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Lancefield Solar Farm

Glint and Glare Assessment

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Glint and Glare Assessment

Prepared for
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Executive Summary

Moir Landscape Architecture (Moir LA) have been engaged by BNRG Leeson to provide a glint and glare assessment of the proposed Lancefield Solar Farm (the Project). The report will accompany the Environmental Impact Statement (EIS) prepared for the Project.

The Project is located along Rochford Road 2.65km northeast of Rochford and 3.5km southwest of the town of Lancefield in the Local Government Area of Macedon Ranges (refer to Figure 1). The subject land is approximately 11.69ha in area and is identified as Lot 1TP168495 and Lot 1LP90207, 313 Collivers Road Lancefield 3435.

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.

Glare modelling has been conducted to include both maximum and minimum tracker height to provide a wider range of observed solar glare based on extremities. 'Shade-slope' backtracking function has been considered to simulate panels returning to a predefined angle after the maximum tilt angle has been attained.

A total of 15 free standing dwellings were identified within 1 km of the Project.
Of the 15 non-involved dwellings assessed, three (3) dwellings were identified as having potential to experience less than 10 hours of glare per year.

Five (5) route receptors were identified as part of the assessment. Based on glare assessment one (1) routes have the potential to experience more than 30 hours of glare per annum 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 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 BNRG Leeson to provide a glint and glare assessment of the Project. The report will accompany the planning permit application 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 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 6.6 metres. Glare modelling has been conducted to correspond to both maximum and minimum tracker height to provide a wider range of observed solar glare based on the extremities.

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.

Glare modelling has been conducted using the Shade-slope backtracking function within the SGHAT tool. Ground Coverage Ratio (GCR) calculations are used within the SGHAT tool for 'Shade-Slope' backtracking analysis. GCR is defined as the ratio of the array length (L) to proposed pitch distance (R) (Doubleday et al. 2016).

$$\mathrm{GCR} = \frac{L}{R} \ .$$

For this assessment GCR is calculated considering L = 4.992m and R = 6.6m. The resulting GCR = 0.75

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

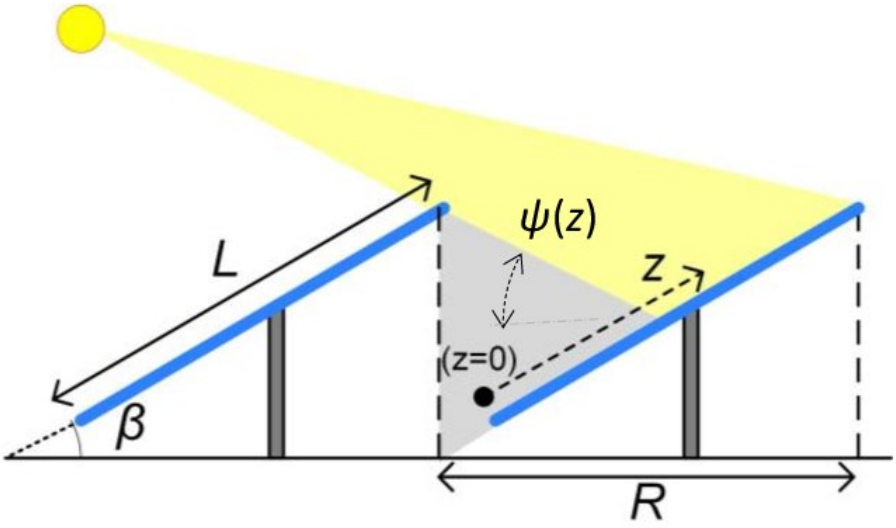


Image 01 Ground Coverage Ratio Calculations (Doubleday et al. 2016)

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°. 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.

Shade-slope backtracking function within the SGHAT tool considers the lowest possible panel rotation angle during backtracking. Therefore, using 0° resting angle option is modelled to determine backtracking operations. This function simulates the impression of the panels returning to a predefined angle after the maximum tilt angle has been attained.

It is important to note that this backtracking 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 0°, assuming the PV modules move directly to 0° once maximum tilt of 60° is reached and represents a worst case scenario.
- To simulate glare experienced mid tracking an angle of 45° and 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 along Rochford Road 2.65km northeast of Rochford and 3.5km south west of the town of Lancefield in the Local Government Area of Macedon Ranges (refer to Figure 1). The subject land approximately measures 11.69ha in area and is identified as Lot 1TP168495 and Lot 1LP90207, 313 Collivers Road Lancefield 3435.

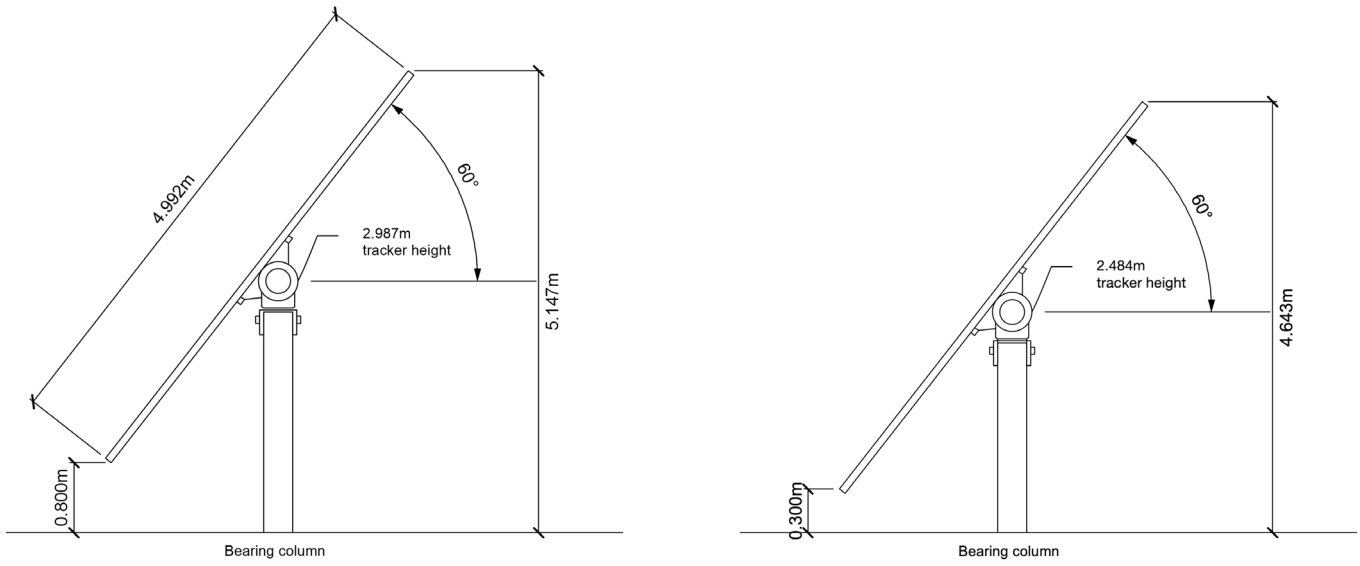
Figure 1 Project Site Context (Map Source: Google Earth, 2021)

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 panels are fixed on a tubular frame with a single axis tracking procedure. For accuracy, Glare analysis has been performed using minimum tracker height of 2.484m and maximum tracker height not exceeding 2.987m when facing at the highest angle

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



Maximum Tracker Height

Minimum Tracker Height

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
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°, 5°, 22° and 45°	Panels following the Sun, to represent backtracking and after dark stowing angles
Maximum Tracker Height	Metres	2.987	Provided by the Client
Minimum Tracker Height	Metres	2.48	Provided by the Client
Backtracking	-	Shade-Slope	Provided by the Client
Ground Coverage Ration	-	0.76	Ratio of the Array length to the pitch distance as 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 11,200 modules mounted on a north/south axis to slowly track movement of the sun. The rows of modules will be spaced approximately 6.6m apart to ensure no shading occurs and allows for ease of access for maintenance purposes.

Refer **Figure 3** for PV array areas.

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PV Array Areas for Assessment

Figure 3 PV Array Areas (Map Source: Google Maps, 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 15 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 Maps, 2021)

Dwelling	Location	Elevation	Distance to the nearest solar panel	Yellow Glare (Hours Per Year):		Recommended Mitigation Measures
				Maximum Tracker Height	Minimum Tracker Height	
OP 01	68 Cullys Road Lancefield 3435	534m	0.43km	0	0	Not Required.
OP 02	118 Cullys Road Lancefield 3435	538m	0.14km	23.5	33.8	Existing vegetation and additional supplementary planting along southern boundary of the Project will likely filter the impact.
OP 03	117 Cullys Road Lancefield 3435	541m	0.08km	58.2	94.1	Existing vegetation and additional supplementary planting along eastern boundary of the Project will likely reduce the impact.
OP 04	50 Cullys Road Rochford 3442	530m	0.10km	0	0	Not Required.
OP 05	351 Rochford Road Rochford 3442	563m	0.91km	0	0	Not Required.
OP 06	2 Otts Lane Lancefield 3435	532m	0.74km	0	0	Not Required.
OP 07	Rochford Road Lancefield 3435	529m	0.70km	0	0	Not Required.
OP 08	270 Rochford Road Lancefield 3435	532m	0.44km	0	0	Not Required.
OP 09	252 Rochford Road Lancefield 3435	525m	0.33km	0	0	Not Required.
OP 10	654 Whitebridge Road Lancefield 3435	526m	0.54km	0	0	Not Required.
OP 11	200 Rochford Road Lancefield 3435	534m	0.42km	0	0	Not Required.
OP 12	300 Collivers Road Lancefield 3435	528m	0.56km	0	0	Not Required.
OP 13	115 Rochford Road Lancefield 3435	521m	0.62km	0	0	Not Required.
OP 14	263 Collivers Road Lancefield 3435	512m	0.64km	0	0	Not Required.
OP 15	263 Collivers Road Lancefield 3435	516m	0.53km	0	0	Not Required.

Table 6. Residential receptor assessment results

Based on the desktop assessment two (2) dwellings will experience potential glare more than 30 hours per year.

Desktop analysis of the dwellings using aerial imagery along indicates existing vegetation surrounding OP02 and OP03 will likely reduce the potential glare experienced from the Project.

Assessment of the outputs with maximum tracker height indicates OP02 will experience potential 'Yellow' glare from mid April to very early September between 16:10 pm - 17:50 pm from the Project for about 23.5 hours per year.

Additionally, assessment of the output with minimum tracker height indicates OP02 will experience potential 'Yellow' glare from early April to early September approximately between 16:10m - 18:00pm from the Project for about 33.8 hours per year.

Assessment of the outputs with maximum tracker height indicates OP03 will experience potential 'Yellow' glare from early January to November between 16:10 pm - 19:50 pm from the Project for about 58.2 hours per year.

Similarly, assessment of the output for the same receptor (OP3), with minimum tracker height, indicates potential 'Yellow' glare experienced almost everyday from January to December approximately between 16:10m - 19:50pm from the Project for about 94.1 hours per year.

Existing vegetation surrounding the dwelling will likely help in reducing potential glare experienced at these locations. Mitigation measures in the form of proposed vegetation along the eastern and southern boundary of the Project will likely filter potential glare at these locations.

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. A total of 5 road receptors were identified within 1 km of the development footprint. These have been shown on Figure 5.

- *Collivers Road*
- *Cullys Road*
- *Otts Lane*
- *Rochford Road*
- *Whitebridge Road*

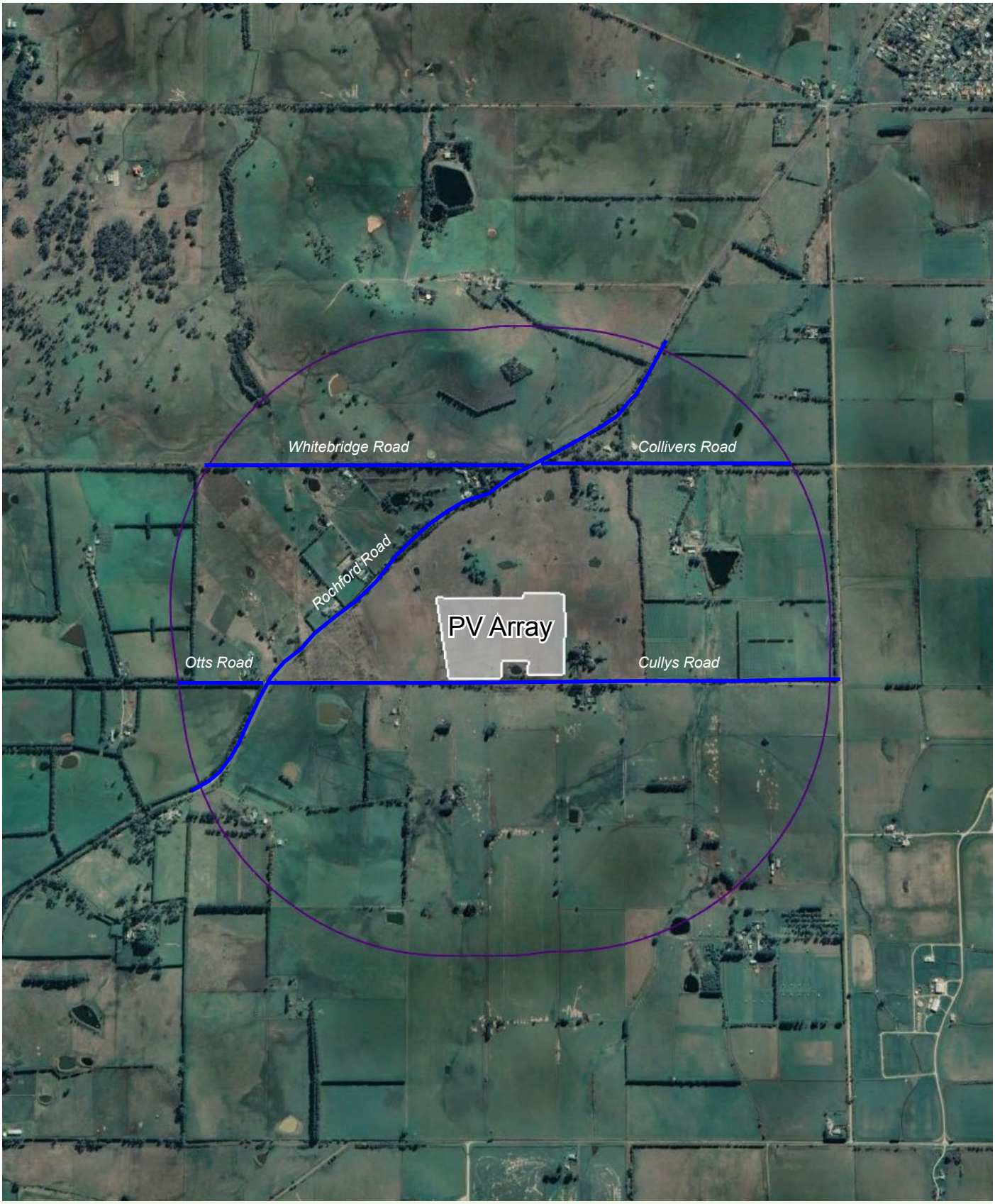

Figure 5 Rail Line and Road Receptors (Map Source: Google Maps, 2021)

5.3 Results of Glint and Glare Assessment - Road and Rail

5 route receptors were identified as part of the assessment. Based on glare assessment 3 routes will experience 'Yellow' glare from the Project. **Table 8** provides an overview of the annual glare experienced along the 5 routes.

