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Hillston Solar Farm

Glint and Glare Assessment

Hillston Way Solar Farm

Glint and Glare Assessment

Prepared for
NGH Consulting on behalf of Risen Energy (Australia) Pty Ltd

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moir landscape architecture

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

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

Executive Summary

Moir Landscape Architecture (Moir LA) have been engaged by NGH consulting on behalf of Risen Energy Pty Ltd (the proponent) to provide a Glint and Glare Assessment for the proposed Hillston Solar Farm (the Project). The report will accompany the Environmental Impact Statement (EIS) prepared for the Project.

Project is located approximately 3.5 kilometres (km) south of Hillston (NSW) in Carrathool Shire Local Government Area (LGA).

The Glint and Glare Assessment has been prepared in accordance with the Department of Planning and Environment (DPE) (now Department of Planning, Housing and Infrastructure (DPHI) Large-Scale Solar Energy Guideline (August 2022) (referred to hereafter as 'the Guideline').

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

- Receptors within 3 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 5 km of the proposed solar array.

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

A total of 19 Private Receptors with a line of sight to the Project and two (2) Public Receptors within 3 km of the Project were identified as sensitive Observation Points (OP). Based on the desktop assessment no potential "Yellow" glare were investigated for Private and Public Receptors.

However, potential glare concerns were identified for 2 Road Receptors and 1 Rail Receptor. Racecourse Road, Kidman Way, and the Temora Roto RailWay will experience 'Yellow' glare from the Project.

One (1) landing strip was identified within a 5 km radius north west of the Project. As part of the assessment two flight paths were identified for each strip. Based on the desktop assessment no potential "Yellow" glare identified for any of these flight paths.

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

The Project has proactively implemented a 5 m landscaping screening buffer along the northern boundary of the PV arrays, to address the potential glare associated with the Project for the nearby receptors.

Principles for mitigation, to reduce potential glare have been discussed in detail in this report in accordance with the *Guideline.*

1.0 Introduction

1.1 The purpose of this report

The Hillston Solar Farm (the Project) is a Regionally Significant Development (RSD) located in Carrathrool Shire Council. This report has been prepared in response to the request from Carrathool Shire Council 'to prepare a glint and glare report in accordance with the Solar Glare Hazard Analysis Tool (SGHAT 3.0) in conjunction with a viewshed analysis'. This report refers to the methodology and performance objectives outlined in the Large-Scale Solar Energy Guideline, 2023, to assist in establishing a baseline for assessment and evaluation.

Glint is generally defined as a momentary flash of bright light while glare can be defined as continuous source of excessive brightness proportionates 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 (DEP (now DPHI), 2022). Assessments must 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).

The performance objectives as the Guideline for Residential Receivers, Road and Rail Receivers and Aviation Receivers are outlined in each of the receiver assessments.

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 and are as follows:

1. **Solar panels 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. **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

Carrathool Shire Council has requested a *"Glint and Glare Assessment Report utilising the Solar Glare Hazard Analysis Tool (SGHAT 3.0) in conjunction with a viewshed analysis".* To assist in establishing a baseline for assessment and evaluation, this report has been prepared in accordance with the Solar Guideline. **Table 1** provides an outline of the stages of the report.

The objective of the assessment as to assess the potential glint and glare resulting from the Project and provide recommendations to reduce potential impacts to ensure there is no significant risk to motorists / pilots and nuisance is minimised at residences.

Report Structure	
Requirements for Glint and Glare Assessment:	**Addressed in report:**
A justification for excluding any modeled glare results because they would be insignificant due to the size, position and luminance of the glare source or high ambient luminance.	**Refer to:** **Section 2.0: Study Methodology**
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 receptor	**Refer to:** **Section 4.0: Residential Receptors** (Assess all residential receptors within 3 km of the proposed solar array that have a line of sight.) **Section 5.0: Road and Rail Receptors** (Assess all roads and rail lines within 1 km of the proposed solar array.) **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.)
Identification of existing vegetation or built structures and a quantitative assessment of whether these features would eliminate or reduce the modeled impacts.	**Refer to:** **Section 7.0: Performance Objectives**
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 neighbor agreements with landowners if all other measures have been exhausted.	**Refer to:** **Section 8.0: Mitigation Recommendations**

Table 1 Overview of Assessment Requirements

2.0 Study Method

2.1 Assessment Methodology

Moir LA have undertaken this Glint and Glare Assessment utilising Solar Glare Hazard Analysis Tool (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 (does not take into account intervening elements such as vegetation and built structures).

2.2 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 throughout 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 with the maximum height of 2.95 m, capable of rotating to a maximum of 60° have been considered to indicate a full rotational range of 120° for this analysis. The trackers are oriented north south with a maximum pitch distance of 7 m. Glare modelling has been conducted to correspond to maximum 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). (Refer to **Image 1**)

$$\text{GCR} = \frac{L}{R}$$

For this assessment GCR is calculated considering L = 2.834 m and R = 7 m. The resulting GCR = 0.40

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

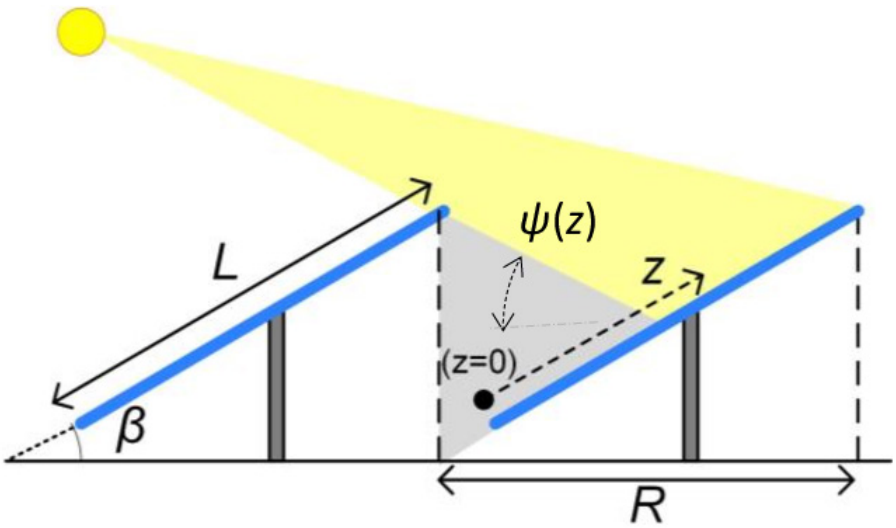


Image 1 Ground Coverage Ratio Calculations (Doubleday et al. 2016)

2.3 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. (Refer to **Image 2**).

The SGHAT tool uses a simplified model of backtracking to avoid shading. Single-axis trackers follow the movement of the sun as it moves east to west throughout the day. Yields are maximised, and light reflection is minimised when panels are directly facing the sun. In times when the sun is not in the tracking range, it is assumed that the panels continuously ‘backtrack’ to their resting angle of 0° (horizontal) over the night . 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.

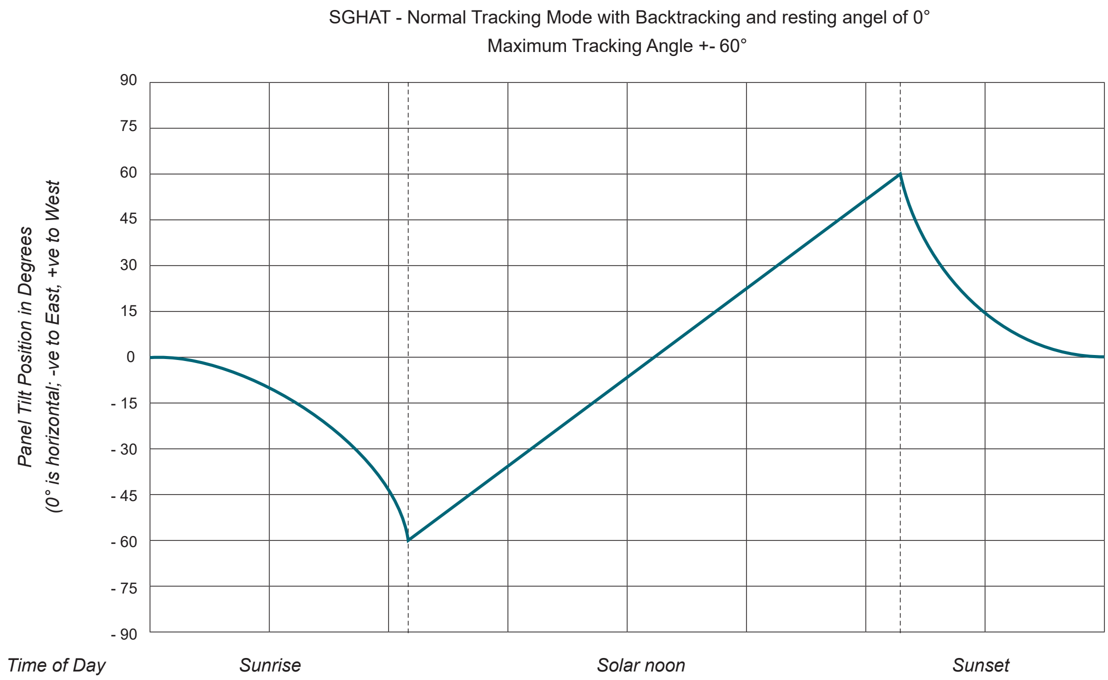
Variable angles of incidence of the sun relative to the panels may occur when the tracking system is performing a backtracking operation, and this variation is somewhat represented by SGHAT software in its update of 2022.

