BLIND CREEK SOLAR FARM

Reflective Glare Assessment

Prepared for:

Blind Creek Solar Farm Pty Ltd
114 Currandooley Road
BUNGENDORE NSW 2621

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SLR

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Blind Creek Solar Farm Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30347-R01-v5.0	29 March 2022	Peter Hayman	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.30347-R01-v4.0	11 March 2022	Peter Hayman	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.30347-R01-v3.0	23 February 2022	Peter Hayman	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.30347-R01-v2.0	25 November 2021	Peter Hayman	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.30347-R01-v1.0	6 August 2021	Peter Hayman	Dr Peter Georgiou	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Blind Creek Solar Farm Pty Ltd (the "Proponent") to carry out a Reflective Glare assessment of the proposed Blind Creek Solar Farm (the "Project"). The Project is located between the southeast shoreline of Lake George and Tarago Road, with the southernmost point of the Project approximately 6 km north of Bungendore.

For the purpose of this report, the nominally 350 MW facility (refer **Section 2**) has been modelled with Canadian Solar HiKu 455 W panels measuring approximately 2.11 m by 1.08 m, positioned on single-axis trackers (maximum tilt ±62°) oriented north-south with spacings varying from 5.25 m up to 7 m.

The current design footprint for the Project analysed in this study is shown in **Figure 2**.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility:
  - Aviation Sector Reflective Glare;
  - Motorist and Rail Operator "Disability" and Pedestrian "Discomfort" Reflective Glare;
  - Industrial Machinery Operator "Disability" Reflective Glare; and
  - Residential "Nuisance" Glare.
- Night-time Illumination Glare if any 24/7 operational security lighting is incorporated into the Project.

Aviation-Related Potential Glare

Quantitative analysis using the FAA-SGHAT (Solar Glare Hazard Analysis Tool) software tool has been used to assess potential glare impacts on Currandooley Airstrip, which lies within the proposed facility's site perimeter.

It is noted that privately-owned Currandooley Airstrip will almost certainly be de-commissioned to make way for solar panels, to be contained within Panel Array ID7 – refer **Figure 8**. The SGHAT analysis of the airstrip was therefore carried out in the (highly unlikely) scenario that the airstrip is preserved in the final (to be constructed) design.

Appendix B of this report sets out options to enable all-year-round usage of the airstrip's Runways 10 and 28. These consist of either operational airstrip strategies (e.g. restricting landings for particular runways at a particular hour of the day for certain given months) or operational panel strategies, e.g. limiting the options for low angle fixed tilt modes, for either maintenance/construction purposes, or for the initial (morning) and final (evening) period of panel Back-Tracking should this mode be chosen for the facility.

Back-Tracking Software has the capability to operate different sections of a PV facility in varying modes, whereby some panel array groups operate in "full" Back-Tracking mode and others are directed to move to various fixed tilt position either at the start or end of the day, typically without significant loss of total facility output. It should therefore be possible, if a Back-Tracking solution is chosen for the facility, to implement tracking controls that would enable virtually all-year-round use of the Currandooley Airstrip at any time of day for both runways.

Alternatively, an operational management plan for airstrip operations could be developed, avoiding periods throughout the year (typically early morning and later afternoon) when potential aviation glare might occur.

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It is noted again however that Currandooley Airstrip will almost certainly be de-commissioned to make way for the proposed facility and, as such, aviation glare issues are non-existent in relation to the current proposal.

Motorist and Rail Traffic Disability Glare

Nil glare is expected during normal ±62° tracking operations.

There is potential for visible reflections which can reach the nominated glare criteria along Currandooley Road if the panels are left parked in a horizontal position or with a slight eastwards tilt – which could occur during construction, maintenance and/or at the end of the day with "Back-Tracking".

Table 6 summarises the mitigation options for eliminating potential motorist disability glare, with combinations of operational mode restrictions and/or perimeter barriers (e.g. vegetation) to eliminate all potential glare conditions. The operational mode restriction would be to avoid an essentially flat tilt angle for PV Arrays 5-8 at the end of the day, i.e. end Back-Tracking each day at a very low tilt angle West. The precise limiting angle should be established during commissioning.

There is NIL potential for glare along Tarago Road, the Quarry Access Road and Bombala Rail Line.

Residential Nuisance Glare

Reflections will not be visible by residential receivers surrounding the facility under normal ±62° tracking operations during which solar panels will track the sun.