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:
			Maximum Tracker Height	Minimum Tracker Height		
Collivers Road	0.49km	514m	0	0	Not Required.	Not Required.
Cullys Road	0.01km	532m	201.4	232.2	A desktop assessment identified no existing vegetation along the road.	Additional screen planting along the southern boundary of the Project.
Otts Lane	0.69km	540m	0	0	Not Required.	Not Required.
Rochford Road	0.21km	545m	0	0	Not Required.	Not Required.
Whitebridge Road	0.50km	530m	0	0	Not Required.	Not Required.

Table 8. Road & Rail receptor assessment results

Based on the desktop assessment one (1) road receptor will experience potential glare exceeding 30 hours per year.

Assessment of the outputs with minimum tracker height indicates Cullys Road to experience approximately 232.32 hours per year potential 'Yellow' glare from mid April to mid August between 06:50 am- 08:20 am and from mid March to very late September between 15:10 pm - 18:30 pm from the Project.

Similarly, assessment of the output with maximum tracker height indicates Cullys Road will experience potential annual 'Yellow' glare of approximately 201.4 hours from late April to mid August between 07:00 am- 08:15 am and from mid March to very late September between 15:10 pm - 18:30 pm from the Project. **(Refer to Appendix A)**

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:

Two (2) dwellings have been assessed as having a high glare rating (> 30 hours per year)

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.

Assessment of the outputs for the maximum and minimum tracker heights indicates OP02 will experience potential 'Yellow' glare of 23.5 and 33.8 hours per year respectively, approximately between 16:10 pm - 18:00 pm from mid April to very early September.

Similarly, considering the maximum tracker heights outputs, OP03 will experience potential 'Yellow Glare' of 58.2 hours per year from early January to December between 16:10 pm - 19:50 pm and 94.1 hours per year potential 'Yellow' glare almost everyday during the same timeframe from the Project when minimum tracker height is considered.

Existing vegetation surrounding the dwellings will likely reduce the potential to experience 'Yellow Glare' at these locations. Additionally, supplementary mitigation measures proposed in Section 8.0 of this report will assist in limiting the glare experienced at these locations.

Mitigation measures in the form of proposed and existing vegetation outlined in **Table 6** will help in reducing potential to experience glare at this location. The time of day glare likely to be experienced is provided for each receptor in **Appendix A.**

Assessment of the outputs for the maximum and minimum tracker heights indicates no glare experienced for dwelling receptors with different 'resting angle' of 5°, 22°, and 45°.**(Refer to 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:

One (1) road receptor have been assessed as having a high glare rating (> 30 hours per year)

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.

Assessment of the outputs for the maximum and minimum tracker heights indicates Cullys Road will likely experience the highest amount of potential 'Yellow' glare of about 201.4 and 232.2 hours annual glare respectively from mid April to mid August between 06:50 am- 08:20 am and from mid March to very late September between 15:10 pm - 18:30 pm from the Project. **(Refer to Appendix A)**

Mitigation measures in the form of proposed and existing vegetation outlined in Table 8 will help in reducing potential glare experienced at this location. The time of day glare likely to be experienced is provided for each receptor in **Appendix A.**

Assessment of the outputs for the maximum and minimum tracker heights with a night time 'stowing angle' of 5° indicates Cullys Road will likely experience potential 'Yellow' glare of about 45.4 hours annual glare from very early May to mid August between 07:00 am- 08:10 am and 77.2 hours annual glare from very early May to very early August between 16:00 am- 17:30 pm. The time of day glare likely to be experienced is provided for each receptor in **Appendix A.**

No glare has been found when modelling was conducted using resting angles of 22° and 45°. **(Refer to Appendix A)**

8.0 Mitigation Measures

An overview of mitigation measures required to reduce the potential impacts have been provided in the assessment tables in **Sections 4.0 - 6.0.**

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

Mitigation principles have been recommended to visually screen solar energy developments or other potential visual impacts (such as glint and glare). These will likely include vegetation screening, or the planting of trees and shrubs as a useful mitigation option at affected locations. On-site screening, such as perimeter planting, should be considered in the first instance. If this is unlikely to be effective, screening can be considered at affected locations.

Figure 7 illustrates the extent of on-site and proposed screening vegetation that will likely limit the potential glare experienced from the Project.

The assessment indicated that Cullys Road will experience potential 'Yellow' glare exceeding 30 hours per year. It is recommended that supplementary vegetation be proposed along the southern boundary of the Project to limit glare impacts to an acceptable level along the affected routes receptors.

Assessment of the outputs also indicated OP02 and OP03 as being a potential location to experience 'Yellow' glare from the Project. Mitigation methods proposed along the southern and southeastern perimeters of the Project will further limit glare impacts at these locations.

Details of the proposed landscaping including species has been included in the LVIA (prepared by others).

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- Development Footprint
- Proposed screen planting
- Existing scattered screen planting

Figure 6 Mitigation Principles (Map Source: Google Maps, 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 (within 1,000 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 glint and glare was assessed for 2 dwelling receptors (OP02, and OP03) will experience high annual 'Yellow' glare from the Project.

Desktop analysis of the dwellings using aerial imagery indicates existing vegetation surrounding OP02 and OP03 will likely filter the potential glare experienced at these locations.

Assessment of the road receptors identified Cullys Road will potentially experience high 'Yellow Glare' from the Project. Assessment based on the aerial imagery indicates lack of existing vegetation along Cullys Road. Supplementary planting along the southern perimeter of the Project will likely assist in reducing potential glare to acceptable level for this receptor.

Assessment of the scenarios with resting angles of 22° and 45° indicated no glare at the public and private receptors. Using a stowing angle of 5° provided a significant reduction in 'Yellow' glare along Cullys Road.

In addition to existing vegetation, supplementary planting along the southern and south eastern array boundary of the Project will further diminish glare impacts experienced at these roads.

Mitigation recommendations suggested in **Section 8** of this report will likely help to reduce the potential glare impacts along the affected routes and dwellings.

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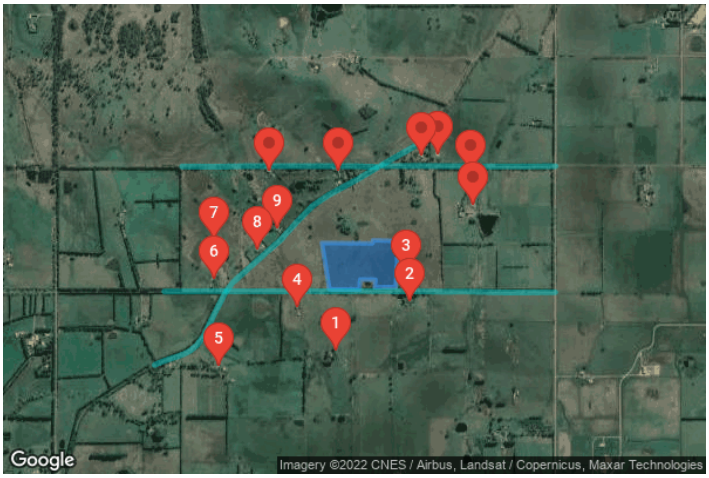
Appendix A

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_0d_2484cmTracker**

Client: NGH

Created 02 Nov, 2022
Updated 07 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 78644.13479
Category 1 MW to 5 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 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	6,319	105.3	21,604	360.1	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,663	27.7	13,929	232.2
Otts Ln	0	0.0	0	0.0
Rochford Road	658	11.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	1,849	30.8	2,030	33.8
OP 3	1,756	29.3	5,645	94.1
OP 4	4	0.1	0	0.0
OP 5	389	6.5	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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.76
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	-37.298372	144.699931	534.73	2.48	537.22
2	-37.298819	144.699889	534.19	2.48	536.67
3	-37.298794	144.701425	538.08	2.48	540.56
4	-37.296997	144.701522	539.97	2.48	542.45
5	-37.296119	144.701442	539.50	2.48	541.98
6	-37.296081	144.699761	540.63	2.48	543.11
7	-37.296261	144.699719	539.81	2.48	542.29
8	-37.296244	144.696011	531.02	2.48	533.50
9	-37.298936	144.696556	532.68	2.48	535.17
10	-37.298933	144.698775	532.57	2.48	535.05
11	-37.298367	144.698811	533.28	2.48	535.77

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	1.50

Glare Analysis Results

Summary of Results

Glare with 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	6,319	105.3	21,604	360.1	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,663	27.7	13,929	232.2
Otts Ln	0	0.0	0	0.0
Rochford Road	658	11.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	1,849	30.8	2,030	33.8
OP 3	1,756	29.3	5,645	94.1
OP 4	4	0.1	0	0.0
OP 5	389	6.5	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

PV: PV array 1 potential temporary after-image

Receptor results ordered by category of glare

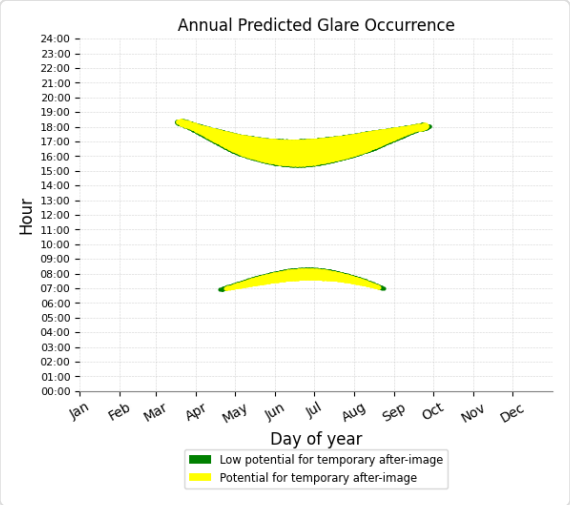
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Cullys Road	1,663	27.7	13,929	232.2
Rochford Road	658	11.0	0	0.0
Collivers Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 2	1,849	30.8	2,030	33.8
OP 3	1,756	29.3	5,645	94.1
OP 4	4	0.1	0	0.0
OP 5	389	6.5	0	0.0
OP 1	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