‘Shade-Slope’ backtracking function within the SGHAT tool considers the lowest possible panel rotation angle during backtracking. Therefore, 0° resting angle option is modelled. 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 however, that this backtracking modelling is not a realistic representation of how a backtracking technique would work in actuality but gives an indication of the potential glare of shifting the PV panels away from the sun after the maximum tilt is reached.

For the purposes of the assessment, the assumptions for backtracking in relation to the Project is as follow:

- Normal tracking with backtracking and a night time stowing angle of 0° - to represent a worst-case scenario for the Project. In this case, the panels move between the operational range (maximum tilt).



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0° Resting Angle

Image 2 Normal Tracking with Backtracking and Resting Angle of 0° (2023)

3.0 Project Overview

3.1 Site Context

The Project is situated at 10738 Kidman Way, Hillston, around 3.5 km south of Hillston (NSW) in Carrathool Shire LGA as shown in **Figure 1**.

The Project involves the operation of a 5 Megawatt (MW) solar farm, with a Battery Energy Storage System (BESS) ranging about 5 MW/10 MWh and the necessary infrastructure to connect it to the existing 33 kV line parallel to the northern boundary of Lot 63. It will cover an area of roughly 251.9 (ha) with a proposed development footprint of around 17.9 (ha).

The Project will be accessible via Norwood Lane, through The Spring Road. It is situated approximately 800 meters from the eastern boundary of the existing Hillston Solar Farm. The regional context and location of the Project can be seen in **Figure 1.**

Figure 1 Project Site Context (Map Source: GoogleEarth, 2023)

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 alloy steel frame (Risen Energy, 2024).

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 maximum tracker height not exceeding 1.72m when facing at the highest angle.

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

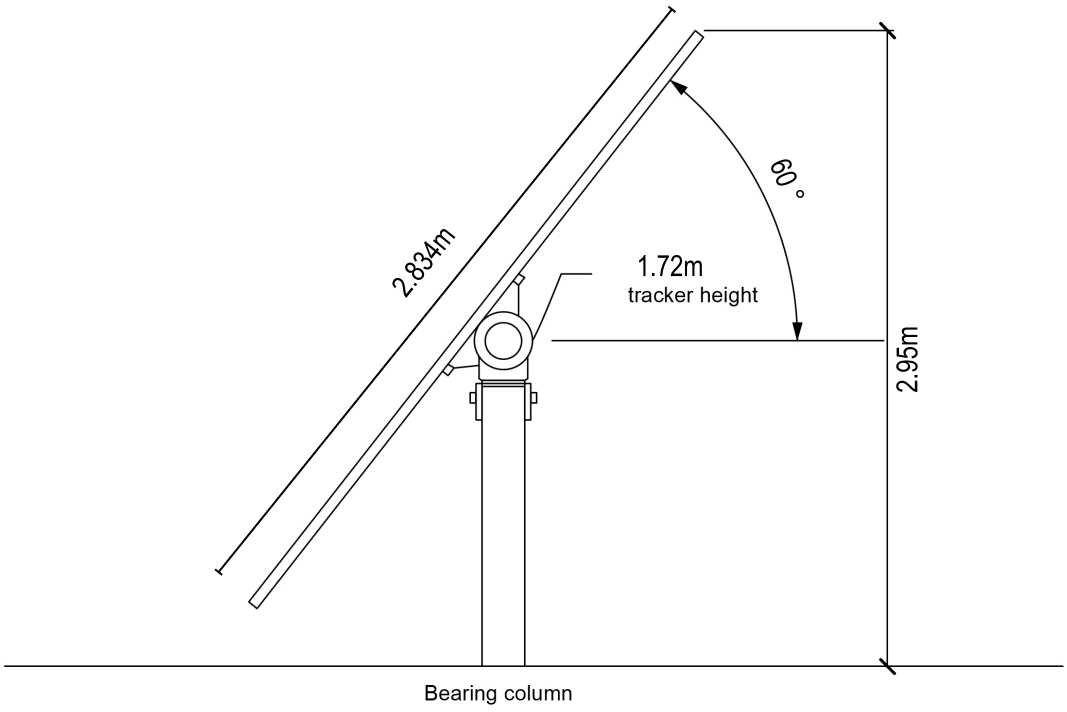


Figure 2 PV Parameters utilised for assessment (provided by Risen Energy)

General Solar PV system inputs:			
Input Data	**Units**	**Value**	**Comments**
Time Zone	UTC	+10	NSW 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 Risen Energy.
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°	Panels following the Sun, to represent backtracking and after dark stowing angles
Maximum Tracker Height	Metres	1.72m	Provided by the Risen Energy.
Backtracking	-	Shade-Slope	Provided by the Risen Energy.
Ground Coverage Ration	-	0.40	Ratio of the Array length to the pitch distance.

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. The rows of modules will be spaced approximately 7 m apart to ensure no shading occurs and allows for ease of access for maintenance purposes (Refer to **Table 2**).

Figure 3 PV Array Areas (Map Source: ESRI, 2023)

4.0 Private Receptors

4.1 Overview of methodology

Table 3 provides an overview of the scope, methodology and performance objectives for assessment of glint and glare on residential receptors.

Glint and Glare Requirements - Private Receptors		
Scope	**Methodology**	**Performance Objective**
All residential receptors within 3 km of the proposed solar array that have a line of sight. Representative viewpoints may be used for residential receptors that are clustered together.	**Analysis of the daily and yearly glare impacts in minutes.** **All residential receptors must be assessed at a height of 1.5 m above ground level.**	**Refer to Table 4.**
Note: Modelling for residential receptors is calculated on a receptor height of 1.5 m AGL.		

Table 3. Residential Receptors Assessment Requirements (Source: DPE(now DPHI), 2022)

Impact rating and performance objectives for glare impacts to residential		
High Glare Impact	**Moderate Glare Impact**	**Low Glare Impact**
> 30 minutes per day **> 30 hours per year**	**< 30 minutes per day** **< 30 hours per year**	**< 10 minutes per day** **< 10 hours per year**
Significant amount of glare that should be avoided	*Implement mitigation measures to reduce impacts as far as practicable*	*No mitigation required*

Table 4. Residential Receptor Impact Rating and Performance Objectives (Source: DPE (now DPHI), 2022)

4.2 Private and Public Receptors

During the desktop assessment, a viewshed analysis was conducted to identify any Private or Public Receptors within 3 km of the Project.

In accordance with the Guidelines, representative viewpoints have been used for residential receivers that are clustered together. Representative receptors were selected to provide a conservative assessment of the residential cluster where possible.

A total of 19 non-associated Private Receptors were found with a direct a line of sight to the Project. Out of these 19, 17 were free-standing rural Private Receptors while two (2) were representative receptors from the town of Hillston. (Refer to **Figure 4**)

In addition to the Private Receptors, two (2) Public Receptor locations were identified within 3 km of the Project. These locations include Hillston Cemetery and Hillston Show Ground (Refer to **Figure 4**).