If panels are left parked in a horizontal or near horizontal position, panel reflections from the proposed facility may be visible for short periods of time in the early morning or late afternoon for certain months of the year.

However, the potential for nuisance glare is considered low to minimal when considering the following factors: local obstruction to many receivers from surrounding vegetation and trees (not included in our analysis), the distances involved for "western" side receivers, and the low angle differences between incoming (direct) solar rays and their accompanying reflections.

Panel reflection visibility potential during the identified periods events can be effectively eliminated entirely by the following measures:

. During Construction and/or Maintenance Periods, avoid very low tilt angles either East or West.

. Under an Operational "Back-Tracking" mode, avoid essentially horizontal panel angles at the start and end of each day. The precise limiting angle should be established during commissioning.

Industrial Machinery Operator Glare

The study has concluded that there will be NIL glare in relation to the industrial operations occurring at the nearby Bungendore Sand Mine and Paragalli Sands operation.

EXECUTIVE SUMMARY

Night-Time Illumination Glare

If 24/7 lighting is required at the facility for operational purposes, there should be negligible impact, assuming the lighting design is in accordance with AS 4282-2019 Control of the Obtrusive Effect of Outdoor Lighting. This would also address any potential adverse eco-lighting issues in relation to nocturnal fauna within and surrounding the site, although, as far as is known, no biodiversity issues have been identified in relation to the Project. Any future lighting design should also be checked against CASA's NASF Guidelines (E & F) in relation to Currandooley Airstrip operations if the airstrip is not de-commissioned and night-time flights are permitted.

Glare Mitigation Measures

The present analysis shows that many of the potential glare and/or visibility conditions identified are associated with circumstances involving solar panels being left in a horizontal or near-horizontal position.

In relation to construction and/or maintenance, Project commitments can be made and monitored to ensure that the successful EPC contractor for the Project avoids any adverse parked-panel conditions associated with potential glare and/or visibility conditions.

In relation to operations, Back-Tracking software is capable of addressing all of the identified potential reflection glare and/or visibility during the operational phase of the Project, specifically, by avoiding the horizontal position of panels at the very start and end of each day. The precise limiting angle should be established during commissioning.

When key Project decisions are finalised during detailed design (e.g. final panel selection, mounting details, etc), the present analysis should be re-visited to confirm the conclusions set out above, but only if key assumptions made in the analysis change significantly.

It is noted that on several previous solar glare studies carried out by SLR, the impact of a change in single-axis track orientation was evaluated for small deviations from a north-south direction, i.e. orientation changes of ±10°. In all cases, the glare analysis results for both normal tracking (typically ±60°) and fixed mode horizontal conditions were essentially the same. If no glare was predicted for a north-south tracker orientation, no glare was likely for a change in orientation of ±10°. Similarly, if glare was predicted for a north-south tracker orientation, glare would also be likely for a change in orientation of ±10°. This suggests that the overall outcomes of this study will remain the same with a modest (i.e. ±10°) change in tracker orientation.

Finally, the project is requesting flexibility to choose newly-improved '2P' style trackers, which stack two panels in portrait orientation across the tracker table instead of one panel, which has been the dominant architecture to date. This change results in less, but more widely-spaced, trackers which is desirable for agri-solar, and reduced impact on archaeology, hydrology and biodiversity. It does require a slightly higher height at full tilt of up to 5 m. SLR does not believe this change would materially alter the conclusions of this report.

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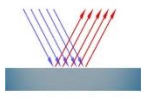
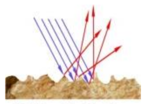
Abbreviations and Definitions

Terms relevant to Daytime Reflective Glare	
PV Panel	Photovoltaic (PV) panels are designed to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity.
Glare	Glare refers to the reflections of the sun off any reflective surface, experienced as a source of excessive brightness relative to the surrounding diffused lighting. Glare covers reflections: . Which can be experienced by both stationary and moving observers (the latter referred to as “glint”). . Which are either specular or diffuse.
Specular	A reflection which is essentially mirror-like – there is virtually no loss of intensity or angle dispersion between the incoming solar ray and outgoing reflection.
Diffuse	A reflection in which the outgoing reflected rays are dispersed over a wide (“diffuse”) range of angle compared to the incoming (parallel) solar rays, typical of “rougher” surfaces.
KVP	Key View Points (KVPs) are offsite locations where receivers of interest have the potential to experience adverse reflective glare.





