-37.943879	147.001012	53.58	2.40	55.98
8	-37.944142	147.003136	53.32	2.40	55.72
9	-37.944455	147.006033	54.96	2.40	57.36

Name: Maffra-Briagolong Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.921442	146.998193	51.69	2.40	54.09
2	-37.922999	146.997184	55.27	2.40	57.67
3	-37.924590	146.996423	58.63	2.40	61.03
4	-37.925005	146.996176	58.99	2.40	61.39
5	-37.925411	146.995639	60.41	2.40	62.81
6	-37.926046	146.994266	69.88	2.40	72.28
7	-37.926323	146.993557	73.71	2.40	76.11
8	-37.926878	146.992817	75.87	2.40	78.27
9	-37.927555	146.992366	77.31	2.40	79.71
10	-37.928160	146.992200	77.68	2.40	80.08
11	-37.929243	146.991926	75.57	2.40	77.97
12	-37.930479	146.991695	71.65	2.40	74.05
13	-37.931665	146.991561	68.92	2.40	71.32
14	-37.932867	146.991341	66.13	2.40	68.53
15	-37.934001	146.991149	63.59	2.40	65.99
16	-37.935187	146.990935	60.13	2.40	62.53
17	-37.936654	146.990662	59.49	2.40	61.89
18	-37.938172	146.990367	55.29	2.40	57.69
19	-37.941124	146.989820	54.13	2.40	56.53
20	-37.942516	146.989579	52.40	2.40	54.80
21	-37.944776	146.989166	51.51	2.40	53.91

Name: McCubbins Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.928287	146.991910	76.89	2.40	79.29
2	-37.927881	146.989077	61.90	2.40	64.30
3	-37.927610	146.986803	60.62	2.40	63.02
4	-37.927229	146.983981	65.40	2.40	67.80
5	-37.926883	146.981204	70.93	2.40	73.33
6	-37.926612	146.978994	70.62	2.40	73.02

Name: Sandy Creek Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942838	146.989343	51.80	2.40	54.20
2	-37.942631	146.987799	51.54	2.40	53.94
3	-37.942500	146.986693	54.49	2.40	56.89
4	-37.942309	146.985202	59.30	2.40	61.70
5	-37.942115	146.983754	57.52	2.40	59.92
6	-37.941895	146.982059	49.42	2.40	51.82

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.925465	147.002955	59.57	1.50
OP 2	2	-37.926187	146.997710	65.00	1.50
OP 3	3	-37.929060	146.980945	61.70	1.50
OP 4	4	-37.931186	146.979830	58.51	1.50
OP 5	5	-37.931643	146.980227	56.16	1.50
OP 6	6	-37.932514	146.980329	52.37	1.50
OP 7	7	-37.934262	146.981245	54.49	1.50
OP 8	8	-37.939161	146.984592	59.75	1.50
OP 9	9	-37.940667	146.983305	54.99	1.50
OP 10	10	-37.941361	146.985150	60.93	1.50
OP 11	11	-37.942004	146.984614	60.63	1.50
OP 12	12	-37.942613	146.983906	57.42	1.50
OP 13	13	-37.942757	146.985547	57.11	1.50
OP 14	14	-37.941852	146.987843	52.72	1.50
OP 15	15	-37.940701	146.987789	55.70	1.50
OP 16	16	-37.943154	146.988683	51.94	1.50
OP 17	17	-37.944508	146.988554	51.70	1.50

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV array 1 and Brewers Hill Road