Figure 4 Residential Receptors (Map Source: ESRI, 2023)

Private Receptor	Address	Coordinates	Elevation	Distance to the nearest solar panel	Yellow Glare (Hours Per Year):	Potential Glint and Glare Rating	Recommended Mitigation Measures
OP 8	Showground, 9109 The Springs Road, Hillston, NSW, 2675	145° 32' 07.95"E 33° 29' 41.55"S	120 m	2.16 km	0	NIL	Not Required.
OP 10	175 Cowper St, Hillston, NSW, 2675	145° 32' 15.58"E 33° 29' 31.18"S	120 m	2.54 km	0	NIL	Not Required.
OP 12	10872 Kidman Way, Hillston, NSW, 2675	145° 32' 01.32"E 33° 30' 30.94"S	121 m	1.06 km	0	NIL	Not Required.
OP 20	8946 The Springs Road, Hillston, NSW, 2675	145° 33' 07.49"E 33° 29' 48.19"S	121 m	3.17 km	0	NIL	Not Required.
OP 112	Norwood Farm, 8939 The Springs Road, Hillston, NSW, 2675	145° 33' 04.59"E 33° 29' 50.88"S	120 m	3.06 km	0	NIL	Not Required.
OP 118	181 Norwood Lane, Hillston, NSW, 2675	145° 32' 50.95"E 33° 30' 42.55"S	120 m	2.19 km	0	NIL	Not Required.
OP 153	129 Norwood Lane, Hillston, NSW, 2675	145° 32' 37.33"E 33° 30' 15.56"S	120 m	2.1 km	0	NIL	Not Required.
OP 166	11014 Kidman Way, Hillston, NSW, 2675	145° 32' 02.30"E 33° 29' 46.53"S	121 m	1.95 km	0	NIL	Not Required.
OP 169	10738 Kidman Way, Hillston, NSW, 2675	145° 31' 54.07"E 33° 31' 16.85"S	120 m	0.93 km	0	NIL	Not Required.
OP 182	10903 Kidman Way, Hillston, NSW, 2675	145° 31' 31.76"E 33° 30' 18.79"S	119 m	0.7 km	0	NIL	Not Required.
OP 204	126 Cowper St, Hillston, NSW, 2675	145° 32' 19.61"E 33° 29' 23.47"S	120 m	2.79 km	0	NIL	Not Required.
OP 223	9019 The Springs Road, Hillston, NSW, 2675	145° 32' 43.66"E 33° 29' 37.31"S	120 m	2.87 km	0	NIL	Not Required.
OP 231	10865 Kidman Way, Hillston, NSW, 2675	145° 31' 50.28"E 33° 30' 36.47"S	118 m	0.75 km	0	NIL	Not Required.
OP 259	Greentrees, 8847 The Springs Road, Hillston, NSW, 2675	145° 33' 08.66"E 33° 30' 19.53"S	121 m	2.82 km	0	NIL	Not Required.
OP 282	The Oasis, 237 Norwood Lane, Hillston, NSW, 2675	145° 32' 30.73"E 33° 30' 51.77"S	121 m	1.64 km	0	NIL	Not Required.
OP 307	8933 The Springs Road, Hillston, NSW, 2675	145° 33' 04.34"E 33° 29' 59.43"S	120 m	2.93 km	0	NIL	Not Required.
OP 324	Westbank Farm, 19 Jardines Rd, Hillston, NSW, 2675	145° 33' 05.82"E 33° 29' 35.73"S	121 m	3.34 km	0	NIL	Not Required.
OP 347	10867 Kidman Way, Hillston, NSW, 2675	145° 31' 41.77"E 33° 30' 36.95"S	118 m	0.53 km	0	NIL	Not Required.
OP 414	Green Trees, 157 Norwood Lane, Hillston, NSW, 2675	145° 32' 38.87"E 33° 30' 25.06"S	119 m	2.05 km	0	NIL	Not Required.
OP 422	Hillston Showground 9109 The Spring Road, Hillston, NSW, 2675	145° 32' 12.22"E 33° 29' 40.65"S	120 m	2.25 km	0	NIL	Not Required.
OP 423	Hillston Cemetery 7301 Kidman Way, Hillston, NSW, 2675	145° 31' 51.99"E 33° 29' 58.19"S	120 m	1.51 km	0	NIL	Not Required.

Table 5. Private and Public Receptors assessment results

According to the result, there is no potential “Yellow” glare that could be observed by Private and Public Receptors.

In line with the Guidelines, there is no requirement for mitigation measures for Private and Public Receptors of the Project. Detailed information for each Private Receptor is provided 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 eye-line 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: Modelling 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). **Modelling 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).		

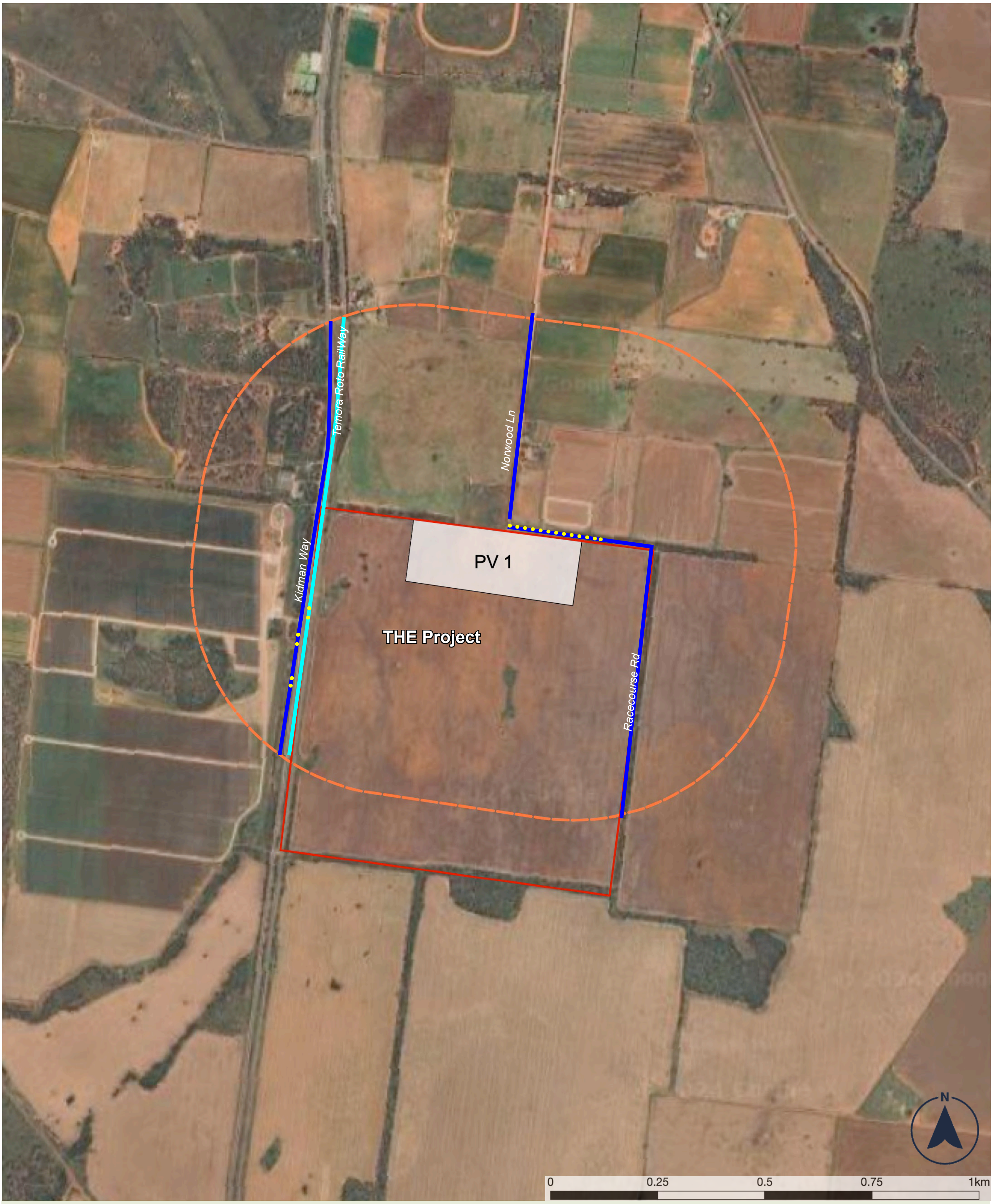
Table 7. Road and Rail Receptor Assessment Requirements (Source: DPE(now DPHI), 2022)

5.2 Road and Rail Receptors

The desktop assessment has identified that Temora Roto RailWay as a Rail Receptor located within a 1 km radius of the Project.

Additionally, three (3) Road Receptors - Kidman Way, Racecourse Road, and Norwood Lane - have been identified within 1 km radius of the Project.

Figure 5 provides a visual representation of the Road and Rail Receptors that have been detected within the proximity of Project.