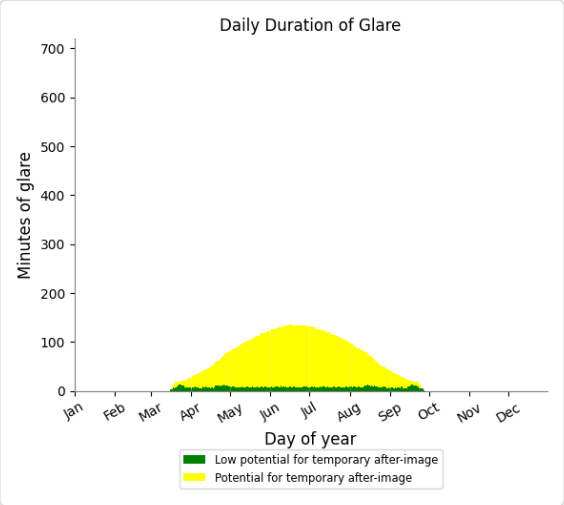
PV array 1 and Cullys Road

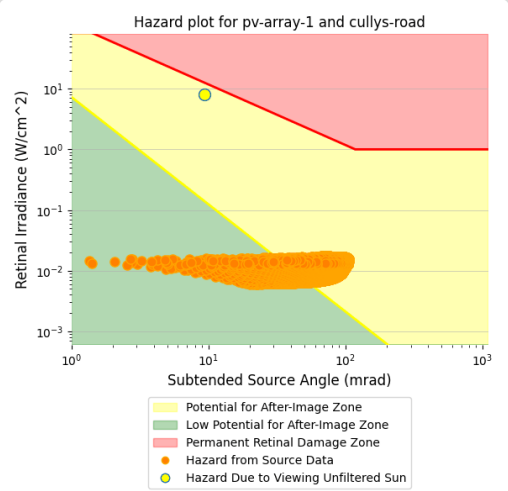
Receptor type: Route

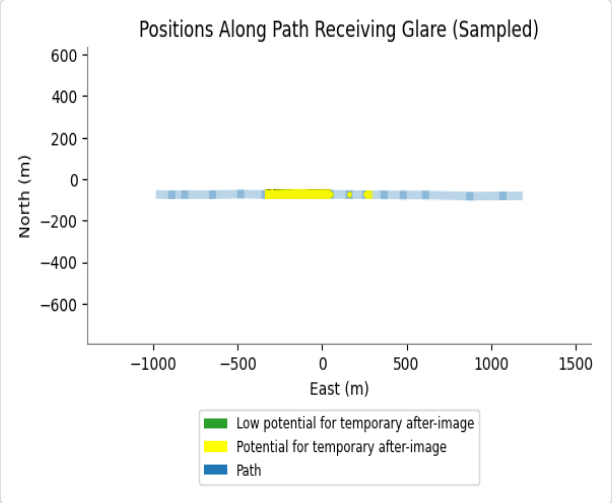
13,929 minutes of yellow glare

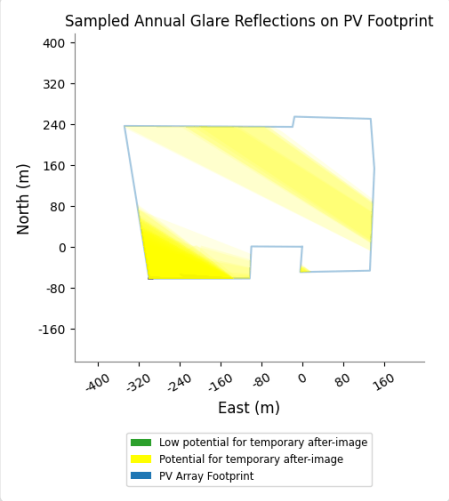
1,663 minutes of green glare





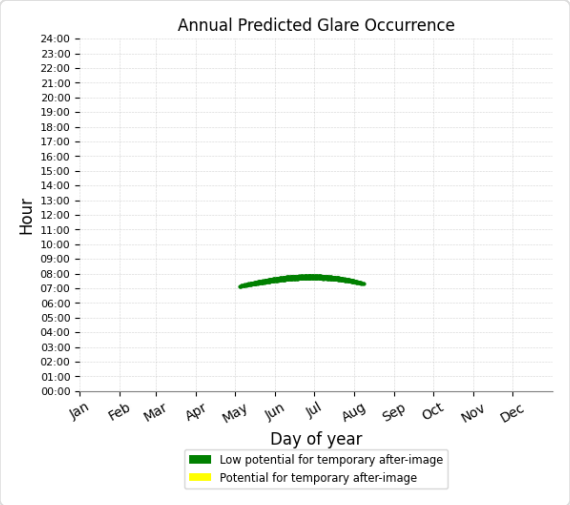


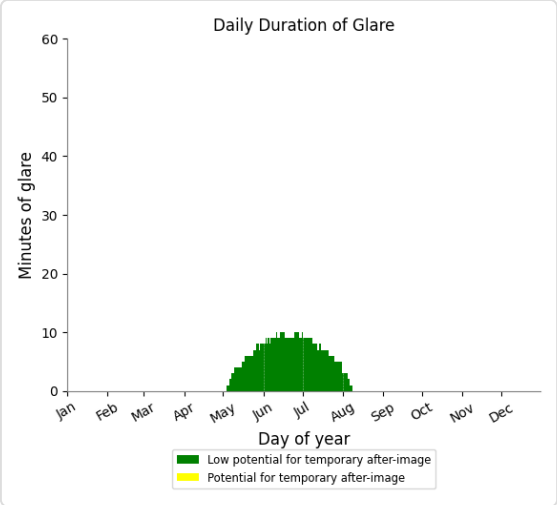


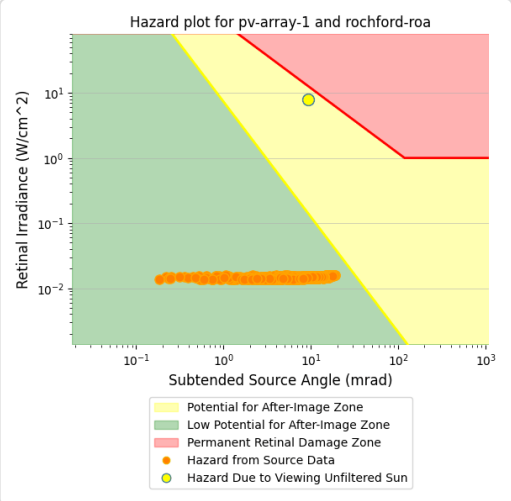


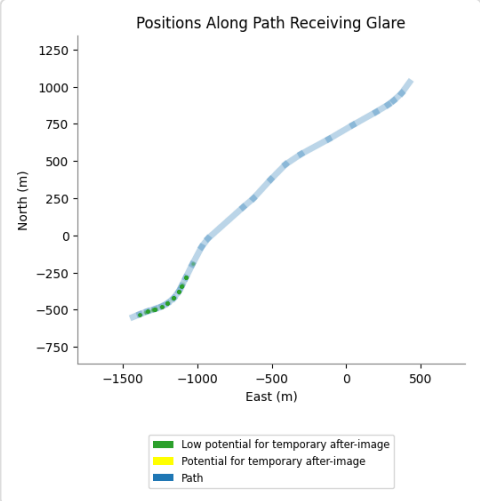
PV array 1 and Rochford Road

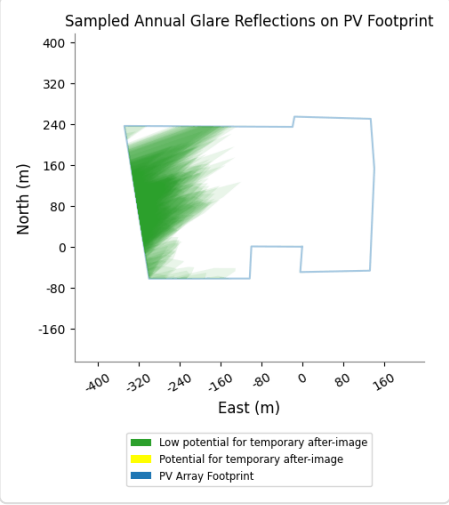
Receptor type: Route
0 minutes of yellow glare
658 minutes of green glare











PV array 1 and Collivers Road

Receptor type: Route

No glare found

PV array 1 and Otts Ln

Receptor type: Route

No glare found

PV array 1 and Whitebridge Road

Receptor type: Route

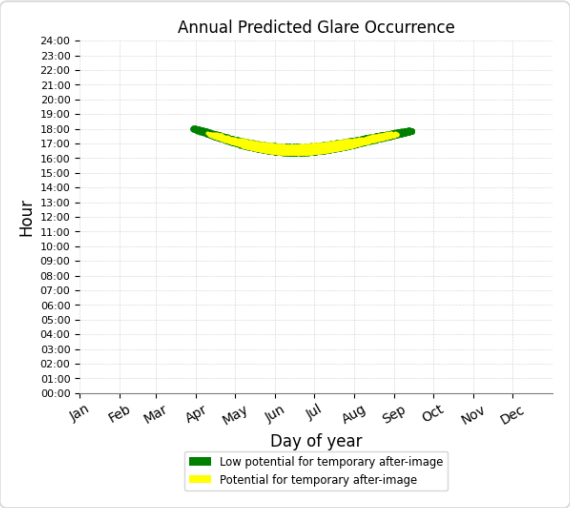
No glare found

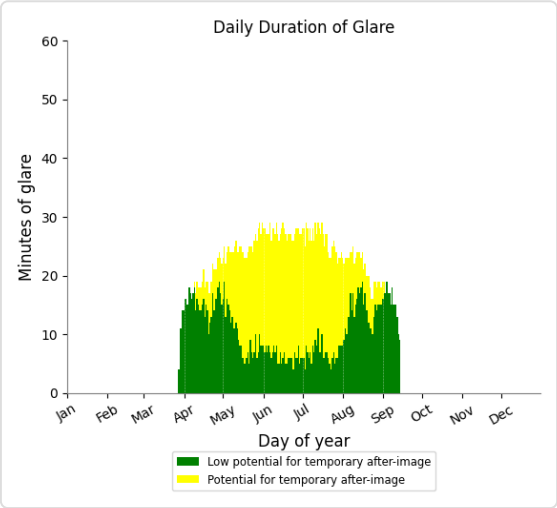
PV array 1 and OP 2

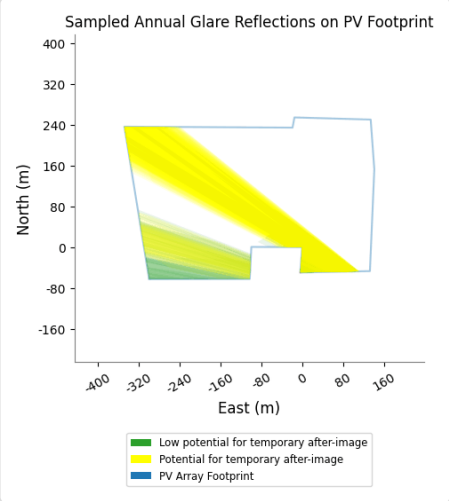
Receptor type: Observation Point

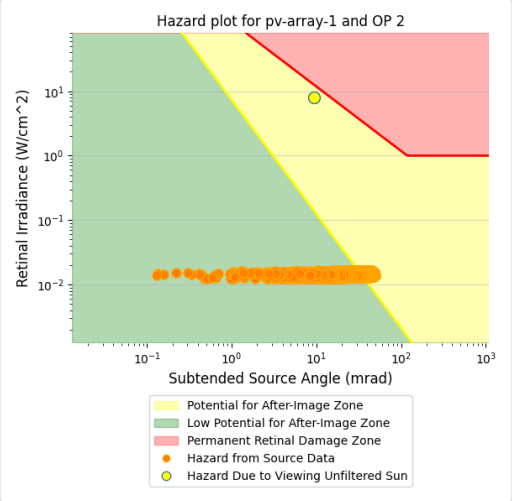
2,030 minutes of yellow glare

1,849 minutes of green glare



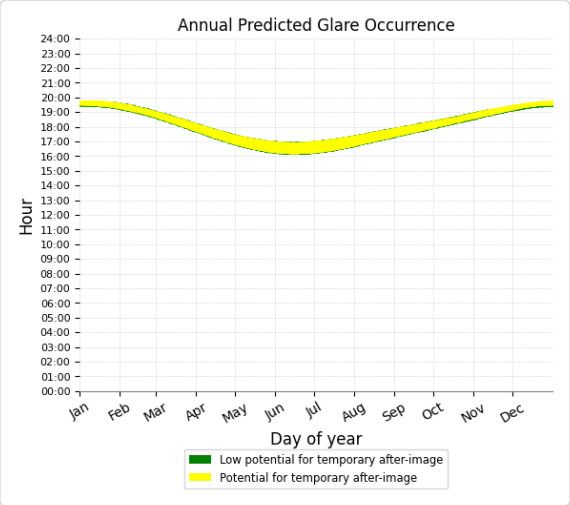


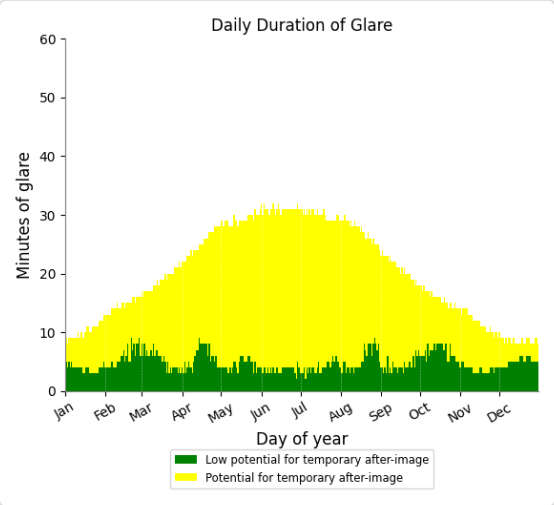


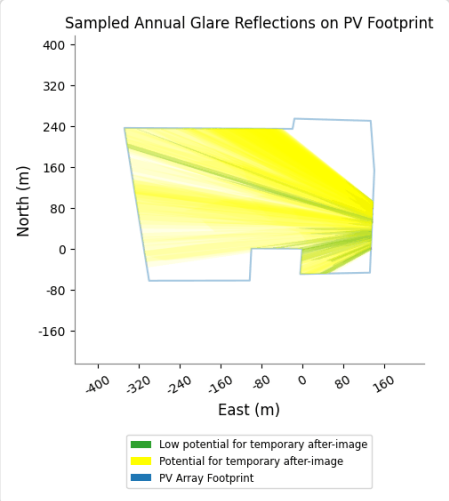


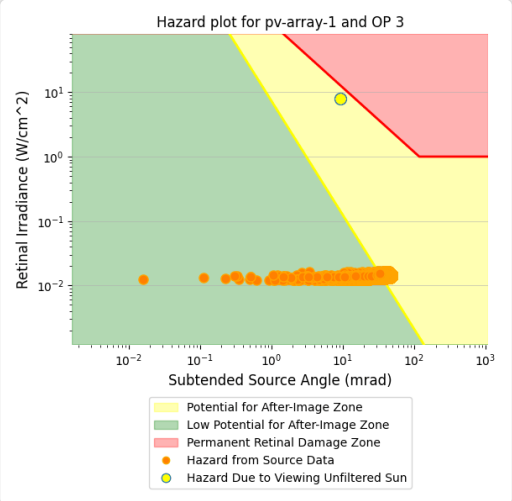
PV array 1 and OP 3

Receptor type: Observation Point
5,645 minutes of yellow glare
1,756 minutes of green glare