Receptor type: Route
No glare found

PV array 1 and Maffra-Briagolong Road

Receptor type: Route
No glare found

PV array 1 and McCubbins Road

Receptor type: Route
No glare found

PV array 1 and Sandy Creek Road

Receptor type: Route
No glare found

PV array 1 and OP 1

Receptor type: Observation Point
No glare found

PV array 1 and OP 2

Receptor type: Observation Point
No glare found

PV array 1 and OP 3

Receptor type: Observation Point
No glare found

PV array 1 and OP 4

Receptor type: Observation Point
No glare found

PV array 1 and OP 5

Receptor type: Observation Point
No glare found

PV array 1 and OP 6

Receptor type: Observation Point
No glare found

PV array 1 and OP 7

Receptor type: Observation Point
No glare found

PV array 1 and OP 8

Receptor type: Observation Point
No glare found

PV array 1 and OP 9

Receptor type: Observation Point
No glare found

PV array 1 and OP 10

Receptor type: Observation Point
No glare found

PV array 1 and OP 11

Receptor type: Observation Point
No glare found

PV array 1 and OP 12

Receptor type: Observation Point
No glare found

PV array 1 and OP 13

Receptor type: Observation Point
No glare found

PV array 1 and OP 14

Receptor type: Observation Point
No glare found

PV array 1 and OP 15

Receptor type: Observation Point
No glare found

PV array 1 and OP 16

Receptor type: Observation Point
No glare found

PV array 1 and OP 17

Receptor type: Observation Point
No glare found

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

FORGESOLAR GLARE ANALYSIS

Project: **2239 MAFFRA SOLAR FARM**
Site configuration: **MAFFRA SOLAR FARM**

Client: NGH

Created 15 Sep, 2022
Updated 15 Sep, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 75794.13406
Category 10 MW to 100 MW
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
Methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.34°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 22.0°
Rated power: -
Panel material: Smooth glass with 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	-37.935714	146.995103	59.89	5.15	65.04
2	-37.936000	146.995781	59.14	5.15	64.29
3	-37.937606	146.996428	58.17	5.15	63.32
4	-37.937322	146.994103	62.08	5.15	67.23
5	-37.931878	146.991947	68.28	5.15	73.43
6	-37.932361	146.995997	57.56	5.15	62.71
7	-37.933053	146.996439	59.45	5.15	64.60
8	-37.933517	146.996403	59.34	5.15	64.49
9	-37.933056	146.995544	58.03	5.15	63.18
10	-37.933000	146.994497	59.19	5.15	64.34

Route Receptors

Name: Brewers Hill Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942576	146.989655	52.23	2.40	54.63
2	-37.942716	146.991028	51.82	2.40	54.22
3	-37.942991	146.993491	49.00	2.40	51.40
4	-37.943147	146.994741	49.17	2.40	51.57
5	-37.943355	146.996452	51.99	2.40	54.39
6	-37.943592	146.998474	52.56	2.40	54.96
7	-37.943879	147.001012	53.58	2.40	55.98
8	-37.944142	147.003136	53.32	2.40	55.72
9	-37.944455	147.006033	54.96	2.40	57.36

Name: Maffra-Briagolong Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.921442	146.998193	51.69	2.40	54.09
2	-37.922999	146.997184	55.27	2.40	57.67
3	-37.924590	146.996423	58.63	2.40	61.03
4	-37.925005	146.996176	58.99	2.40	61.39
5	-37.925411	146.995639	60.41	2.40	62.81
6	-37.926046	146.994266	69.88	2.40	72.28
7	-37.926323	146.993557	73.71	2.40	76.11
8	-37.926878	146.992817	75.87	2.40	78.27
9	-37.927555	146.992366	77.31	2.40	79.71
10	-37.928160	146.992200	77.68	2.40	80.08
11	-37.929243	146.991926	75.57	2.40	77.97
12	-37.930479	146.991695	71.65	2.40	74.05
13	-37.931665	146.991561	68.92	2.40	71.32
14	-37.932867	146.991341	66.13	2.40	68.53
15	-37.934001	146.991149	63.59	2.40	65.99
16	-37.935187	146.990935	60.13	2.40	62.53
17	-37.936654	146.990662	59.49	2.40	61.89
18	-37.938172	146.990367	55.29	2.40	57.69
19	-37.941124	146.989820	54.13	2.40	56.53
20	-37.942516	146.989579	52.40	2.40	54.80
21	-37.944776	146.989166	51.51	2.40	53.91

Name: McCubbins Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.928287	146.991910	76.89	2.40	79.29
2	-37.927881	146.989077	61.90	2.40	64.30
3	-37.927610	146.986803	60.62	2.40	63.02
4	-37.927229	146.983981	65.40	2.40	67.80
5	-37.926883	146.981204	70.93	2.40	73.33
6	-37.926612	146.978994	70.62	2.40	73.02

Name: Sandy Creek Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942838	146.989343	51.80	2.40	54.20
2	-37.942631	146.987799	51.54	2.40	53.94
3	-37.942500	146.986693	54.49	2.40	56.89
4	-37.942309	146.985202	59.30	2.40	61.70
5	-37.942115	146.983754	57.52	2.40	59.92
6	-37.941895	146.982059	49.42	2.40	51.82