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- PV Array Area
- Project Boundary
- 1 km from nearest panel
- Extent of Road Receptor identified within 1 km of Project
- Extent of Rail Receptor identified within 1 km of Project
- Potential for Yellow Glare

Figure 5 Rail and Road Receptors (Map Source: ESRI, 2023)

5.3 Results of Glint and Glare Assessment - Road and Rail

Two (3) Road Receptors and one (1) Rail Receptor were considered as part of the assessment. **Table 7** provides an overview of the annual glare experienced along the identified roads and railway.

Road / Rail Receptor:	Approximate Distance to the Project:	Elevation:	Yellow Glare (Hours Per Year):	Existing screening factors:	Mitigation Recommendations:
Kidman Way	0.43km	118-120m	1.2	Limited existing scattered vegetation between the road and the Project will partially obscure potential glare from the Project.	Additional screening vegetation along the western and southern boundary of the Project will likely mitigate further potential glare from the Project. (Refer to **Figure 7)**
Norwood Ln	0.0km	118-120m	0.0	-	Not Required.
Racecourse Rd	0.0km	119-122m	39.0	No existing screen vegetation.	Additional screening vegetation along the northern boundary of the Project will likely mitigate further potential glare from the Project. (Refer to **Figure 7**)
Temora Roto Rail Way	0.41 km	118-120m	0.6	No existing screen vegetation.	Additional screening vegetation along the western and southern boundary of the Project will likely mitigate further potential glare from the Project. (Refer to **Figure 7**)

Table 7. Road & Rail Receptor assessment results

Based on the glare assessment, it has been determined that the areas of Kidman Way, Racecourse Road, and Temora Roto RailWay are Projected to experience 'Yellow' glare from the Project.

The 'Yellow' glare occurrence is expected to take place at Kidman Way for a total of 1.2 hours per year. This glare could occur from June to early July, anytime between 7:10 am and 7:40 am, but will not exceed 1.2 hours total per year.

At Racecourse Road, the 'Yellow' glare is Projected to occur for a total of 39 hours per year. This glare could occur from early October to early March, anytime between 5:00 am to 6:20 am, and from September to early April, anytime between 17:45 pm to 19:30 pm, but will not exceed 39 hours total per year.

The Temora Roto RailWay expected to experience a total amount of 0.6 hours of potential 'Yellow' glare per year. This glare could occur between June and July, anytime from 7:15 am to 7:30 am, but will not exceed 0.6 hours total per year.

According to the performance objectives "*if yellow 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*".

Aerial imagery suggests there is limited intervening vegetation scattered between the affected section of Kidman Way and the Project. Aerial imagery also indicates that there is generally no intervening vegetation between the Project and Racecourse Road and Temora Railway. (Refer to **Figure 5**)

It is essential to note that this assessment is based on a worst-case scenario and does not consider factors such as weather conditions, intervening elements such as vegetation or built structures that might impact the actual glare experienced.

For more detailed information on the glare impact on each Road and Rail Receptor, refer to the comprehensive glare impact output provided in **Appendix A**.

6.0 Aviation Receptors

6.1 Overview of Methodology

Table 8 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: Modelling for Flight Path receptors is calculated on a threshold crossing height of 50 ft (15 m) in 2 mile (3.21 km) 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 8. Aviation Receptor Assessment Requirements (Source: DPE (now DPHI), 2022)

6.2 Aviation Receptors

The desktop assessment has identified the presence of one (1) landing strip, Hillston Aerodrome, located within a 5km radius on north west of the development footprint. For each landing strip, two flight paths have been identified, each with a threshold distance of 2 miles (equivalent to 3.21 km) (Refer to **Figure 6**).

6.3 Results of Glint and Glare Assessment - Aviation Receptors

Based on the desktop assessment, two (2) Flight Point thresholds (a threshold of 2 miles representing the flight paths from the identified landing strips) are situated within this 5 km. (Refer to **Figure 6**). The assessment found that no glare was identified for any of the flight paths associated with these thresholds. As a result and in accordance with the Guideline, no mitigation measures are deemed necessary.

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

Aviation Receptor:	Approximate Distance to the Project:	Ground Elevation:	Yellow Glare (Hours Per Year):	Mitigation Recommendations:
FP01	2.87km	117m	0	Not Required.
FP02	3.00km	119m	0	Not Required.

Table 9. Aviation receptor assessment results

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PV Array Area
Project Boundary
5 km from nearest panel
Aviation Receptor
2mile Flight Path threshold

Figure 6 Aviation Receptors (Map Source: ESRI, 2023)

7.0 Performance Objectives

7.1 Summary of assessment results

7.1.1 Private and Public Receptors

Table 5 provides a comprehensive overview of the scope, methodology, and performance objectives related to the assessment of glint and glare on private and Public Receptors. The assessment conducted by Moir LA is summarized as follows:

A total of 19 private and two (2) Public Receptors have been assessed. No receptors have been identified to have a potential for experiencing 'Yellow' glare.
Consequently, no mitigation measures are necessary in accrodance with the Guideline.

7.1.2 Road and Rail Receptors

Table 7 provides a comprehensive overview of the scope, methodology, and performance objectives concerning the assessment of glint and glare on Road Receptors. The assessment conducted by Moir LA is summarised below:

Two (2) Road Receptors and One (1) Rail Receptor have been assessed as having a potential glare.

The assessment indicates that Racecourse Road, Kidman Way, and Temora Roto RailWay are expected to experience the potential "Yellow" glare from the Project.

The following details outline the occurrence of glare in specific locations:

- Racecourse Road: Glare is Projected to occur between early October and early March, lasting for about 39 hours per year. Glare will take place between 5:00 am to 6:20 am and from September to early April between 17:45 pm to 19:30 pm.
- Kidman Way: Glare is expected to occur between June and early July, lasting for about 1.2 hours per year, specifically between 7:10 am and 7:40 am.
- Temora Roto RailWay: The potential 'Yellow' glare is expected to occur from early June to July, lasting for about 0.6 hours per year. The glare is expected to take place between 7:15 am to 7:30 am.

In accordance with the performance objectives for Road and Rail Receptors, *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*.

It has been noted through aerial imagery analysis that there is limited screening vegetation present in the area affected by Kidman Way and the Project. This limited vegetation might partially diminish the glare experienced by Road Receptors.

However, a desktop evaluation revealed the absence of screening vegetation between the Project and Racecourse Road and Temora Roto RailWay. Therefore, further mitigation is required in line with the Guideline, refer **Section 8**.

8.0 Mitigation

8.1 Overview of Impacts

As previously mentioned, it is crucial to consider strategies for either avoiding or mitigating impacts associated with glare for various receptors within specific proximity limits. The following provides a summary of the key findings the assessment:

Private and Public Receptors:

- A total of 19 private and two (2) Public Receptors have been assessed. No receptors have been identified to have a potential for experiencing 'Yellow' glare. Consequently, no mitigation measures are considered necessary.

Road Receptors:

- Among the three (3) roads and one (1) RailWay identified within a 1 km radius of the Project, two (2) Road Receptors and the railway were determined to experience potential yellow glare. The Kidman Way receptor has limited screening vegetation that partially screens the glare impacts associated with the Project. Aerial images revealed the absence of screening vegetation between the Project and Racecourse Road and Temora Roto RailWay.

Aviation Receptors:

- An assessment of the two (2) flight paths originating from Hillston Aerodrome found that there are no glare impacts affecting aviation receptors. Therefore, these flight paths are not impacted by glare from the Project.

These findings provide a comprehensive overview of the glare impact assessment and highlight areas where potential mitigation strategies or adjustments will be required to minimise glare impacts on specific receptors.

8.2 Proposed Mitigation Strategies

One of the most effective methods for reducing the potential glare impact at private, road, and Rail Receptors is to implement screen planting along the Project boundary or, as applicable, at affected viewpoints.