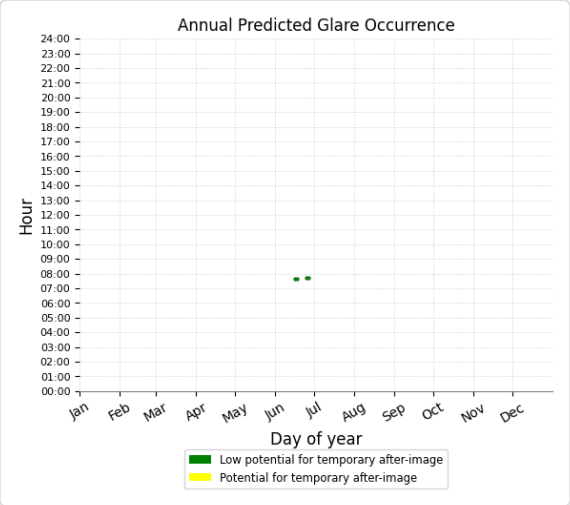


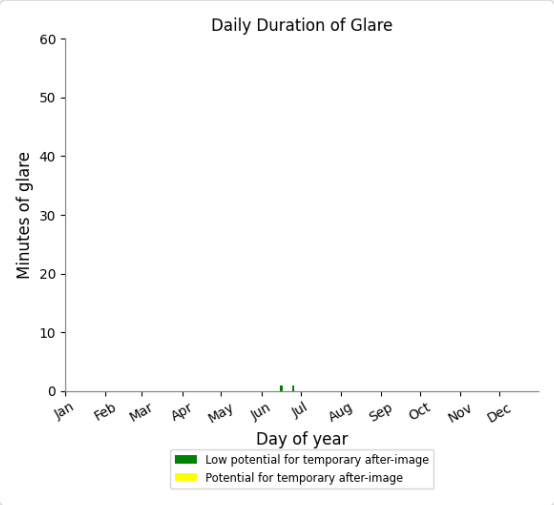


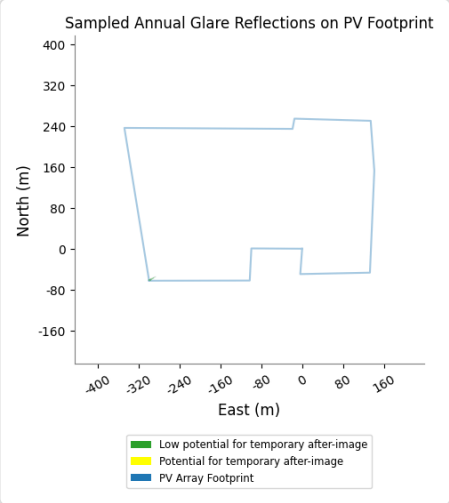


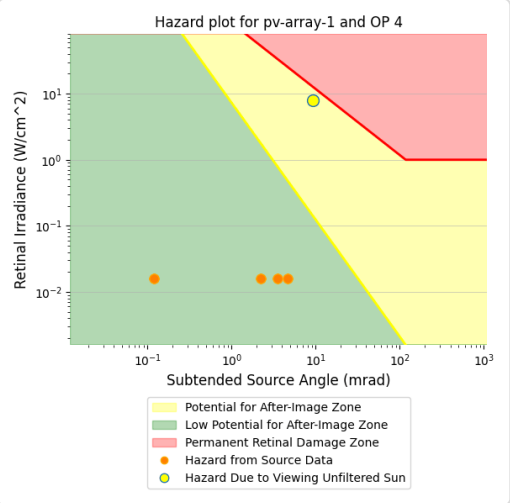
PV array 1 and OP 4

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



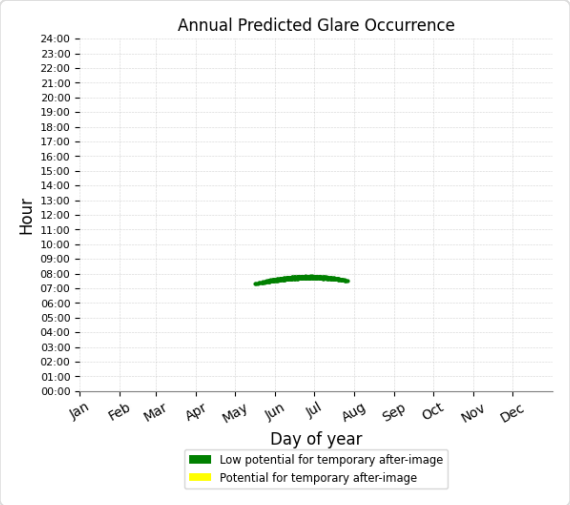


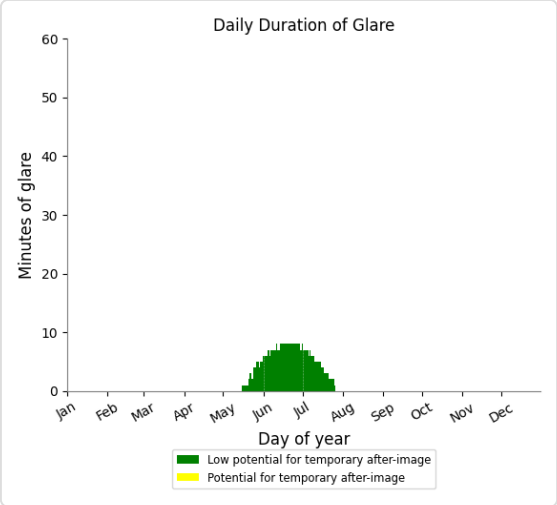


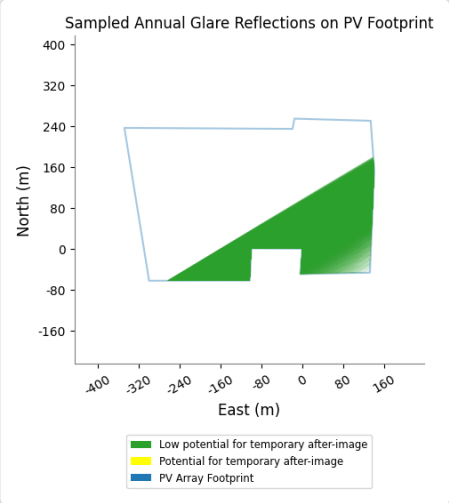


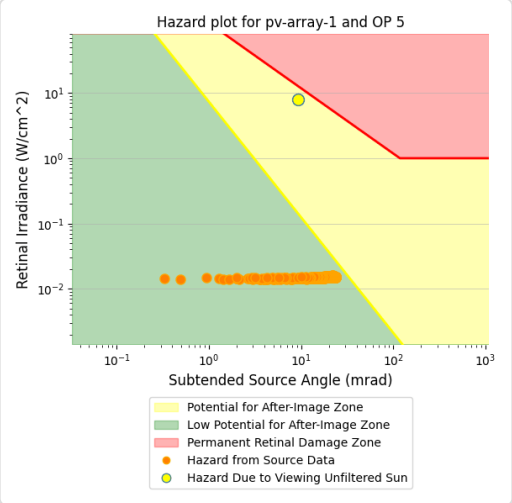
PV array 1 and OP 5

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









PV array 1 and OP 1

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

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):

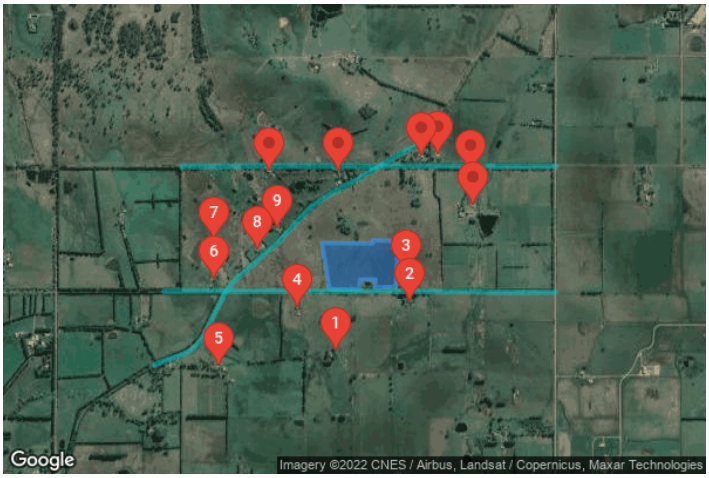
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_0d_2987cmtRACKER**

Client: NGH

Created 01 Nov, 2022
Updated 07 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 78563.13479
Category 1 MW to 5 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 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	7,143	119.0	16,989	283.1	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,495	24.9	12,082	201.4
Otts Ln	0	0.0	0	0.0
Rochford Road	652	10.9	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	1,832	30.5	1,412	23.5
OP 3	2,786	46.4	3,495	58.2
OP 4	0	0.0	0	0.0
OP 5	378	6.3	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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 0.0°
Ground Coverage Ratio: 0.76
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	-37.298372	144.699931	534.73	2.99	537.72
2	-37.298819	144.699889	534.19	2.99	537.18
3	-37.298794	144.701425	538.08	2.99	541.06
4	-37.296997	144.701522	539.97	2.99	542.95
5	-37.296119	144.701442	539.50	2.99	542.48
6	-37.296081	144.699761	540.63	2.99	543.61
7	-37.296261	144.699719	539.81	2.99	542.79
8	-37.296244	144.696011	531.02	2.99	534.00
9	-37.298936	144.696556	532.68	2.99	535.67
10	-37.298933	144.698775	532.57	2.99	535.56
11	-37.298367	144.698811	533.28	2.99	536.27

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	1.50

Glare Analysis Results

Summary of Results

Glare with 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	7,143	119.0	16,989	283.1	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,495	24.9	12,082	201.4
Otts Ln	0	0.0	0	0.0
Rochford Road	652	10.9	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	1,832	30.5	1,412	23.5
OP 3	2,786	46.4	3,495	58.2
OP 4	0	0.0	0	0.0
OP 5	378	6.3	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

PV: PV array 1 potential temporary after-image

Receptor results ordered by category of glare

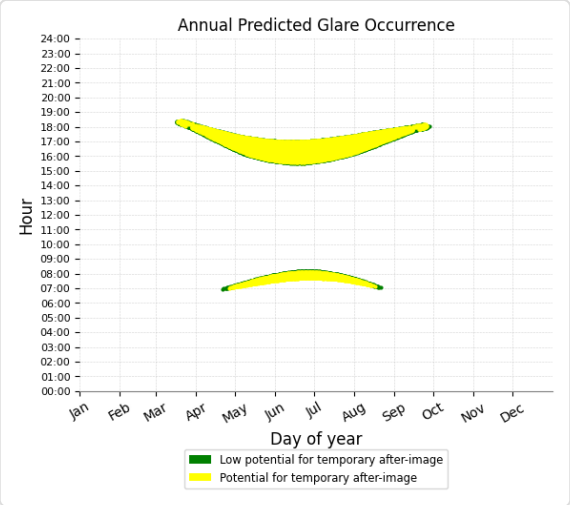
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Cullys Road	1,495	24.9	12,082	201.4
Rochford Road	652	10.9	0	0.0
Collivers Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 2	1,832	30.5	1,412	23.5
OP 3	2,786	46.4	3,495	58.2
OP 5	378	6.3	0	0.0
OP 1	0	0.0	0	0.0
OP 4	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