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.925465	147.002955	59.57	1.50
OP 2	2	-37.926187	146.997710	65.00	1.50
OP 3	3	-37.929060	146.980945	61.70	1.50
OP 4	4	-37.931186	146.979830	58.51	1.50
OP 5	5	-37.931643	146.980227	56.16	1.50
OP 6	6	-37.932514	146.980329	52.37	1.50
OP 7	7	-37.934262	146.981245	54.49	1.50
OP 8	8	-37.939161	146.984592	59.75	1.50
OP 9	9	-37.940667	146.983305	54.99	1.50
OP 10	10	-37.941361	146.985150	60.93	1.50
OP 11	11	-37.942004	146.984614	60.63	1.50
OP 12	12	-37.942613	146.983906	57.42	1.50
OP 13	13	-37.942757	146.985547	57.11	1.50
OP 14	14	-37.941852	146.987843	52.72	1.50
OP 15	15	-37.940701	146.987789	55.70	1.50
OP 16	16	-37.943154	146.988683	51.94	1.50
OP 17	17	-37.944508	146.988554	51.70	1.50

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV array 1 and Brewers Hill Road

Receptor type: Route
No glare found

PV array 1 and Maffra-Briagolong Road

Receptor type: Route
No glare found

PV array 1 and McCubbins Road

Receptor type: Route
No glare found

PV array 1 and Sandy Creek Road

Receptor type: Route
No glare found

PV array 1 and OP 1

Receptor type: Observation Point
No glare found

PV array 1 and OP 2

Receptor type: Observation Point
No glare found

PV array 1 and OP 3

Receptor type: Observation Point
No glare found

PV array 1 and OP 4

Receptor type: Observation Point
No glare found

PV array 1 and OP 5

Receptor type: Observation Point
No glare found

PV array 1 and OP 6

Receptor type: Observation Point
No glare found

PV array 1 and OP 7

Receptor type: Observation Point
No glare found

PV array 1 and OP 8

Receptor type: Observation Point
No glare found

PV array 1 and OP 9

Receptor type: Observation Point
No glare found

PV array 1 and OP 10

Receptor type: Observation Point
No glare found

PV array 1 and OP 11

Receptor type: Observation Point
No glare found

PV array 1 and OP 12

Receptor type: Observation Point
No glare found

PV array 1 and OP 13

Receptor type: Observation Point
No glare found

PV array 1 and OP 14

Receptor type: Observation Point
No glare found

PV array 1 and OP 15

Receptor type: Observation Point
No glare found

PV array 1 and OP 16

Receptor type: Observation Point
No glare found

PV array 1 and OP 17

Receptor type: Observation Point
No glare found

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.
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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

FORGESOLAR GLARE ANALYSIS

Project: **2239 MAFFRA SOLAR FARM**
Site configuration: **MAFFRA SOLAR FARM**

Client: NGH

Created 15 Sep, 2022
Updated 15 Sep, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 75794.13406
Category 10 MW to 100 MW
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
Methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Instant
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.34°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 45.0°
Rated power: -
Panel material: Smooth glass with 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	-37.935714	146.995103	59.89	5.15	65.04
2	-37.936000	146.995781	59.14	5.15	64.29
3	-37.937606	146.996428	58.17	5.15	63.32
4	-37.937322	146.994103	62.08	5.15	67.23
5	-37.931878	146.991947	68.28	5.15	73.43
6	-37.932361	146.995997	57.56	5.15	62.71
7	-37.933053	146.996439	59.45	5.15	64.60
8	-37.933517	146.996403	59.34	5.15	64.49
9	-37.933056	146.995544	58.03	5.15	63.18
10	-37.933000	146.994497	59.19	5.15	64.34

Route Receptors

Name: Brewers Hill Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942576	146.989655	52.23	2.40	54.63
2	-37.942716	146.991028	51.82	2.40	54.22
3	-37.942991	146.993491	49.00	2.40	51.40
4	-37.943147	146.994741	49.17	2.40	51.57
5	-37.943355	146.996452	51.99	2.40	54.39
6	-37.943592	146.998474	52.56	2.40	54.96
7	-37.943879	147.001012	53.58	2.40	55.98
8	-37.944142	147.003136	53.32	2.40	55.72
9	-37.944455	147.006033	54.96	2.40	57.36