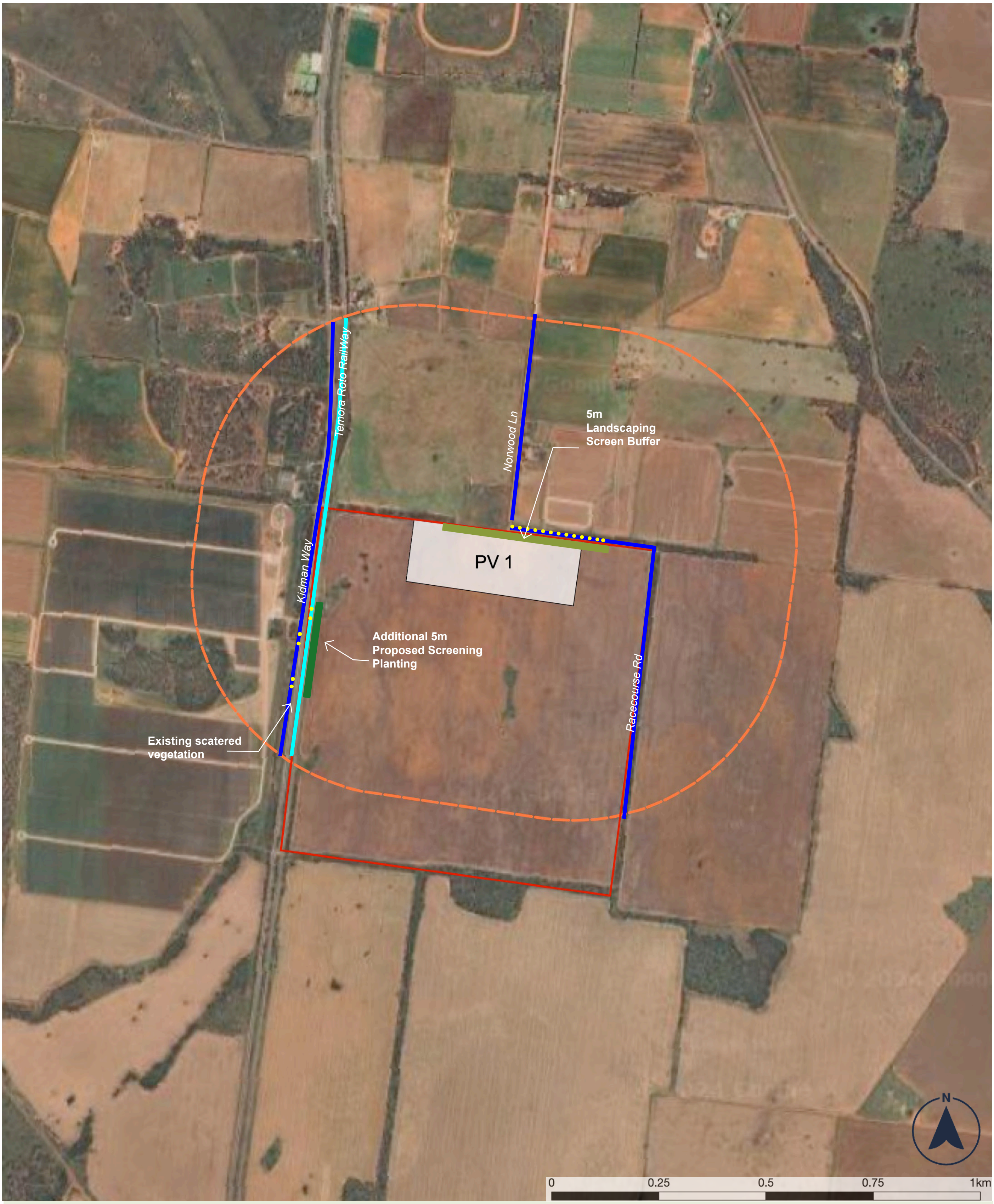
Mitigation principles have been recommended in accordance with DPE's (now DPHI) Technical Guidelines.

The Technical Supplement states: *Vegetation screening, or the planting of trees and shrubs, to visually screen solar energy Projects or other potential visual impacts (such as glint and glare) from view may be a useful mitigation option for selected viewpoints. 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 viewpoints.*

The Project has implemented a 5 m landscaping screening buffer in accordance with Risen Energy's Project layout and principles. This buffer will be created as a 5 m zone of screening vegetation on the northern boundary of PV Arrays as part of the Project's establishment. The aim of this strategic placement of vegetation is to potentially reduce glare impacts from the Project, especially from Racecourse Road.

To meet the Guideline's requirements, additional screen planting is necessary to eliminate the possibility of 'yellow' glare from Kidman Way and Temora Roto RailWay. This would involve an additional 5 m screening planting along part of the Project's western property boundary.

To provide a clear visual representation of the extent and locations of proposed screening vegetation, refer to **Figure 7**.



LEGEND

- PV Array Area
- Project Boundary
- 1 km from nearest panel
- Extent of Road Receptor identified within 1 km of Project
- Extent of Rail Receptor identified within 1 km of Project
- Potential for Yellow Glare
- 5m Landscaping Screen Buffer proposed by Risen Energy
- Additional 5 m Proposed Screen Planting

Figure 7 Mitigation Screening (Map Source: ESRI, 2023)

9.0 Conclusion

This assessment identifies the potential glint and glare impacts from the Project on surrounding receptors, including Residential Receptors within 3 km of the Project, Road and Rail Receptors within 1 km, and Aviation Receptors within 5 km.

The assessment reveals that a total of 19 private and two (2) Public Receptors have been assessed, with no Receptors identified as having a potential for experiencing ‘Yellow’ glare. Consequently, no mitigation measures are considered necessary in line with the Guideline for Residential Receptors.

The assessment reveals that two (2) Road Receptors and one (1) Rail Receptor have been assessed as having a potential glare. The assessment indicates that Racecourse Road, Kidman Way, and Temora Roto RailWay are expected to experience the potential “Yellow” glare from the Project.

In accordance with the performance objectives for Road and Rail Receptors, *if glare is geometrically possible, measures should be taken to eliminate the occurrence of glare*.

It has been noted through aerial imagery analysis that there is insufficient screening vegetation.

The Project has implemented a 5 m landscaping screening buffer in accordance with Risen Energy’s Project layout and principles. The aim of this strategic placement of vegetation is to potentially reduce the identified potential glare impact of the Project on nearby Road Receptors. In addition to this, further screening in the form of a 5 m buffer is recommended along the Project’s western property boundary.

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Appendix A

FORGESOLAR GLARE ANALYSIS

Project: **2428 Hillston Solar Farm**
Site configuration: **2428_HillstonSolarFarm_20240320**

Created 20 Mar, 2024
Updated 28 Mar, 2024
Time-step 1 minute
Timezone offset UTC10
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 5 MW to 10 MW
Site ID 114775.19777

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

Summary of Results Glare with 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	1,335	22.2	2,449	40.8	-

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

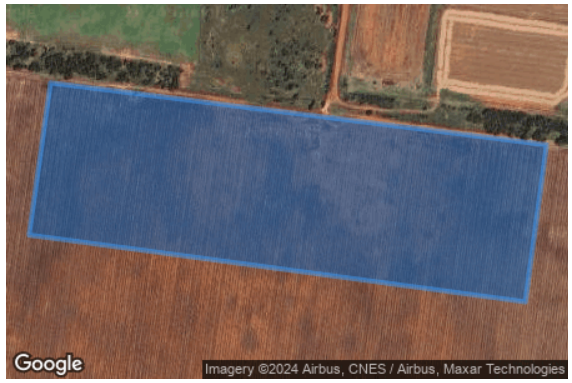
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Kidman Way	29	0.5	75	1.2
Norwood Ln	0	0.0	0	0.0
Racecourse Rd	561	9.3	2,339	39.0
Temora Roto Rail Way	60	1.0	35	0.6
FP 1	0	0.0	0	0.0
FP 2	685	11.4	0	0.0
OP 8	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 112	0	0.0	0	0.0
OP 118	0	0.0	0	0.0
OP 153	0	0.0	0	0.0
OP 166	0	0.0	0	0.0
OP 169	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 182	0	0.0	0	0.0
OP 223	0	0.0	0	0.0
OP 231	0	0.0	0	0.0
OP 259	0	0.0	0	0.0
OP 282	0	0.0	0	0.0
OP 307	0	0.0	0	0.0
OP 324	0	0.0	0	0.0
OP 347	0	0.0	0	0.0
OP 414	0	0.0	0	0.0
OP 422	0	0.0	0	0.0
OP 423	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: 0.4
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	-33.517923	145.536059	117.25	1.72	118.97
2	-33.518811	145.544584	119.49	1.72	121.21
3	-33.521058	145.544219	118.45	1.72	120.17
4	-33.520101	145.535690	117.47	1.72	119.19