Terms relevant to Night-Time Illumination	
Luminous intensity	The concentration of luminous flux emitted in a specific direction. Unit: candela (Cd).
Luminance **AS 1158.2:2020**	This is the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as façade glazing) when viewed from a specified direction. Unit: Cd/m^2
Illuminance **AS 1158.2:2020**	This is the physical measure of illumination. It is the luminous flux arriving at a surface divided by the area of the illuminated surface – the unit is lux (lx) … 1 lx = 1 lm/m^2 The term covers both “Horizontal Illuminance” (the value of illuminance on a designated horizontal plane at ground level) and “Vertical Illuminance” (the value of illuminance on a designated vertical plane at a height of 1.5m above ground level).
Glare **AS 1158.2:2020**	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.
Threshold Increment (TI) **AS 4282:2019**	TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare.

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Blind Creek Solar Farm Pty Ltd to carry out a Reflective Glare assessment of the proposed Blind Creek Solar Farm (the "Project"). The Project is located between the southeast shoreline of Lake George and Tarago Road, with the southernmost point of the Project approximately 6 km north of Bungendore.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

1.1 Structure of Report

The remainder of this report is structured as follows:

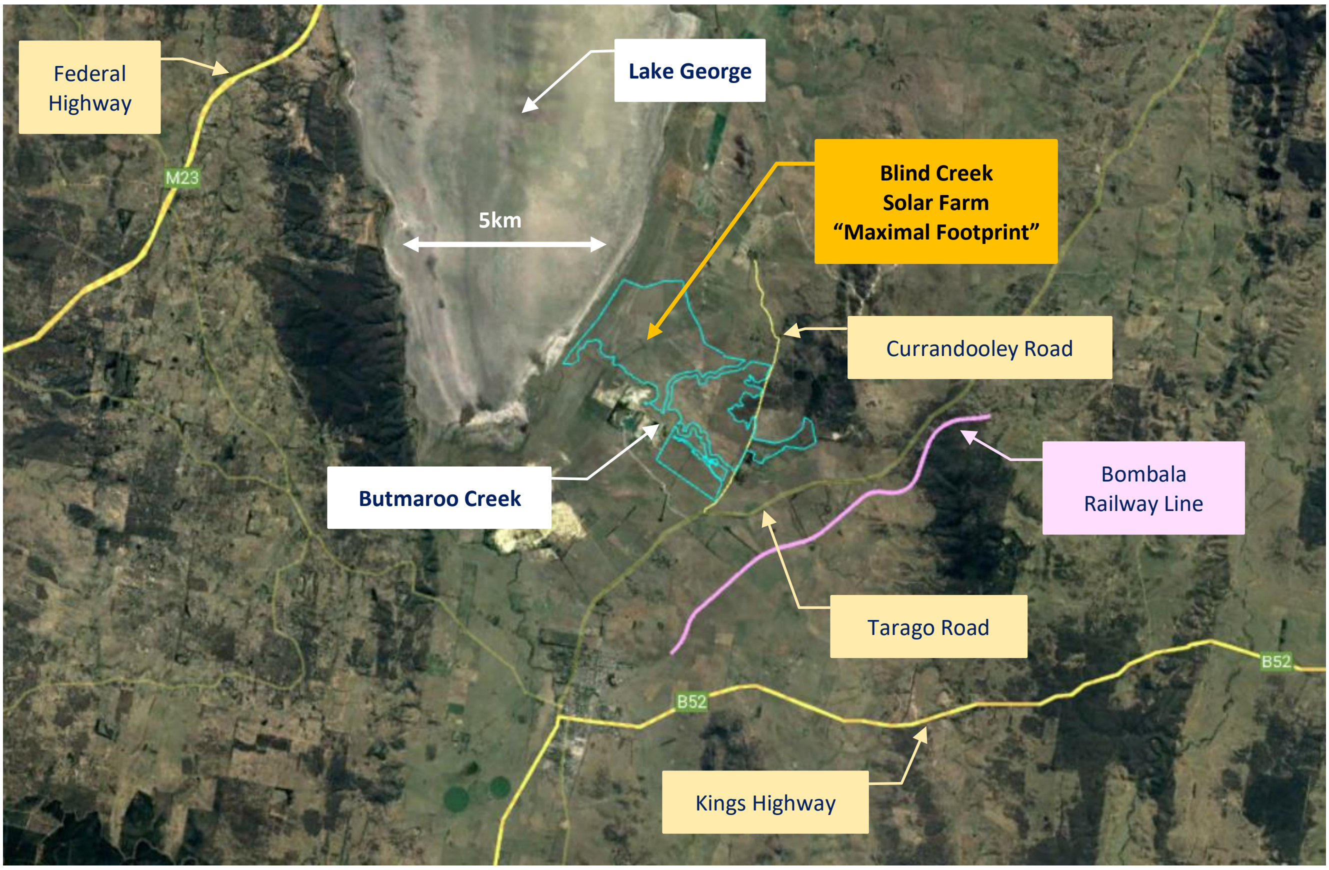
- **Section 2** describes the Project and surrounding environment;
- **Section 3** describes the input parameters needed to carry out the glare analysis;
- **Section 4** presents the analysis and results covering aviation glare;
- **Section 5** presents the analysis and results covering road and rail disability glare;
- **Section 6** presents the analysis and results covering residential nuisance glare;
- **Section 7** presents the analysis and results covering industrial machinery disability glare;
- **Section 8** presents the analysis and results covering night-time illumination glare;
- **Section 9** presents the conclusions of the study.