Name: Maffra-Briagolong Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.921442	146.998193	51.69	2.40	54.09
2	-37.922999	146.997184	55.27	2.40	57.67
3	-37.924590	146.996423	58.63	2.40	61.03
4	-37.925005	146.996176	58.99	2.40	61.39
5	-37.925411	146.995639	60.41	2.40	62.81
6	-37.926046	146.994266	69.88	2.40	72.28
7	-37.926323	146.993557	73.71	2.40	76.11
8	-37.926878	146.992817	75.87	2.40	78.27
9	-37.927555	146.992366	77.31	2.40	79.71
10	-37.928160	146.992200	77.68	2.40	80.08
11	-37.929243	146.991926	75.57	2.40	77.97
12	-37.930479	146.991695	71.65	2.40	74.05
13	-37.931665	146.991561	68.92	2.40	71.32
14	-37.932867	146.991341	66.13	2.40	68.53
15	-37.934001	146.991149	63.59	2.40	65.99
16	-37.935187	146.990935	60.13	2.40	62.53
17	-37.936654	146.990662	59.49	2.40	61.89
18	-37.938172	146.990367	55.29	2.40	57.69
19	-37.941124	146.989820	54.13	2.40	56.53
20	-37.942516	146.989579	52.40	2.40	54.80
21	-37.944776	146.989166	51.51	2.40	53.91

Name: McCubbins Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.928287	146.991910	76.89	2.40	79.29
2	-37.927881	146.989077	61.90	2.40	64.30
3	-37.927610	146.986803	60.62	2.40	63.02
4	-37.927229	146.983981	65.40	2.40	67.80
5	-37.926883	146.981204	70.93	2.40	73.33
6	-37.926612	146.978994	70.62	2.40	73.02

Name: Sandy Creek Road
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.942838	146.989343	51.80	2.40	54.20
2	-37.942631	146.987799	51.54	2.40	53.94
3	-37.942500	146.986693	54.49	2.40	56.89
4	-37.942309	146.985202	59.30	2.40	61.70
5	-37.942115	146.983754	57.52	2.40	59.92
6	-37.941895	146.982059	49.42	2.40	51.82

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.925465	147.002955	59.57	1.50
OP 2	2	-37.926187	146.997710	65.00	1.50
OP 3	3	-37.929060	146.980945	61.70	1.50
OP 4	4	-37.931186	146.979830	58.51	1.50
OP 5	5	-37.931643	146.980227	56.16	1.50
OP 6	6	-37.932514	146.980329	52.37	1.50
OP 7	7	-37.934262	146.981245	54.49	1.50
OP 8	8	-37.939161	146.984592	59.75	1.50
OP 9	9	-37.940667	146.983305	54.99	1.50
OP 10	10	-37.941361	146.985150	60.93	1.50
OP 11	11	-37.942004	146.984614	60.63	1.50
OP 12	12	-37.942613	146.983906	57.42	1.50
OP 13	13	-37.942757	146.985547	57.11	1.50
OP 14	14	-37.941852	146.987843	52.72	1.50
OP 15	15	-37.940701	146.987789	55.70	1.50
OP 16	16	-37.943154	146.988683	51.94	1.50
OP 17	17	-37.944508	146.988554	51.70	1.50

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual 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
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Brewers Hill Road	0	0.0	0	0.0
Maffra-Briagolong Road	0	0.0	0	0.0
McCubbins Road	0	0.0	0	0.0
Sandy Creek Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
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OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0

PV array 1 and Brewers Hill Road

Receptor type: Route
No glare found

PV array 1 and Maffra-Briagolong Road

Receptor type: Route
No glare found

PV array 1 and McCubbins Road

Receptor type: Route
No glare found

PV array 1 and Sandy Creek Road

Receptor type: Route
No glare found

PV array 1 and OP 1

Receptor type: Observation Point
No glare found

PV array 1 and OP 2

Receptor type: Observation Point
No glare found

PV array 1 and OP 3

Receptor type: Observation Point
No glare found

PV array 1 and OP 4

Receptor type: Observation Point
No glare found

PV array 1 and OP 5

Receptor type: Observation Point
No glare found

PV array 1 and OP 6

Receptor type: Observation Point
No glare found

PV array 1 and OP 7

Receptor type: Observation Point
No glare found

PV array 1 and OP 8

Receptor type: Observation Point
No glare found

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PV array 1 and OP 13

Receptor type: Observation Point
No glare found

PV array 1 and OP 14

Receptor type: Observation Point
No glare found

PV array 1 and OP 15

Receptor type: Observation Point
No glare found

PV array 1 and OP 16

Receptor type: Observation Point
No glare found

PV array 1 and OP 17

Receptor type: Observation Point
No glare found

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.
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