Route Receptors

Name: Kidman Way
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-33.508616	145.532040	118.63	2.40	121.03
2	-33.510199	145.532110	117.12	2.40	119.52
3	-33.511456	145.532152	117.60	2.40	120.00
4	-33.512453	145.532163	118.98	2.40	121.38
5	-33.513643	145.532045	119.37	2.40	121.77
6	-33.514891	145.531831	120.31	2.40	122.71
7	-33.516273	145.531589	118.31	2.40	120.71
8	-33.518142	145.531278	118.71	2.40	121.11
9	-33.519873	145.530978	118.13	2.40	120.53
10	-33.521841	145.530629	118.66	2.40	121.06
11	-33.524301	145.530221	117.78	2.40	120.18
12	-33.525589	145.529964	117.63	2.40	120.03
13	-33.527485	145.529663	117.08	2.40	119.48

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-33.509059	145.542409	118.50	2.40	120.90
2	-33.510597	145.542152	118.12	2.40	120.52
3	-33.512207	145.541905	119.00	2.40	121.40
4	-33.513460	145.541680	121.00	2.40	123.40
5	-33.514846	145.541454	120.52	2.40	122.92
6	-33.516948	145.541133	118.77	2.40	121.17
7	-33.518272	145.540886	118.80	2.40	121.20

Name: Racecourse Rd
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-33.518357	145.540968	119.05	2.40	121.45
2	-33.518500	145.542470	120.29	2.40	122.69
3	-33.518697	145.544358	119.81	2.40	122.21
4	-33.518893	145.545667	118.68	2.40	121.08
5	-33.519037	145.547234	119.83	2.40	122.23
6	-33.519215	145.548264	118.92	2.40	121.32
7	-33.520253	145.548071	118.74	2.40	121.14
8	-33.521469	145.547856	119.61	2.40	122.01
9	-33.522427	145.547717	120.54	2.40	122.94
10	-33.523339	145.547566	121.88	2.40	124.28
11	-33.524484	145.547363	121.27	2.40	123.67
12	-33.525235	145.547244	120.88	2.40	123.28
13	-33.526255	145.547073	119.24	2.40	121.64
14	-33.527543	145.546837	118.07	2.40	120.47
15	-33.528866	145.546611	118.65	2.40	121.05
16	-33.529778	145.546472	118.41	2.40	120.81
17	-33.530664	145.546311	118.54	2.40	120.94
18	-33.531522	145.546139	119.82	2.40	122.22

Name: Temora Roto Rail Way
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-33.527587	145.530013	116.65	3.00	119.65
2	-33.526120	145.530292	117.15	3.00	120.15
3	-33.524438	145.530549	117.38	3.00	120.38
4	-33.522825	145.530839	118.40	3.00	121.40
5	-33.522078	145.530970	118.16	3.00	121.16
6	-33.521707	145.531035	118.08	3.00	121.08
7	-33.521134	145.531126	117.98	3.00	120.98
8	-33.520349	145.531252	117.76	3.00	120.76
9	-33.519663	145.531375	118.02	3.00	121.02
10	-33.519135	145.531467	118.44	3.00	121.44
11	-33.518751	145.531526	118.35	3.00	121.35
12	-33.517943	145.531668	118.14	3.00	121.14
13	-33.517353	145.531780	118.00	3.00	121.00
14	-33.516933	145.531839	118.34	3.00	121.34
15	-33.516186	145.531963	117.85	3.00	120.85
16	-33.515245	145.532110	119.29	3.00	122.29
17	-33.514100	145.532293	119.69	3.00	122.69
18	-33.513174	145.532437	118.11	3.00	121.11
19	-33.512096	145.532593	118.52	3.00	121.52
20	-33.511179	145.532802	117.69	3.00	120.69
21	-33.510562	145.532926	117.69	3.00	120.69
22	-33.509868	145.532963	117.21	3.00	120.21
23	-33.508965	145.532920	117.05	3.00	120.05
24	-33.508458	145.532888	118.05	3.00	121.05

Flight Path Receptors

Name: FP 1
Description:
Threshold height: 15 m
Direction: 250.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	-33.492346	145.530178	116.99	15.24	132.23
Two-mile	-33.482619	145.562865	121.82	179.09	300.91

Name: FP 2
Description:
Threshold height: 15 m
Direction: 70.1°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	-33.495997	145.517046	118.31	15.24	133.55
Two-mile	-33.505819	145.484400	118.01	184.23	302.24

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 8	8	-33.494875	145.535540	120.75	1.50
OP 10	10	-33.491995	145.537661	120.51	1.50
OP 12	12	-33.508595	145.533700	121.56	1.50
OP 20	20	-33.496720	145.552082	121.23	1.50
OP 112	112	-33.497467	145.551274	120.63	1.50
OP 118	118	-33.511820	145.547485	120.40	1.50
OP 153	153	-33.504323	145.543703	120.26	1.50
OP 166	166	-33.496259	145.533972	121.60	1.50
OP 169	169	-33.521347	145.531686	120.10	1.50
OP 182	182	-33.505220	145.525488	119.87	1.50
OP 223	223	-33.493696	145.545462	120.78	1.50
OP 231	231	-33.510130	145.530634	118.41	1.50
OP 259	259	-33.505425	145.552406	121.55	1.50
OP 282	282	-33.514380	145.541870	121.21	1.50
OP 307	307	-33.499841	145.551205	120.69	1.50
OP 324	324	-33.493254	145.551615	121.75	1.50
OP 347	347	-33.510263	145.528269	118.75	1.50
OP 414	414	-33.506961	145.544130	119.75	1.50
OP 422	422	-33.494624	145.536728	120.40	1.50
OP 423	423	-33.499498	145.531108	120.38	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	1,335	22.2	2,449	40.8	-

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

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Kidman Way	29	0.5	75	1.2
Norwood Ln	0	0.0	0	0.0
Racecourse Rd	561	9.3	2,339	39.0
Temora Roto Rail Way	60	1.0	35	0.6
FP 1	0	0.0	0	0.0
FP 2	685	11.4	0	0.0
OP 8	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 112	0	0.0	0	0.0
OP 118	0	0.0	0	0.0
OP 153	0	0.0	0	0.0
OP 166	0	0.0	0	0.0
OP 169	0	0.0	0	0.0
OP 182	0	0.0	0	0.0
OP 223	0	0.0	0	0.0
OP 231	0	0.0	0	0.0
OP 259	0	0.0	0	0.0
OP 282	0	0.0	0	0.0
OP 307	0	0.0	0	0.0
OP 324	0	0.0	0	0.0
OP 347	0	0.0	0	0.0
OP 414	0	0.0	0	0.0
OP 422	0	0.0	0	0.0
OP 423	0	0.0	0	0.0

PV: PV array 1 potential temporary after-image

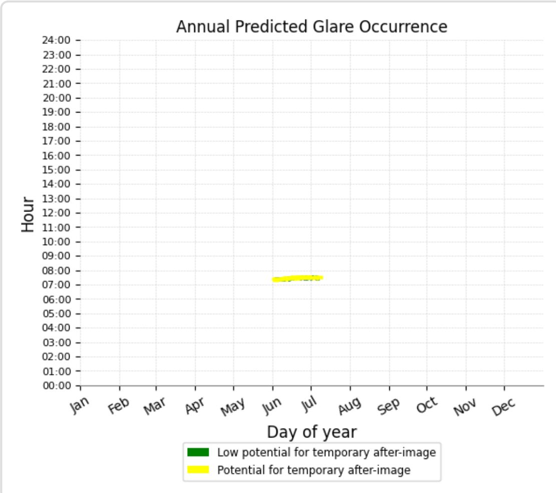
Receptor results ordered by category of glare

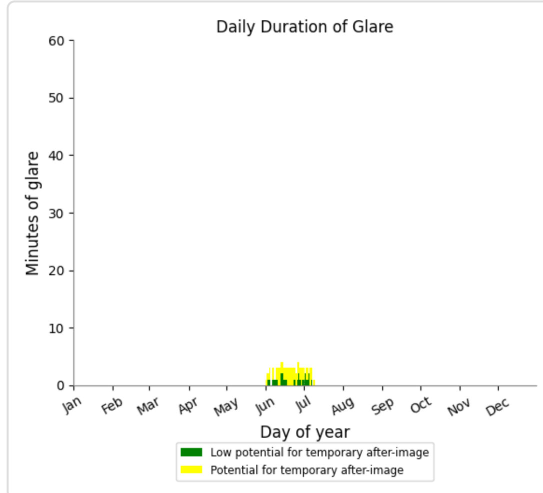
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Kidman Way	29	0.5	75	1.2
Racecourse Rd	561	9.3	2,339	39.0
Temora Roto Rail Way	60	1.0	35	0.6
Norwood Ln	0	0.0	0	0.0
FP 2	685	11.4	0	0.0
FP 1	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 112	0	0.0	0	0.0
OP 118	0	0.0	0	0.0
OP 153	0	0.0	0	0.0
OP 166	0	0.0	0	0.0
OP 169	0	0.0	0	0.0
OP 182	0	0.0	0	0.0
OP 223	0	0.0	0	0.0
OP 231	0	0.0	0	0.0
OP 259	0	0.0	0	0.0
OP 282	0	0.0	0	0.0
OP 307	0	0.0	0	0.0
OP 324	0	0.0	0	0.0
OP 347	0	0.0	0	0.0
OP 414	0	0.0	0	0.0
OP 422	0	0.0	0	0.0
OP 423	0	0.0	0	0.0