2 PROPOSED BLIND CREEK SOLAR FARM PROJECT

2.1 Site Location

The Project is seeking approval for a photovoltaic (PV) solar plant with a nominal capacity of 350 MW, occupying an area up to 800 ha from within the 1,000 ha "maximal footprint" shown in **Figure 1**. The Project would be located between the southeast shoreline of Lake George and Tarago Road, with the southernmost point of the Project approximately 6 km north of Bungendore.

Figure 1 Blind Creek Solar Farm "Maximal" Footprint - Location Map



2.2 Project Constraints Identification

In the early development phases of the Project, the potential extent of the proposed facility was the extensive "maximal" footprint shown in **Figure 1**.

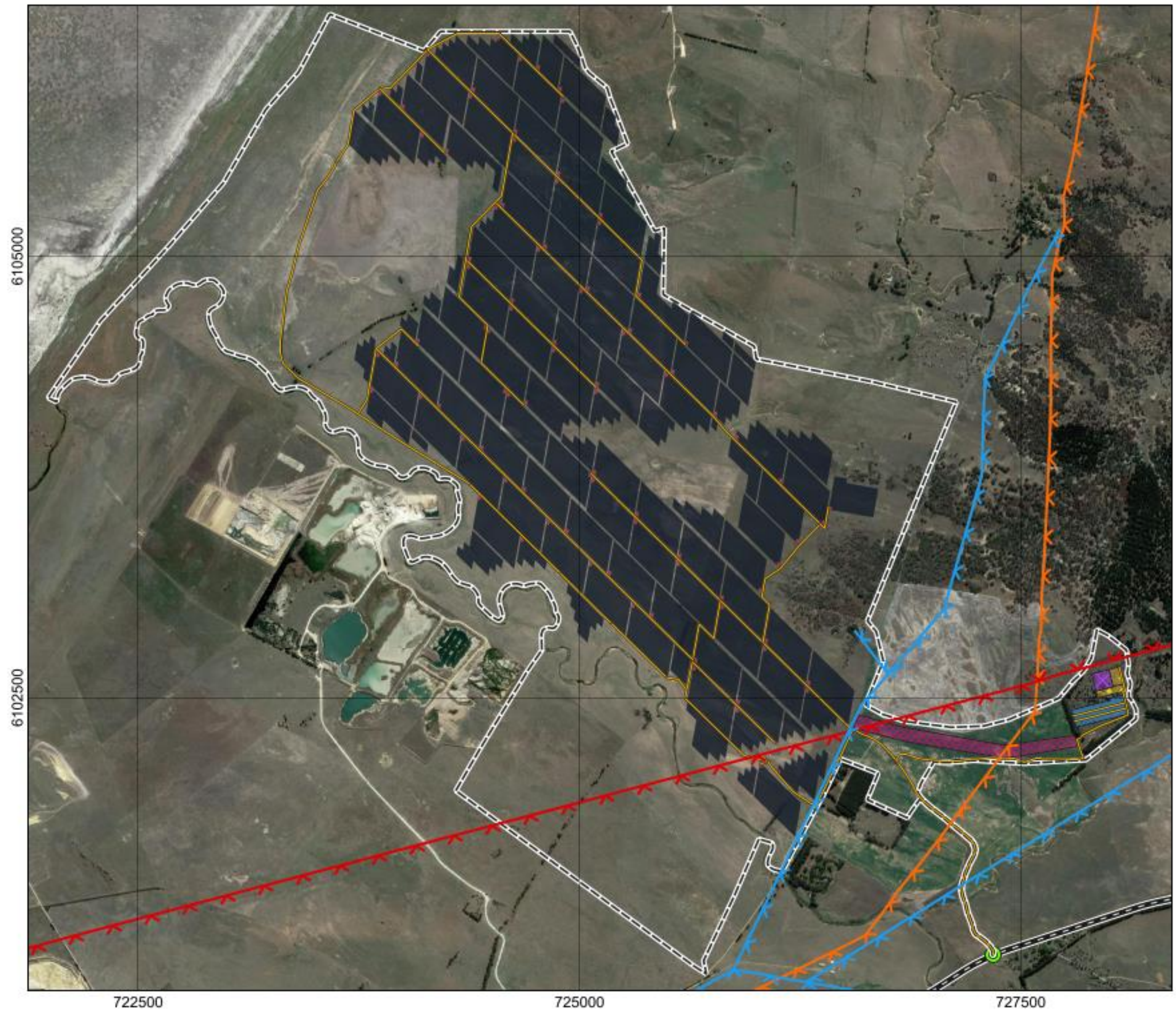
Since that time, the land required for the Project has been subject to ongoing constraints identification through various site investigations, e.g. native vegetation, areas of cultural or heritage significance, etc.