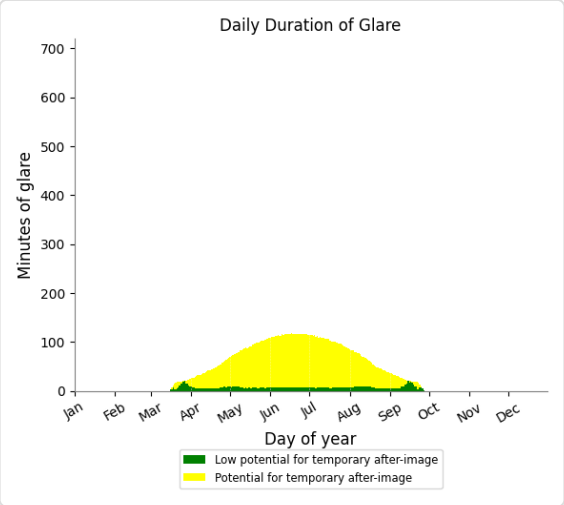
PV array 1 and Cullys Road

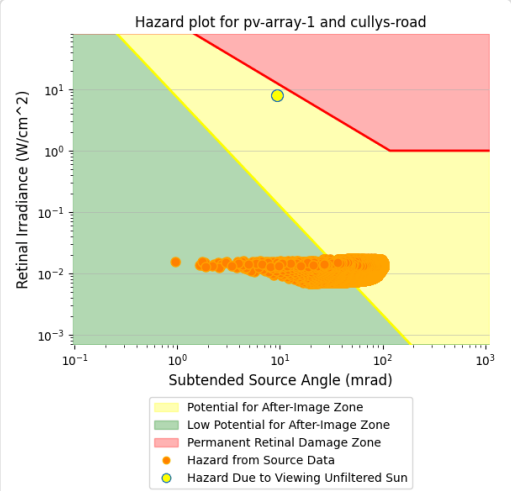
Receptor type: Route

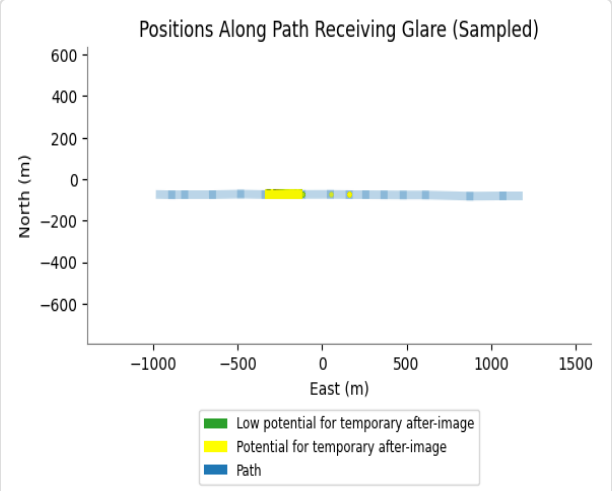
12,082 minutes of yellow glare

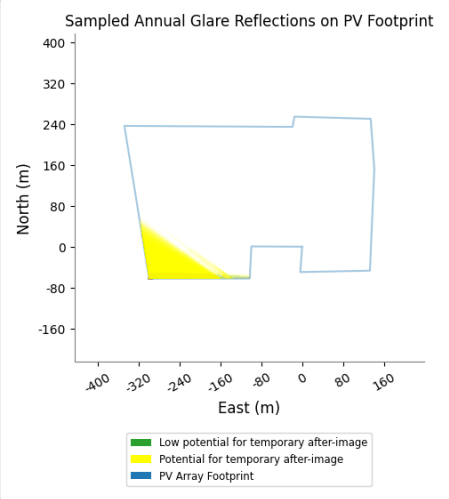
1,495 minutes of green glare





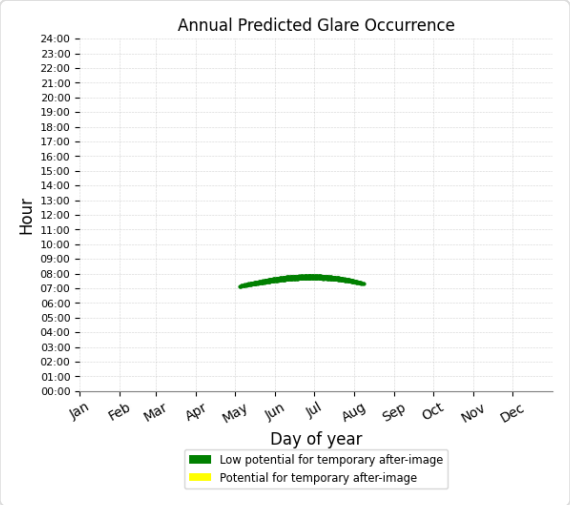


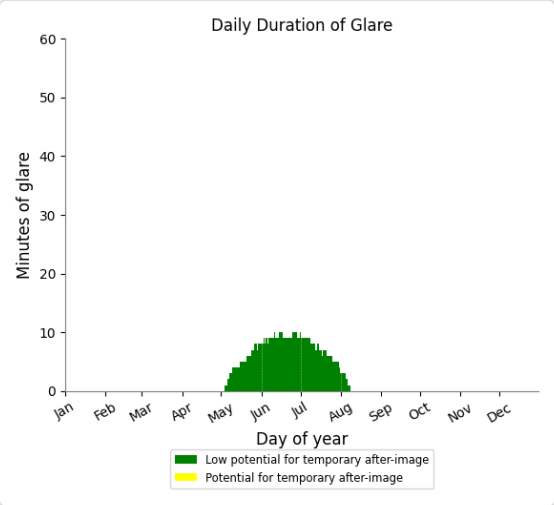


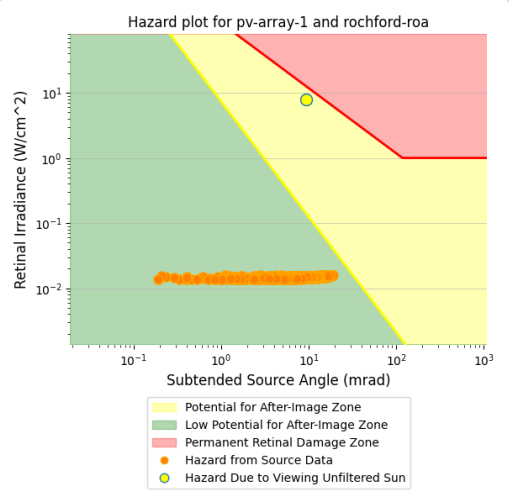


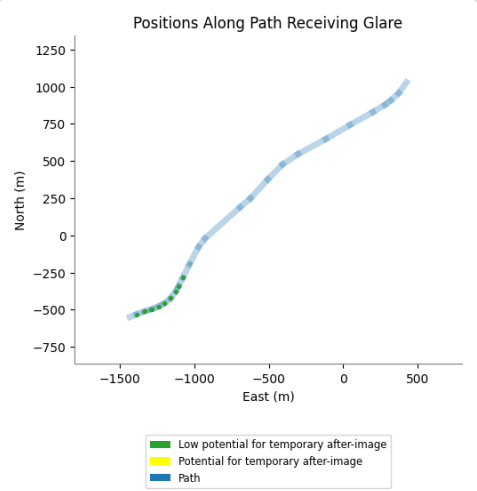
PV array 1 and Rochford Road

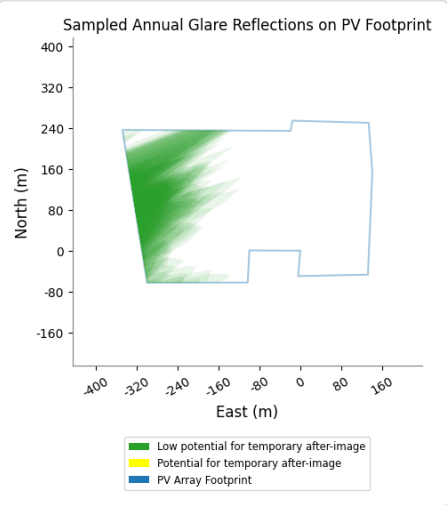
Receptor type: Route
0 minutes of yellow glare
652 minutes of green glare











PV array 1 and Collivers Road

Receptor type: Route

No glare found

PV array 1 and Otts Ln

Receptor type: Route

No glare found

PV array 1 and Whitebridge Road

Receptor type: Route

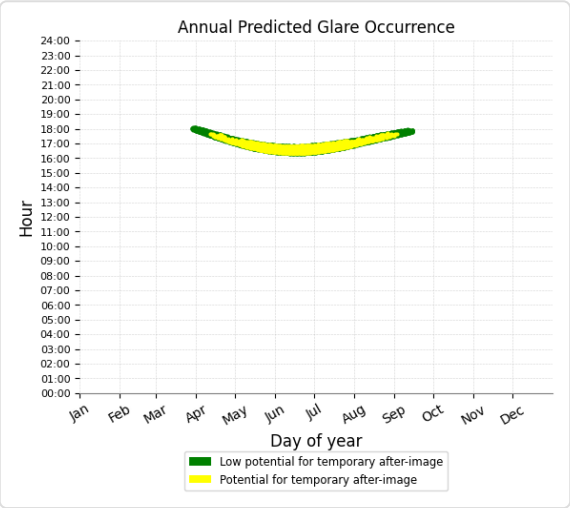
No glare found

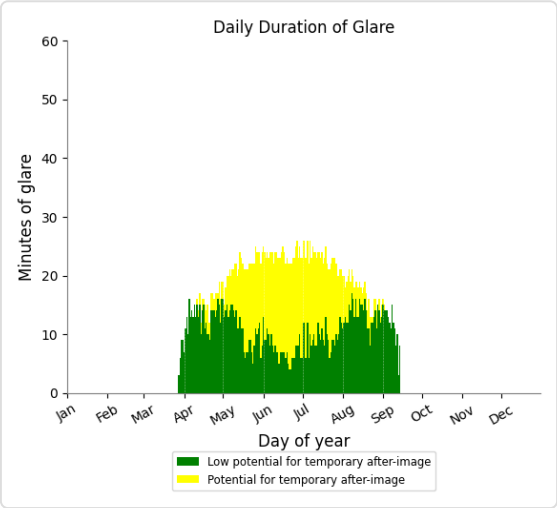
PV array 1 and OP 2

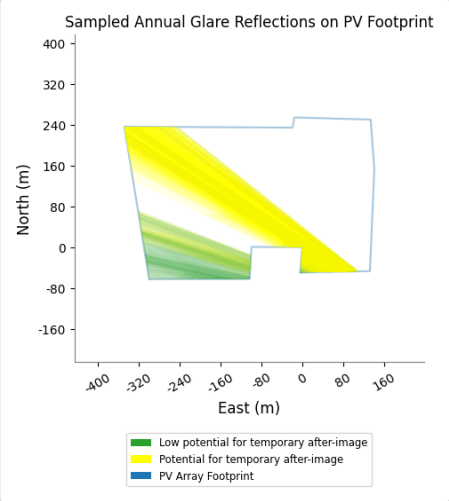
Receptor type: Observation Point

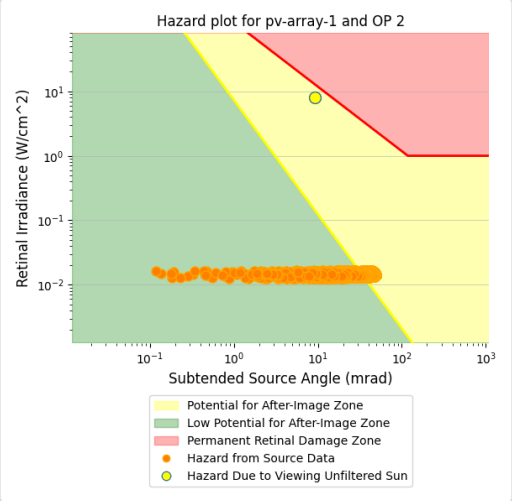
1,412 minutes of yellow glare

1,832 minutes of green glare



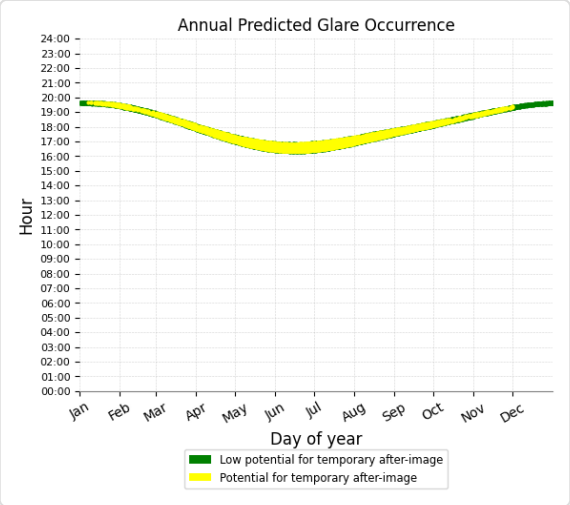


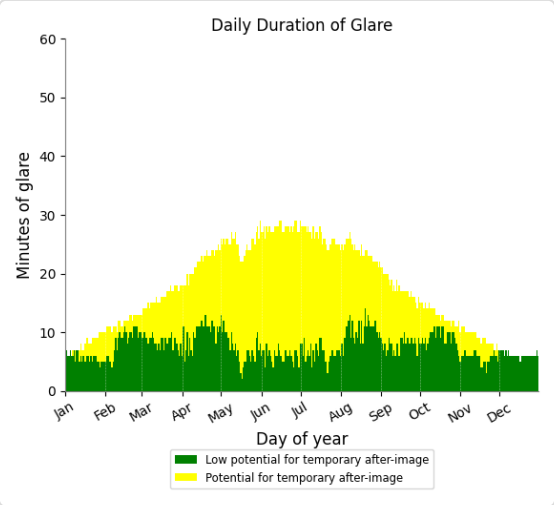


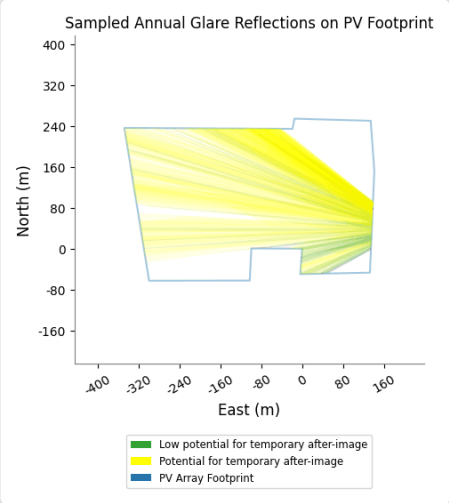


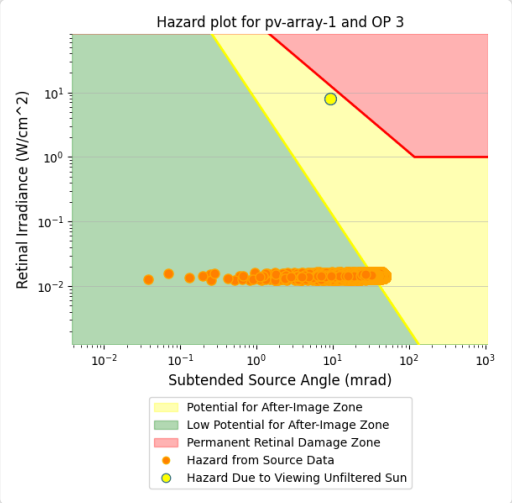
PV array 1 and OP 3

Receptor type: Observation Point
3,495 minutes of yellow glare
2,786 minutes of green glare