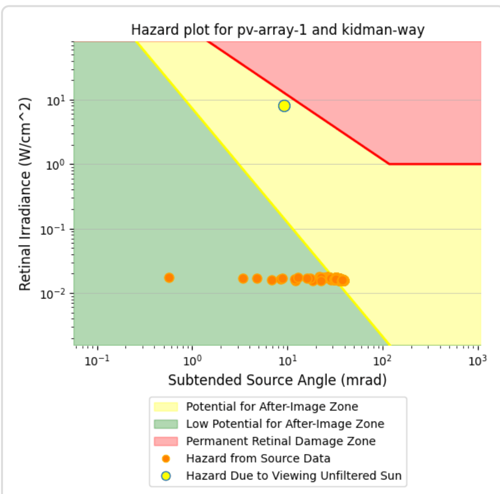
PV array 1 and Route: Kidman Way

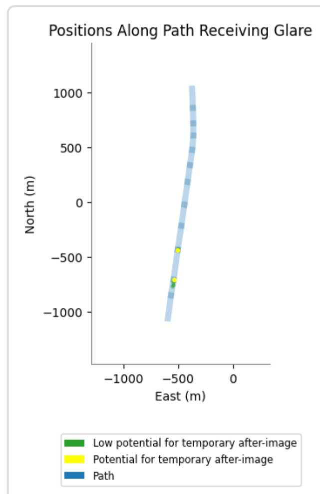
Yellow glare: 75 min.

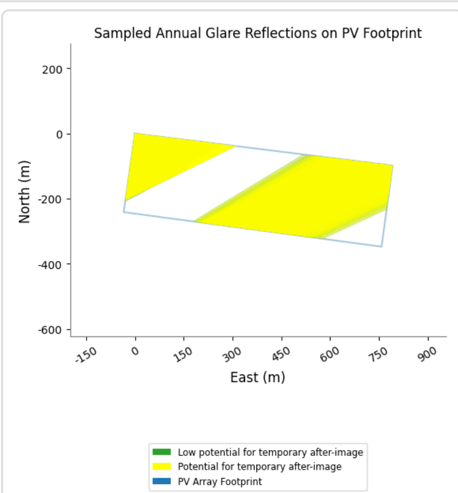
Green glare: 29 min.







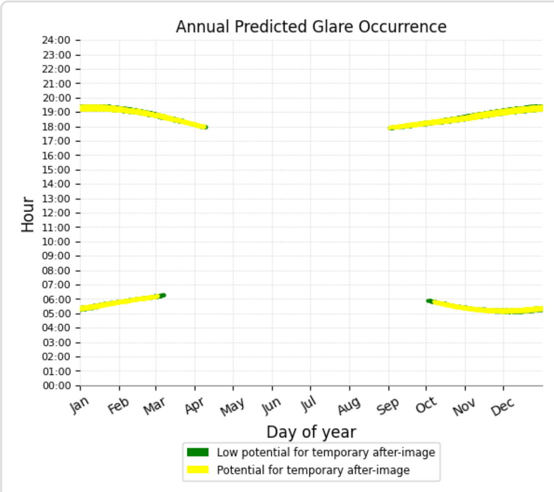


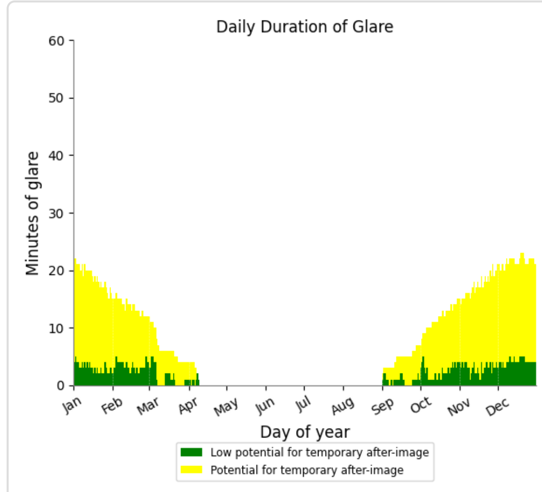


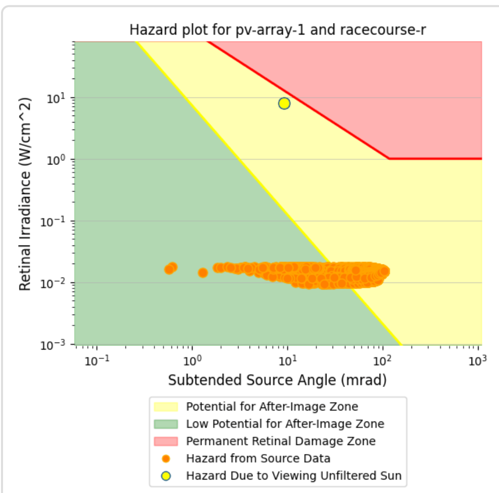
PV array 1 and Route: Racecourse Rd

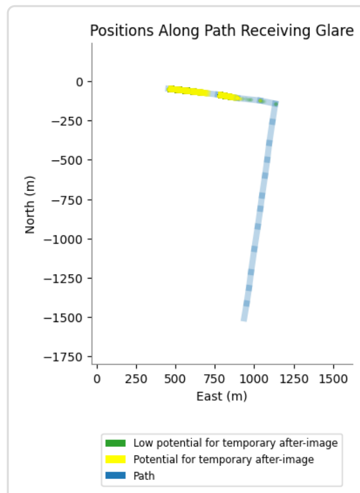
Yellow glare: 2,339 min.

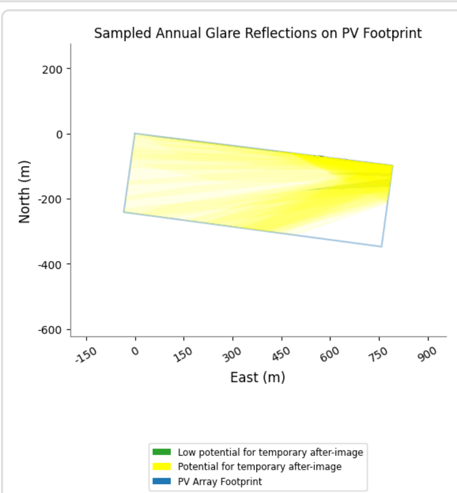
Green glare: 561 min.







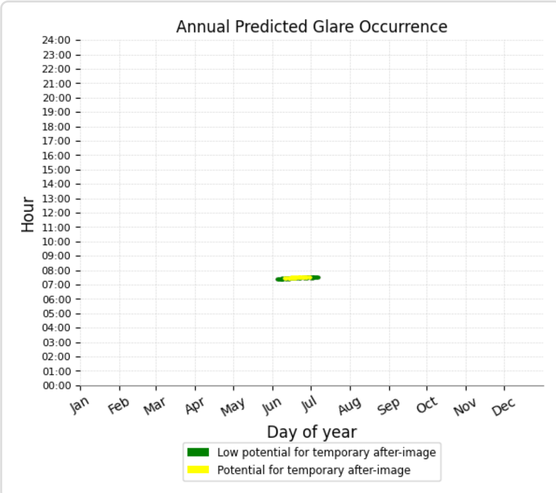


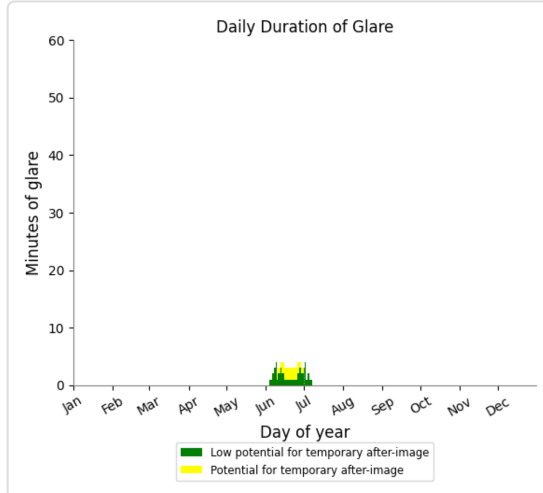


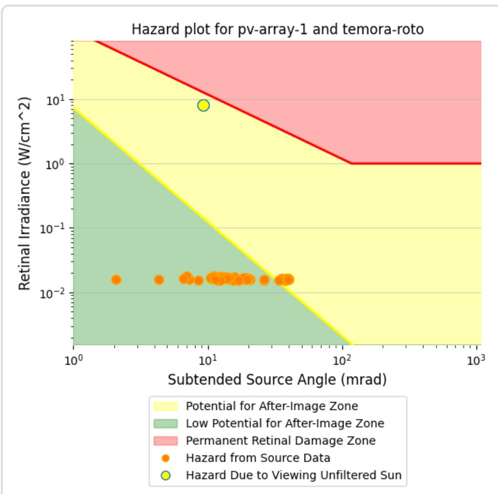
PV array 1 and Route: Temora Roto Rail Way