Accordingly, the footprint of the Project has been undergoing refinement as these site investigations have proceeded, taking into account the assessment of any constraints and their associated impact.

2.3 Project Actual Footprint

As of January 2022, and reflecting the ongoing constraints identification process, the currently proposed Project footprint is shown in **Figure 2**.

Figure 2 January 2022 Design Layout of the Project



Comparison of Latest January 2022 Design Footprint with the "Maximal" Footprint

A comparison between **Figure 1** and **Figure 2** shows that the current design footprint is a substantially-reduced subset of the early "maximal" footprint. In particular the current design footprint of the proposed facility:

- Does not include PV arrays in the areas closest to Lake George;
- Does not include PV arrays on the east side of Currandooley Road; and
- Does not include PV arrays on the south side of Butmaroo Creek.

2.4 Key Project Components

From a glare point of view, the key components of the Project are:

- the facility's photovoltaic (PV) modules and their **daytime reflective** glare potential; and
- the facility's security/emergency lighting design and potential **night-time illumination** glare issues, if any such 24/7 lighting is to be incorporated into the Project.

Solar Panel Mounted Array – refer Figure 3

The proposed ground-mounted array within the overall facility (refer **Figure 3(a)**) would consist of solar panels mounted on single-axis trackers oriented in a north-south direction:

- For the purpose of this report, the module used for this study is the Canadian Solar HiKu 455 W panel, measuring 2.11 m x 1.08 m and reaching a maximum height above ground of 4m at full tilt;
- The panel-support trackers are "single-axis", "1 in Portrait" (1P) capable of rotating solar panels to a maximum of ±62° - refer example shown in **Figure 3(b)**;
- The trackers are oriented north-south and would be spaced between 5.25 m and 7 m apart.
- As noted elsewhere in this report, the Project is seeking design flexibility, namely (i) the opportunity to slightly alter the azimuth of the tracking tables from 0° (North) up to 10° East, and (ii) the option to use recently improved "2 in Portrait" (2P) trackers, which results in fewer more widely-spaced trackers, at a slightly higher height at full tilt (up to 5 m). SLR does not believe that these changes would materially alter the conclusions of this report.

Figure 3 Blind Creek Solar Farm – "Maximal" Footprint Site Layout and Panel-Tracker Geometry