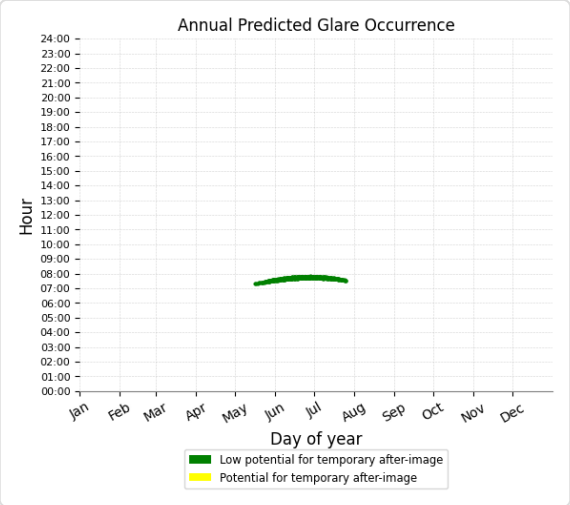


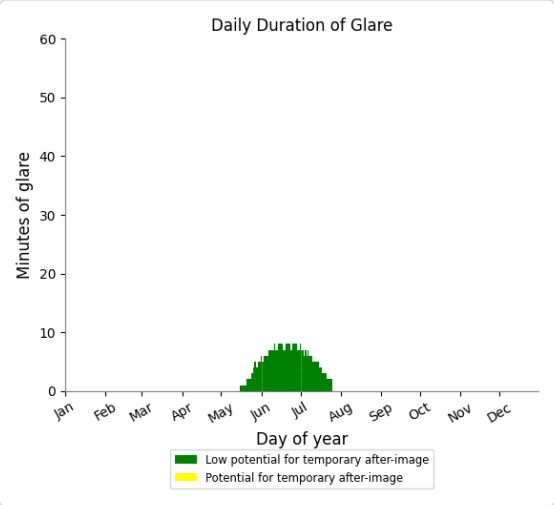


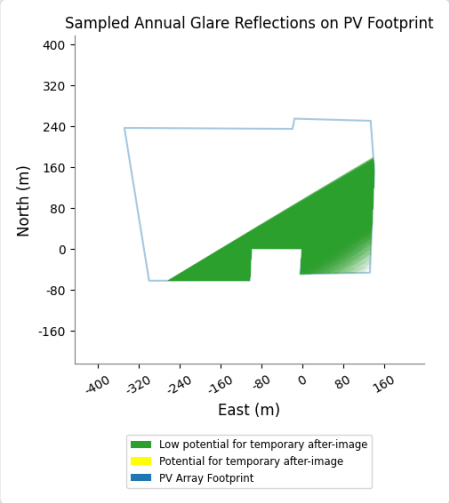


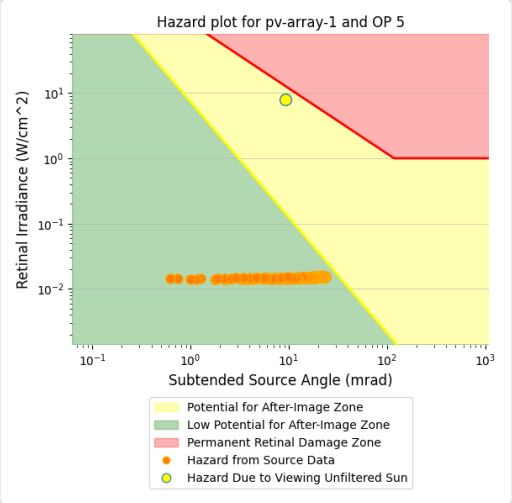
PV array 1 and OP 5

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









PV array 1 and OP 1

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 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

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):

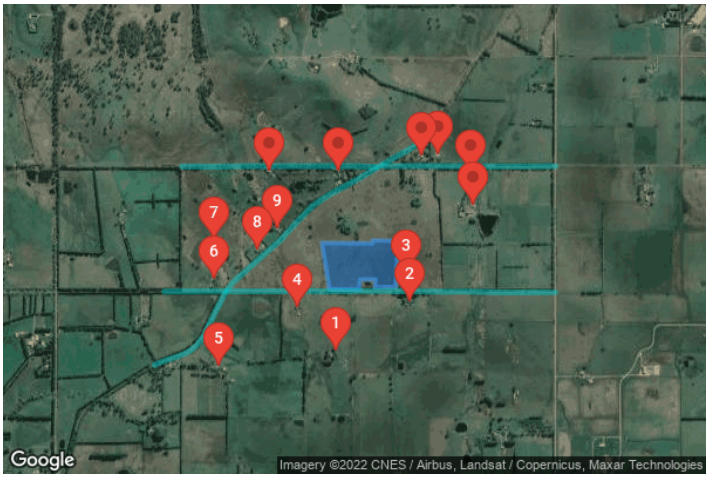
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_5d_2484cmTracker**

Client: NGH

Created 14 Nov, 2022
Updated 14 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 79379.13479
Category 1 MW to 5 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 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	1,281	21.4	4,632	77.2	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,235	20.6	4,632	77.2
Otts Ln	0	0.0	0	0.0
Rochford Road	46	0.8	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.76
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	-37.298372	144.699931	534.73	2.48	537.22
2	-37.298819	144.699889	534.19	2.48	536.67
3	-37.298794	144.701425	538.08	2.48	540.56
4	-37.296997	144.701522	539.97	2.48	542.45
5	-37.296119	144.701442	539.50	2.48	541.98
6	-37.296081	144.699761	540.63	2.48	543.11
7	-37.296261	144.699719	539.81	2.48	542.29
8	-37.296244	144.696011	531.02	2.48	533.50
9	-37.298936	144.696556	532.68	2.48	535.17
10	-37.298933	144.698775	532.57	2.48	535.05
11	-37.298367	144.698811	533.28	2.48	535.77

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	1.50

Glare Analysis Results

Summary of Results

Glare with 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	1,281	21.4	4,632	77.2	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	1,235	20.6	4,632	77.2
Otts Ln	0	0.0	0	0.0
Rochford Road	46	0.8	0	0.0
Whitebridge 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

PV: PV array 1 potential temporary after-image

Receptor results ordered by category of glare

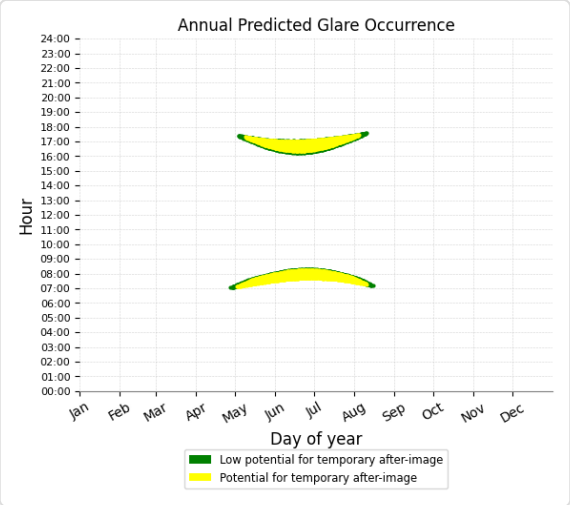
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Cullys Road	1,235	20.6	4,632	77.2
Rochford Road	46	0.8	0	0.0
Collivers Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
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

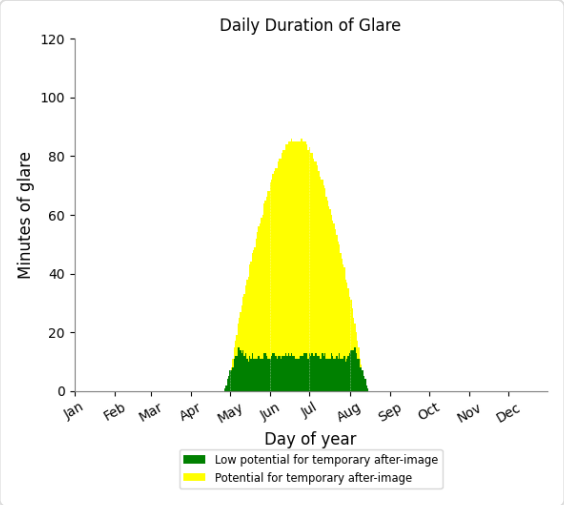
PV array 1 and Cullys Road

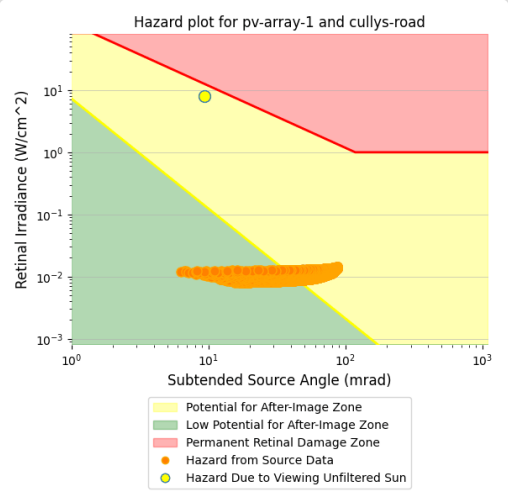
Receptor type: Route

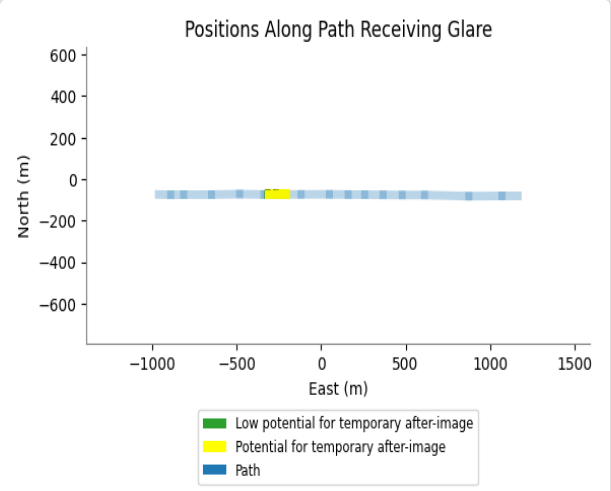
4,632 minutes of yellow glare

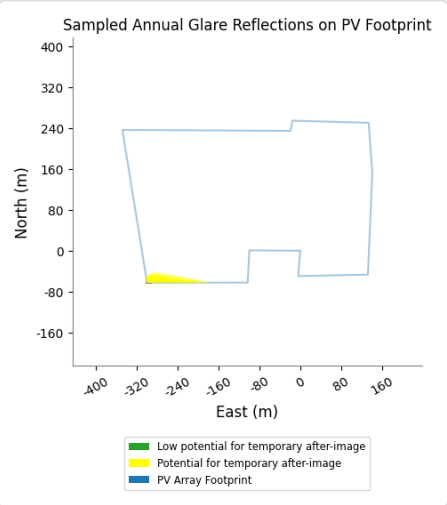
1,235 minutes of green glare





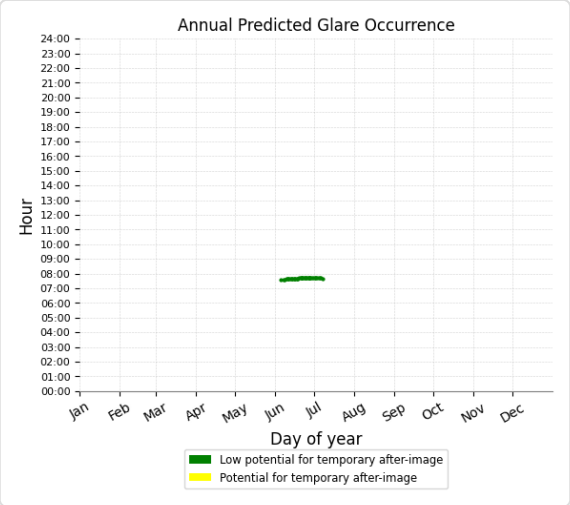


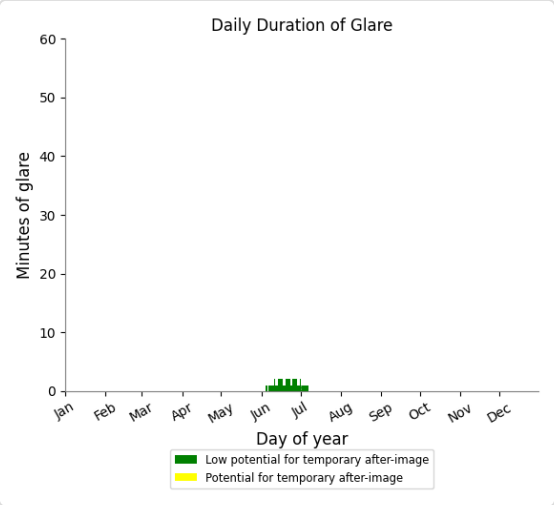


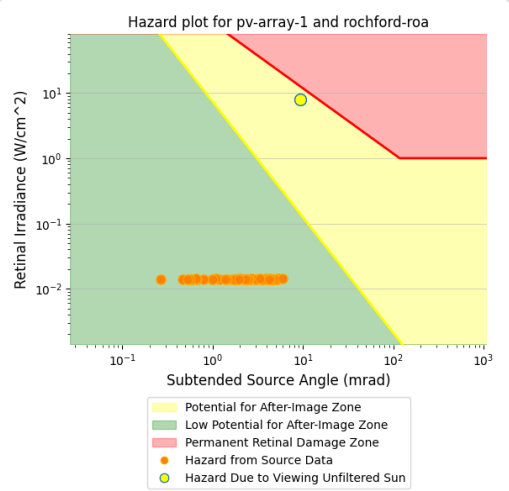


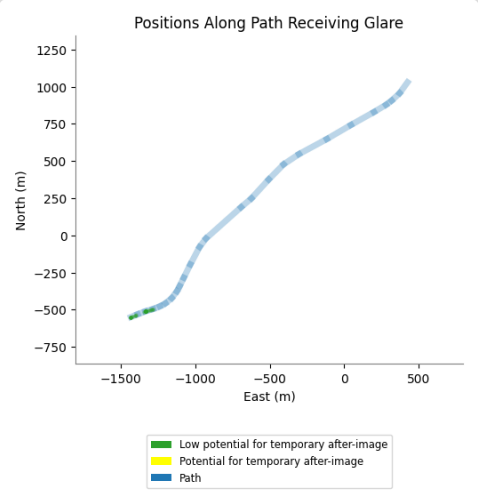
PV array 1 and Rochford Road

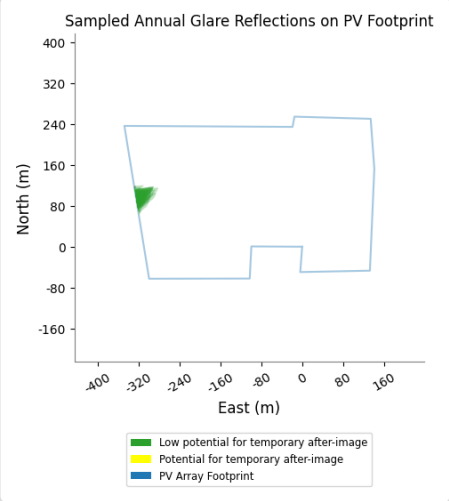
Receptor type: Route
0 minutes of yellow glare
46 minutes of green glare











PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

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):

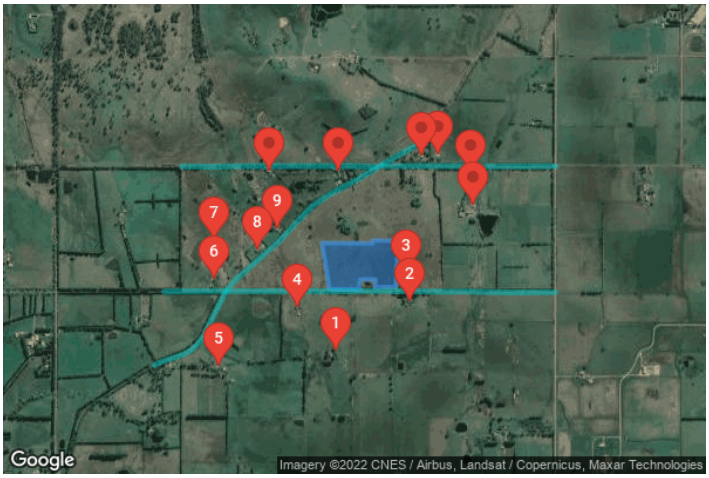
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_5d_2987cmH**

Client: NGH

Created 02 Nov, 2022
Updated 14 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 78643.13479
Category 1 MW to 5 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 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	968	16.1	2,721	45.4	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	930	15.5	2,721	45.4
Otts Ln	0	0.0	0	0.0
Rochford Road	38	0.6	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.75
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	-37.298372	144.699931	534.73	2.99	537.72
2	-37.298819	144.699889	534.19	2.99	537.18
3	-37.298794	144.701425	538.08	2.99	541.06
4	-37.296997	144.701522	539.97	2.99	542.95
5	-37.296119	144.701442	539.50	2.99	542.48
6	-37.296081	144.699761	540.63	2.99	543.61
7	-37.296261	144.699719	539.81	2.99	542.79
8	-37.296244	144.696011	531.02	2.99	534.00
9	-37.298936	144.696556	532.68	2.99	535.67
10	-37.298933	144.698775	532.57	2.99	535.56
11	-37.298367	144.698811	533.28	2.99	536.27

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	1.50

Glare Analysis Results

Summary of Results

Glare with 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	968	16.1	2,721	45.4	-

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
Collivers Road	0	0.0	0	0.0
Cullys Road	930	15.5	2,721	45.4
Otts Ln	0	0.0	0	0.0
Rochford Road	38	0.6	0	0.0
Whitebridge 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

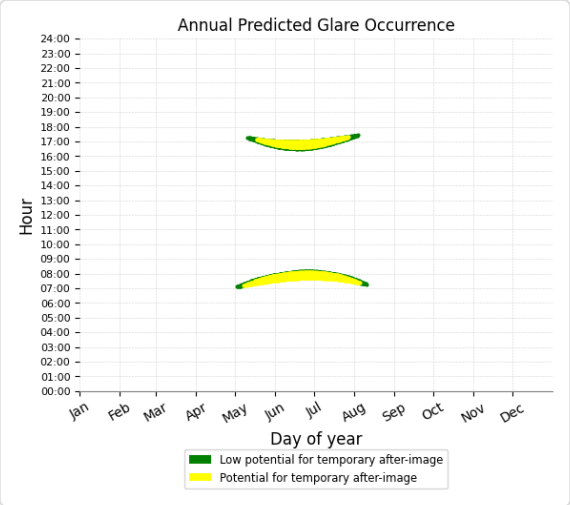
PV: PV array 1 potential temporary after-image

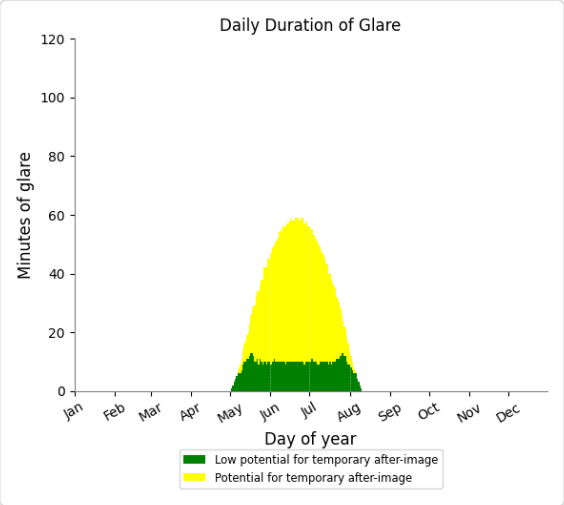
Receptor results ordered by category of glare

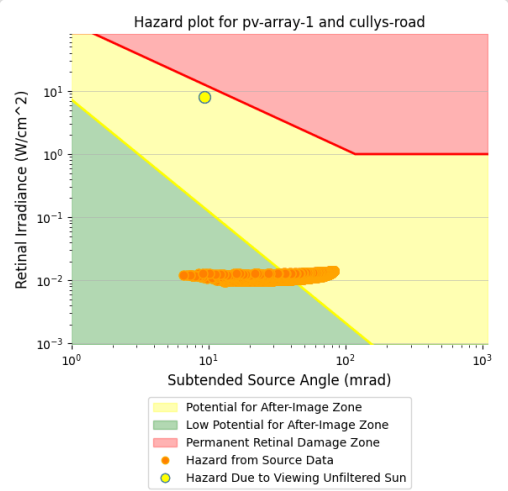
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Cullys Road	930	15.5	2,721	45.4
Rochford Road	38	0.6	0	0.0
Collivers Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Whitebridge Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
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

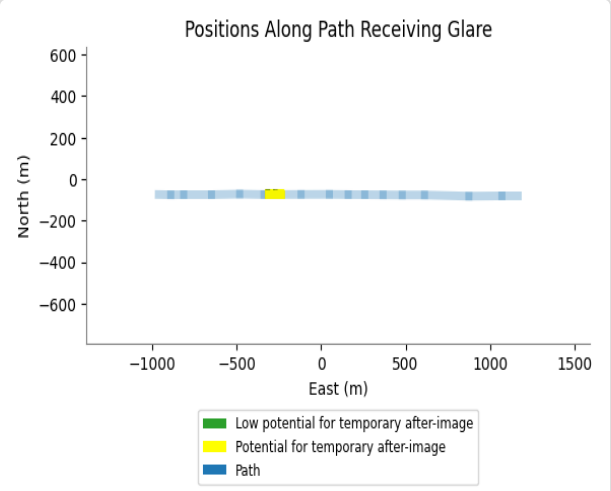
PV array 1 and Cullys Road

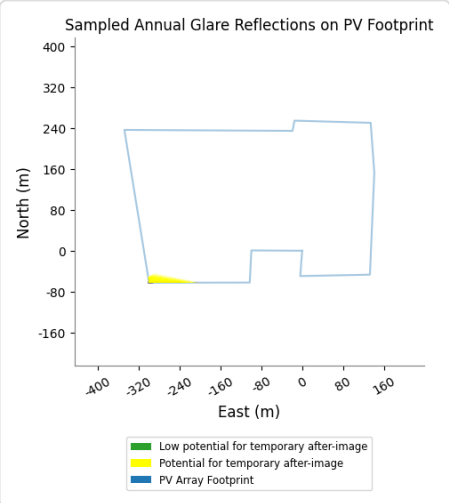
Receptor type: Route
2,721 minutes of yellow glare
930 minutes of green glare





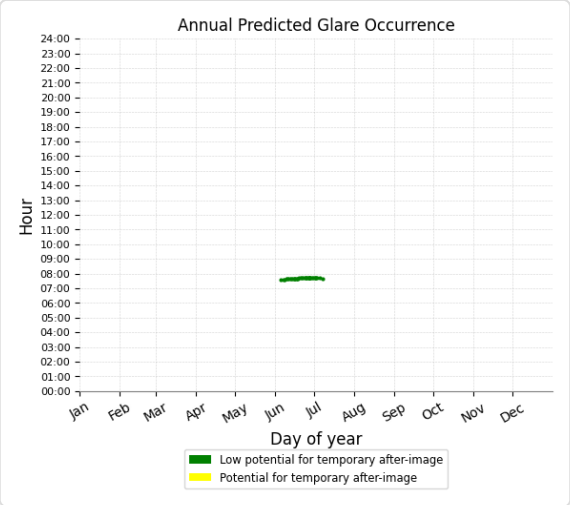


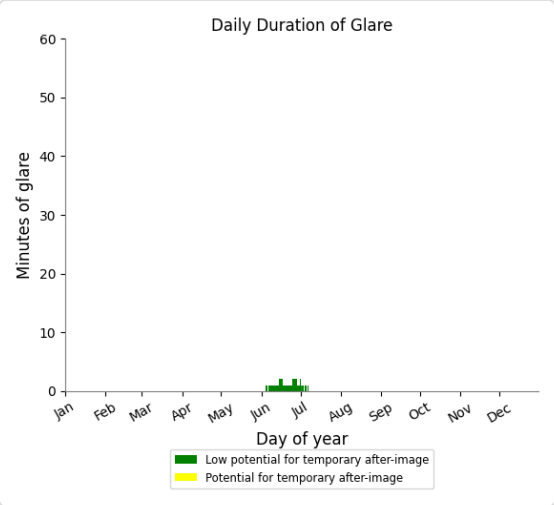


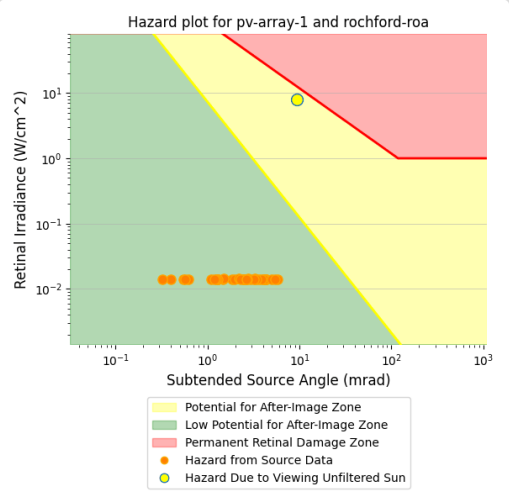


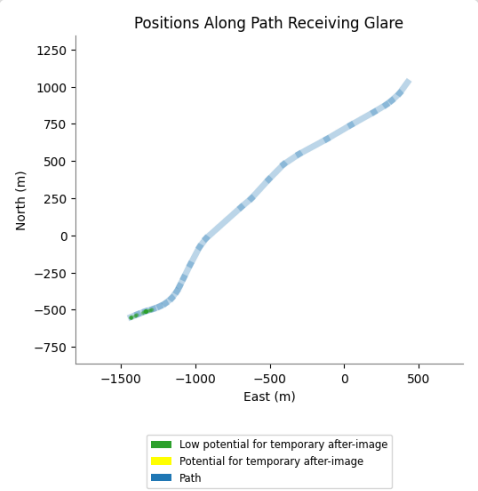
PV array 1 and Rochford Road

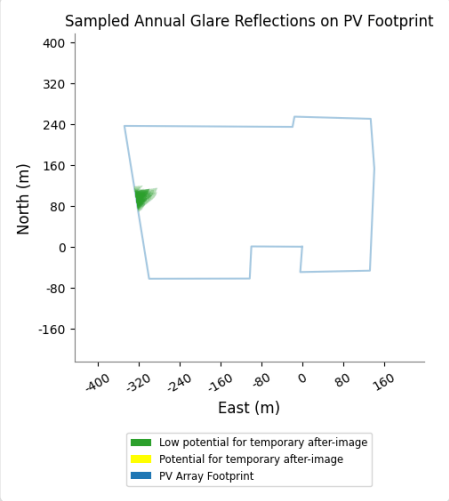
Receptor type: Route
0 minutes of yellow glare
38 minutes of green glare











PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

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 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):