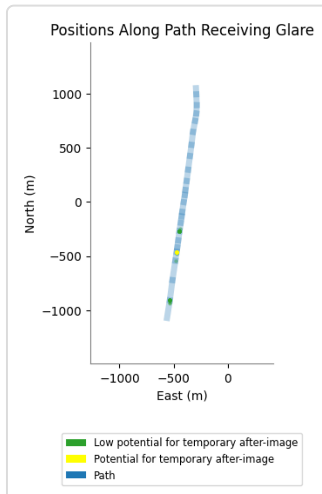
Yellow glare: 35 min.

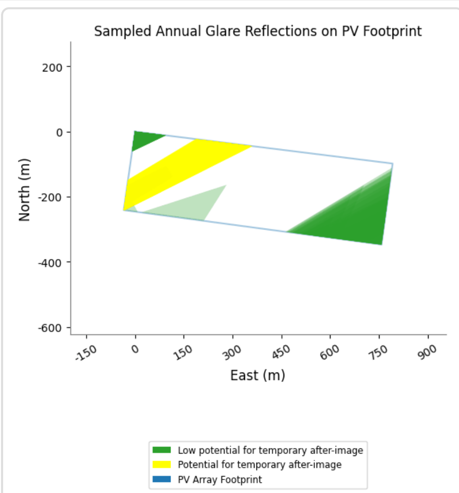
Green glare: 60 min.











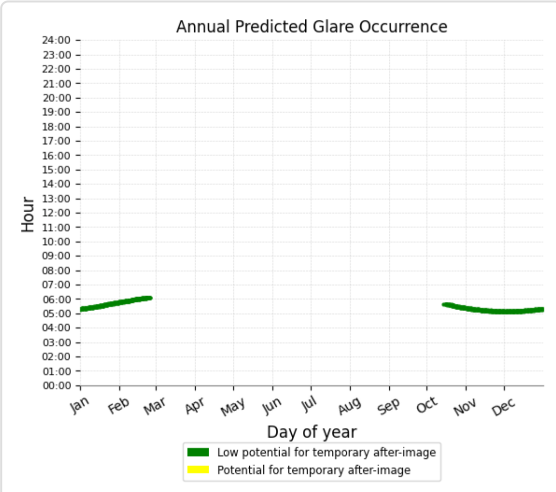
PV array 1 and Route: Norwood Ln

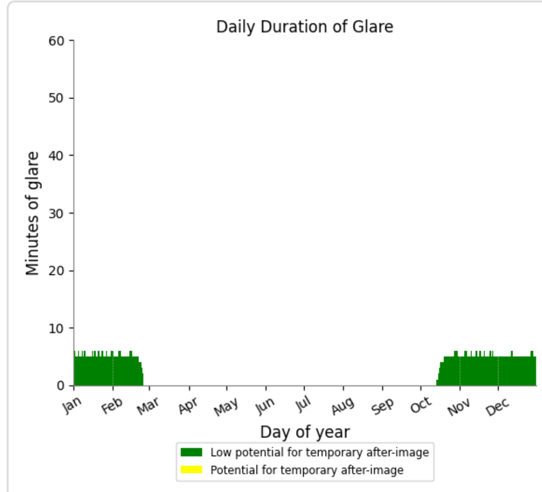
No glare found

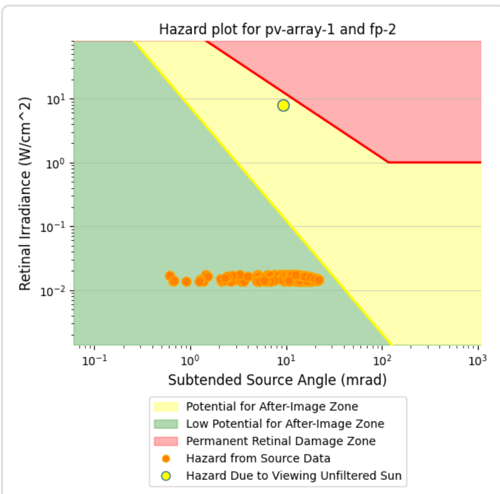
PV array 1 and FP: FP 2

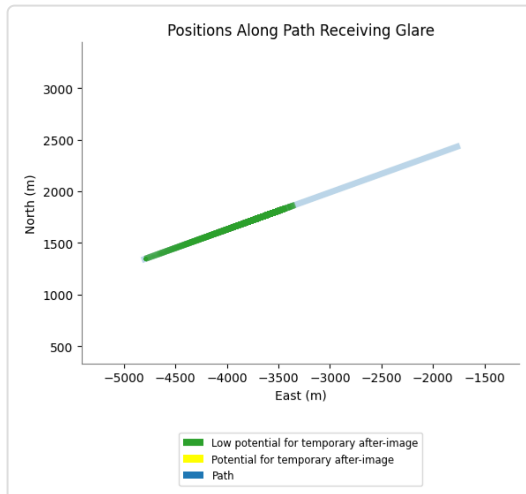
Yellow glare: none

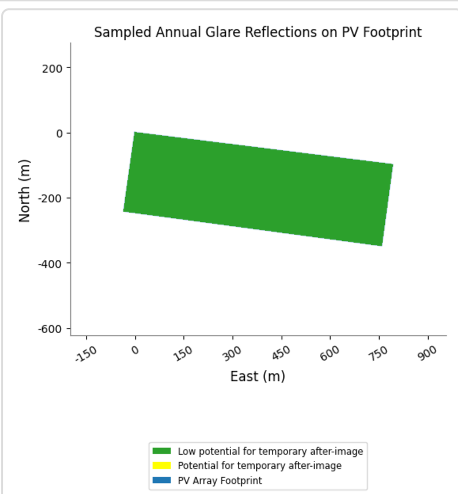
Green glare: 685 min.

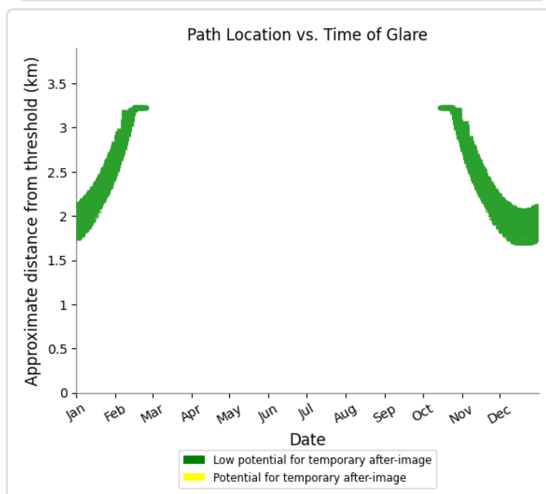












PV array 1 and FP: FP 1

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 20

No glare found

PV array 1 and OP 112

No glare found

PV array 1 and OP 118

No glare found

PV array 1 and OP 153

No glare found

PV array 1 and OP 166

No glare found

PV array 1 and OP 169

No glare found

PV array 1 and OP 182

No glare found

PV array 1 and OP 223

No glare found

PV array 1 and OP 231

No glare found

PV array 1 and OP 259

No glare found

PV array 1 and OP 282

No glare found

PV array 1 and OP 307

No glare found

PV array 1 and OP 324

No glare found

PV array 1 and OP 347

No glare found

PV array 1 and OP 414

No glare found

PV array 1 and OP 422

No glare found

PV array 1 and OP 423

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