(a) Indicative Tracker Layout

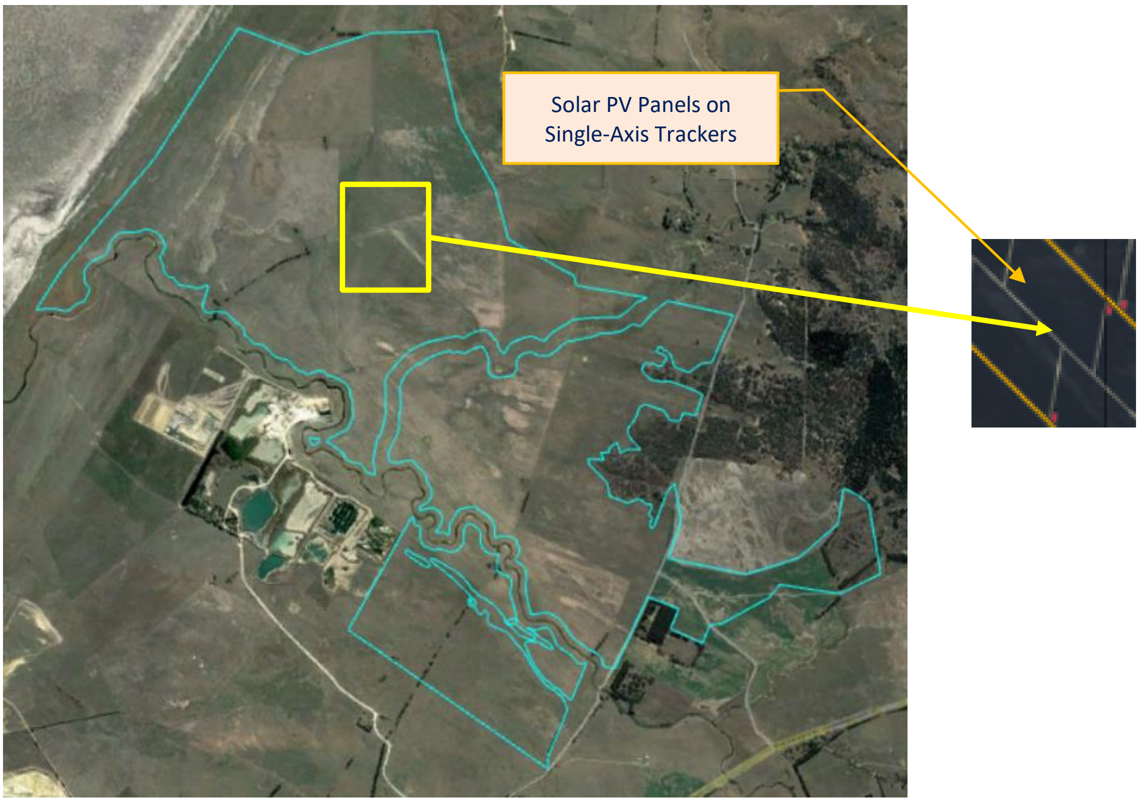
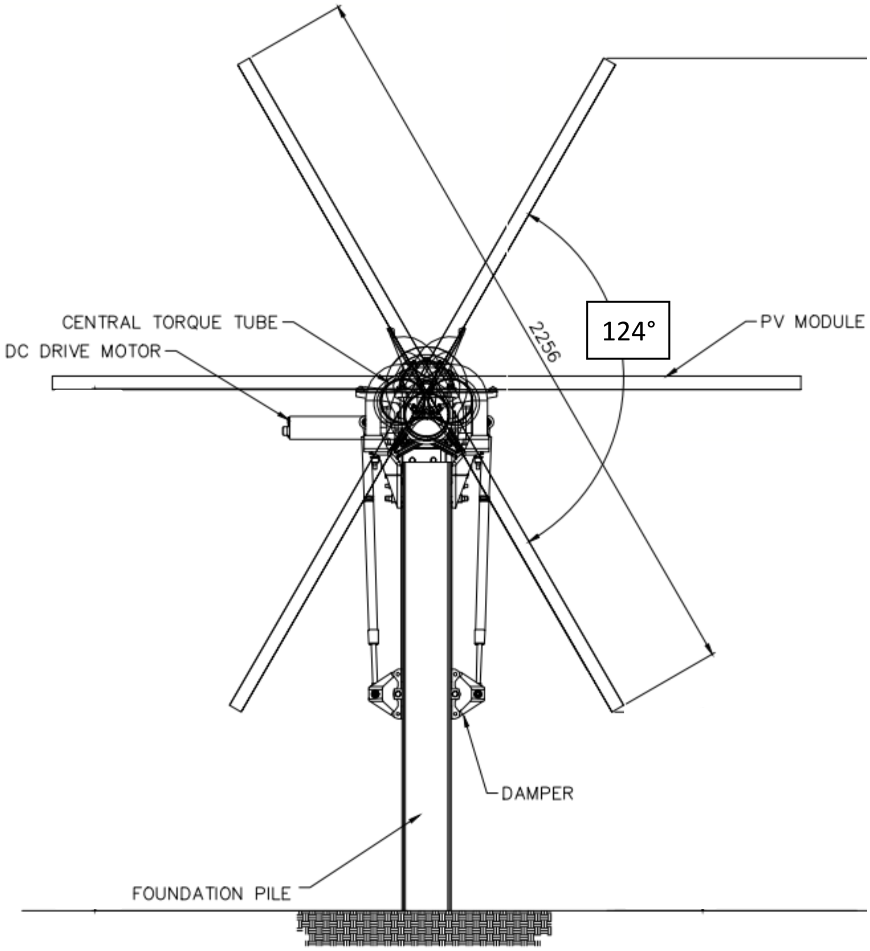