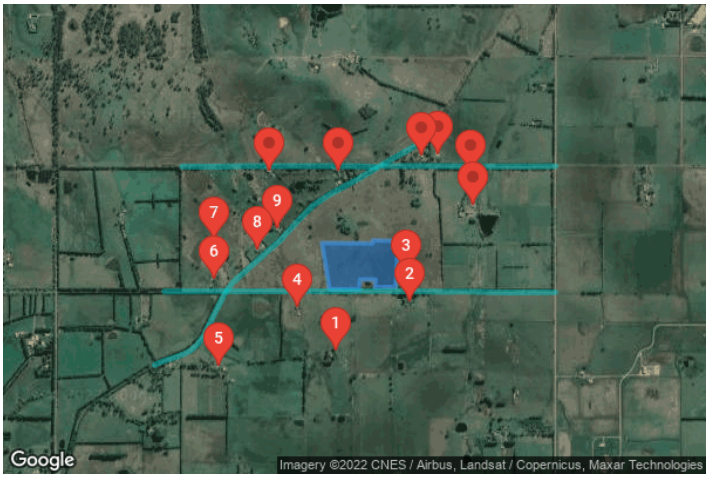
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_22d_2987cmH**

Client: NGH

Created 14 Nov, 2022
Updated 20 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 79380.13479
Category 1 MW to 5 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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 22.0°
Ground Coverage Ratio: 0.75
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	-37.298372	144.699931	534.73	2.48	537.22
2	-37.298819	144.699889	534.19	2.48	536.67
3	-37.298794	144.701425	538.08	2.48	540.56
4	-37.296997	144.701522	539.97	2.48	542.45
5	-37.296119	144.701442	539.50	2.48	541.98
6	-37.296081	144.699761	540.63	2.48	543.11
7	-37.296261	144.699719	539.81	2.48	542.29
8	-37.296244	144.696011	531.02	2.48	533.50
9	-37.298936	144.696556	532.68	2.48	535.17
10	-37.298933	144.698775	532.57	2.48	535.05
11	-37.298367	144.698811	533.28	2.48	535.77

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Cullys Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Rochford Road

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

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):

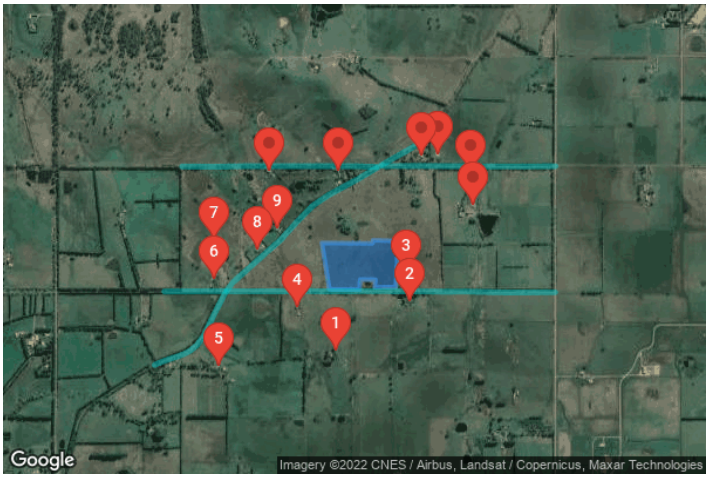
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_22d_2987cmH**

Client: NGH

Created 14 Nov, 2022
Updated 20 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 79380.13479
Category 1 MW to 5 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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 22.0°
Ground Coverage Ratio: 0.75
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	-37.298372	144.699931	534.73	2.99	537.72
2	-37.298819	144.699889	534.19	2.99	537.18
3	-37.298794	144.701425	538.08	2.99	541.06
4	-37.296997	144.701522	539.97	2.99	542.95
5	-37.296119	144.701442	539.50	2.99	542.48
6	-37.296081	144.699761	540.63	2.99	543.61
7	-37.296261	144.699719	539.81	2.99	542.79
8	-37.296244	144.696011	531.02	2.99	534.00
9	-37.298936	144.696556	532.68	2.99	535.67
10	-37.298933	144.698775	532.57	2.99	535.56
11	-37.298367	144.698811	533.28	2.99	536.27

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Cullys Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Rochford Road

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

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):

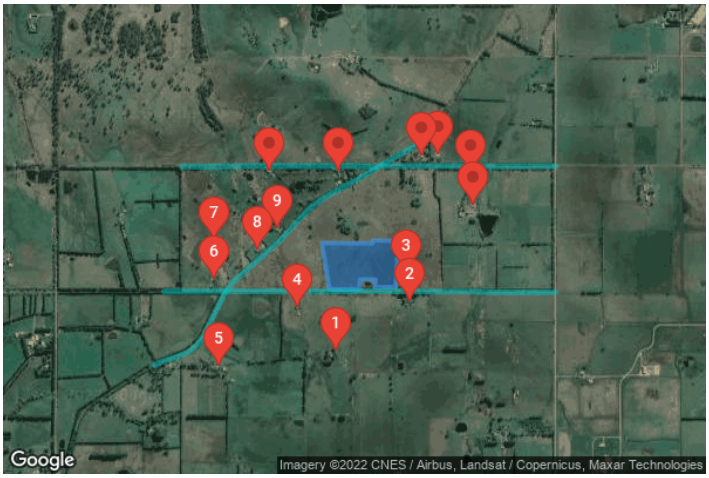
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_45d_2484cmTracker**

Client: NGH

Created 14 Nov, 2022
Updated 14 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 79384.13479
Category 1 MW to 5 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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 45.0°
Ground Coverage Ratio: 0.76
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	-37.298372	144.699931	534.73	2.48	537.22
2	-37.298819	144.699889	534.19	2.48	536.67
3	-37.298794	144.701425	538.08	2.48	540.56
4	-37.296997	144.701522	539.97	2.48	542.45
5	-37.296119	144.701442	539.50	2.48	541.98
6	-37.296081	144.699761	540.63	2.48	543.11
7	-37.296261	144.699719	539.81	2.48	542.29
8	-37.296244	144.696011	531.02	2.48	533.50
9	-37.298936	144.696556	532.68	2.48	535.17
10	-37.298933	144.698775	532.57	2.48	535.05
11	-37.298367	144.698811	533.28	2.48	535.77

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Cullys Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Rochford Road

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

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):

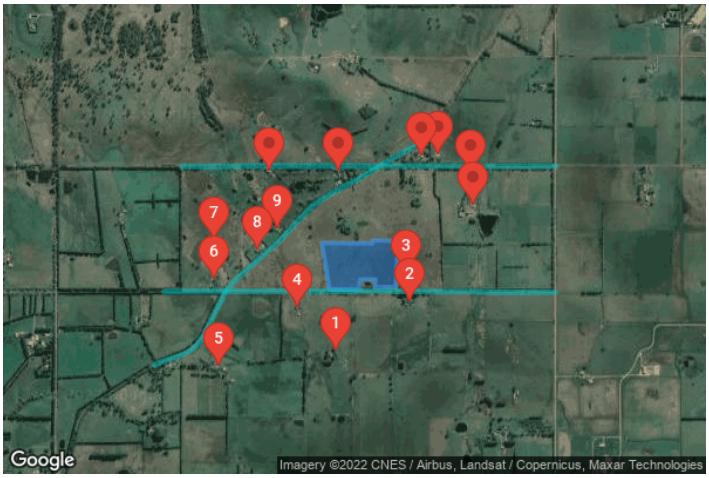
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FORGESOLAR GLARE ANALYSIS

Project: **2237 LANCEFIELD**
Site configuration: **Lancefield Solar Farm 20221102_45d_2987cmH**

Client: NGH

Created 14 Nov, 2022
Updated 14 Nov, 2022
Time-step 1 minute
Timezone offset UTC10
Site ID 79381.13479
Category 1 MW to 5 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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 45.0°
Ground Coverage Ratio: 0.75
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	-37.298372	144.699931	534.73	2.99	537.72
2	-37.298819	144.699889	534.19	2.99	537.18
3	-37.298794	144.701425	538.08	2.99	541.06
4	-37.296997	144.701522	539.97	2.99	542.95
5	-37.296119	144.701442	539.50	2.99	542.48
6	-37.296081	144.699761	540.63	2.99	543.61
7	-37.296261	144.699719	539.81	2.99	542.79
8	-37.296244	144.696011	531.02	2.99	534.00
9	-37.298936	144.696556	532.68	2.99	535.67
10	-37.298933	144.698775	532.57	2.99	535.56
11	-37.298367	144.698811	533.28	2.99	536.27

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291777	144.713106	510.51	2.40	512.91
2	-37.291794	144.710327	507.98	2.40	510.38
3	-37.291794	144.708310	505.71	2.40	508.11
4	-37.291777	144.705906	514.58	2.40	516.98
5	-37.291760	144.702781	534.87	2.40	537.27
6	-37.291768	144.701148	531.12	2.40	533.52
7	-37.291774	144.700641	530.04	2.40	532.44
8	-37.291742	144.700435	530.01	2.40	532.41

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299044	144.689079	529.42	2.40	531.82
2	-37.299055	144.689902	527.76	2.40	530.16
3	-37.299051	144.690766	525.00	2.40	527.40
4	-37.299051	144.692622	526.90	2.40	529.30
5	-37.299025	144.694502	530.28	2.40	532.68
6	-37.299046	144.696122	533.00	2.40	535.40
7	-37.299040	144.698598	532.34	2.40	534.74
8	-37.299037	144.700489	534.82	2.40	537.22
9	-37.299049	144.701744	539.06	2.40	541.46
10	-37.299051	144.702850	537.72	2.40	540.12
11	-37.299057	144.704071	532.40	2.40	534.80
12	-37.299065	144.705350	525.39	2.40	527.79
13	-37.299065	144.706838	520.21	2.40	522.61
14	-37.299117	144.709798	538.31	2.40	540.71
15	-37.299104	144.712002	537.25	2.40	539.65
16	-37.299104	144.713086	537.46	2.40	539.86

Name: Otts Ln
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.299041	144.688902	529.86	2.40	532.26
2	-37.299037	144.688495	531.01	2.40	533.41
3	-37.299045	144.686971	537.30	2.40	539.70
4	-37.299058	144.685764	544.11	2.40	546.51
5	-37.299058	144.684471	557.48	2.40	559.88

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.303323	144.683760	581.28	2.40	583.68
2	-37.303152	144.684269	577.81	2.40	580.21
3	-37.302977	144.684854	572.88	2.40	575.28
4	-37.302832	144.685444	567.69	2.40	570.09
5	-37.302670	144.685959	563.33	2.40	565.73
6	-37.302491	144.686377	560.31	2.40	562.71
7	-37.302171	144.686860	554.74	2.40	557.14
8	-37.301761	144.687246	548.06	2.40	550.46
9	-37.301445	144.687461	543.67	2.40	546.07
10	-37.300937	144.687772	538.37	2.40	540.77
11	-37.300131	144.688271	532.48	2.40	534.88
12	-37.299073	144.688974	529.78	2.40	532.18
13	-37.298560	144.689458	526.93	2.40	529.33
14	-37.296665	144.692118	526.17	2.40	528.57
15	-37.296128	144.692907	525.90	2.40	528.30
16	-37.294980	144.694221	527.46	2.40	529.86
17	-37.294068	144.695348	528.73	2.40	531.13
18	-37.293445	144.696517	530.97	2.40	533.37
19	-37.292532	144.698631	534.35	2.40	536.75
20	-37.291680	144.700457	529.91	2.40	532.31
21	-37.290894	144.702212	527.51	2.40	529.91
22	-37.290455	144.703124	520.76	2.40	523.16
23	-37.290202	144.703548	517.69	2.40	520.09
24	-37.289751	144.704154	514.02	2.40	516.42
25	-37.289093	144.704753	510.58	2.40	512.98

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.291823	144.700014	530.67	2.40	533.07
2	-37.291785	144.698721	533.31	2.40	535.71
3	-37.291776	144.697219	533.11	2.40	535.51
4	-37.291778	144.695107	531.16	2.40	533.56
5	-37.291778	144.692392	530.24	2.40	532.64
6	-37.291778	144.690171	517.36	2.40	519.76
7	-37.291805	144.688487	516.35	2.40	518.75
8	-37.291796	144.685772	521.38	2.40	523.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.302554	144.697070	538.07	1.50
OP 2	2	-37.299634	144.702466	537.98	1.50
OP 3	3	-37.298030	144.702255	539.93	1.50
OP 4	4	-37.300008	144.694238	530.26	1.50
OP 5	5	-37.303406	144.688473	560.62	1.50
OP 6	6	-37.298376	144.688112	531.90	1.50
OP 7	7	-37.296119	144.688120	528.29	1.50
OP 8	8	-37.296630	144.691341	524.22	1.50
OP 9	9	-37.295398	144.692816	524.56	1.50
OP 10	10	-37.292094	144.692212	527.20	1.50
OP 11	11	-37.292048	144.697252	532.80	1.50
OP 12	12	-37.291222	144.703357	527.00	1.50
OP 13	13	-37.291156	144.704529	519.29	1.50
OP 14	14	-37.292213	144.706894	511.67	1.50
OP 15	15	-37.294094	144.707090	513.56	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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge 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

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
Collivers Road	0	0.0	0	0.0
Cullys Road	0	0.0	0	0.0
Otts Ln	0	0.0	0	0.0
Rochford Road	0	0.0	0	0.0
Whitebridge Road	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

PV array 1 and Collivers Road

Receptor type: Route
No glare found

PV array 1 and Cullys Road

Receptor type: Route
No glare found

PV array 1 and Otts Ln

Receptor type: Route
No glare found

PV array 1 and Rochford Road

Receptor type: Route
No glare found

PV array 1 and Whitebridge 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

Assumptions

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