Fig.3 (cont'd)

(b) Example Single-Axis Tracker Profile (±62° Tilt)



3 GLARE IMPACT ASSESSMENT - INPUTS

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels
- Night-time Illumination glare if any 24/7 operational security lighting is located within the site

3.1 Project Site Solar Angles – Annual Variations

One of the challenging issues encountered with daytime solar panel glare is the varying nature of the reflections, whose duration will vary with time of day and day of the year as the sun's rays follow variable incoming angles between the two extremes of:

- summer solstice - sunrise incoming rays from just south of east, maximum annual altitude for midday rays, sunset incoming rays from just south of west
- winter solstice - sunrise incoming rays from the northeast, minimum annual altitude for midday rays, sunset incoming rays from the northwest

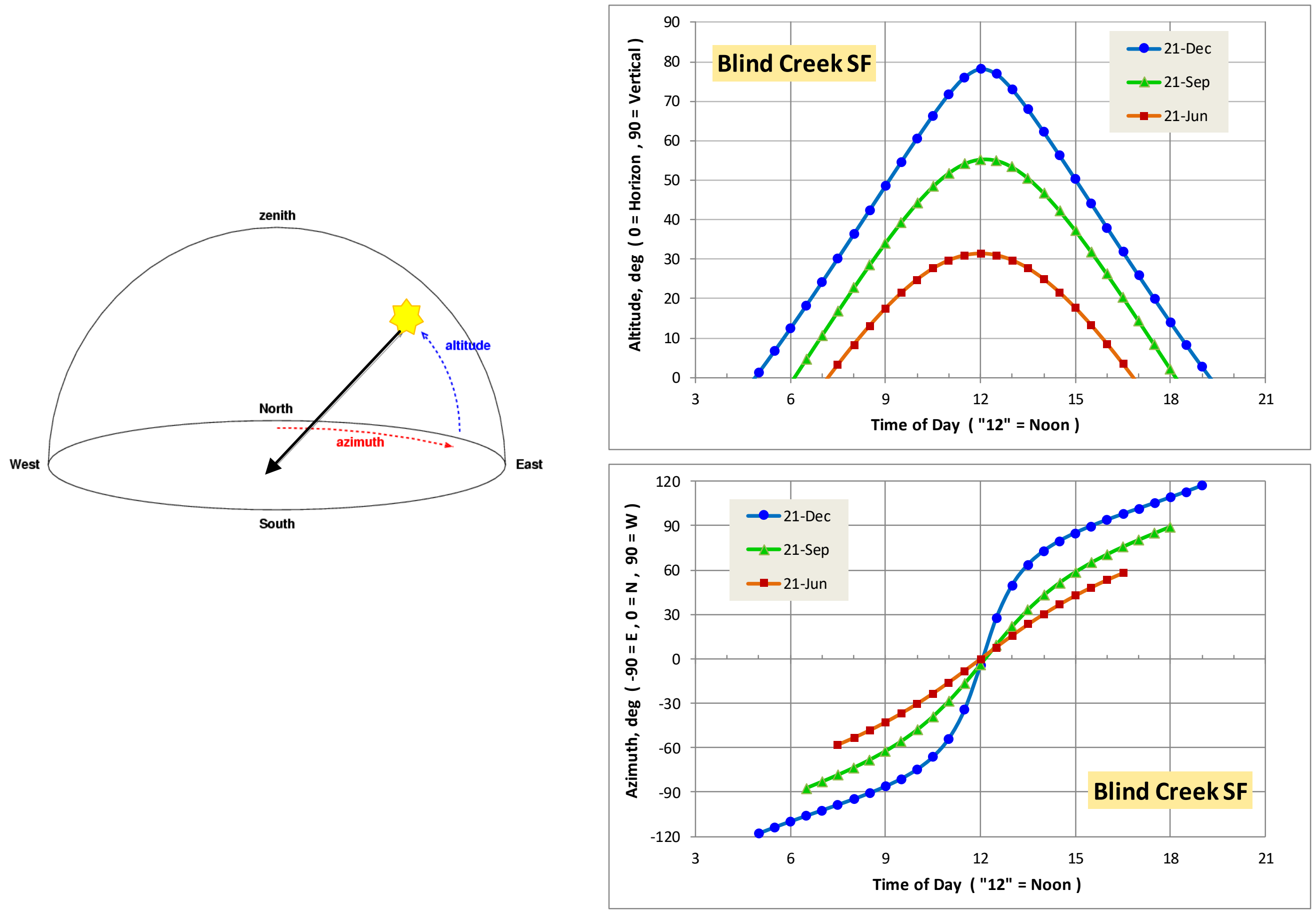
Any solar glare analysis must consider the complete cycle of annual reflection variations noted above.

The potential range of incoming solar angles at the Project site relevant to daytime glare is shown in **Figure 4**, with relevant critical angles summarised in **Table 1**.

Table 1 Key Annual Solar Angle Characteristics for Project Site

Day of Year	Sunrise	Sunset	Azimuth Range (sunrise-sunset)	Max Altitude
Summer Solstice	4:53 am	7:15 pm	119.1° E of North to 119.1° W of North	78.2°
Equinox	6:07 am	6:11 pm	90.7° E of North to 90.7° W of North	55.3°
Winter Solstice	7:11 am	4:49 pm	60.8° E of North to 60.8° W of North	31.4°

Figure 4 Project Site Incoming Solar Angle Variations



3.2 Solar Panel Reflectivity

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface. Consequently, solar PV panels are designed to minimise reflections off the surface of each panel. Reflections are a function of:

- the angle at which the light is incident onto the panel (which will vary depending on the specific location, time of day and day of the year), and
- the index of refraction of the front surface of the panel and associated degree of diffuse (non-directional) versus specular (directional or mirror-like) reflection which is a function of surface texture of the front module (reflecting) surface.

Some typical reflectivity values (given in terms of the "n" refractive index value) are:

- Snow (fresh, flaky) n = 1.98
- Standard Window Glass n = 1.52
- Plexiglass, Perspex n = 1.50
- Water n = 1.333
- Solar Glass n = 1.33
- Solar Glass with AR Coating n = 1.25

Standard PV Solar Panels

Representative reflectivity curves are shown in **Figure 5**.

Figure 5 Typical Reflectivity Curves as a Function of Incidence Angle

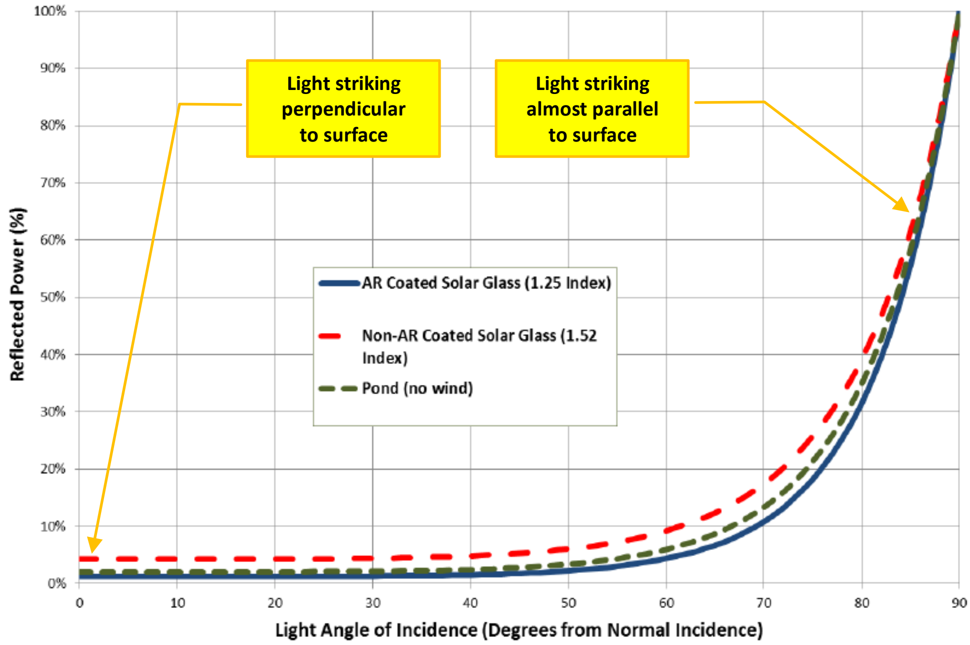


Figure 5 shows that:

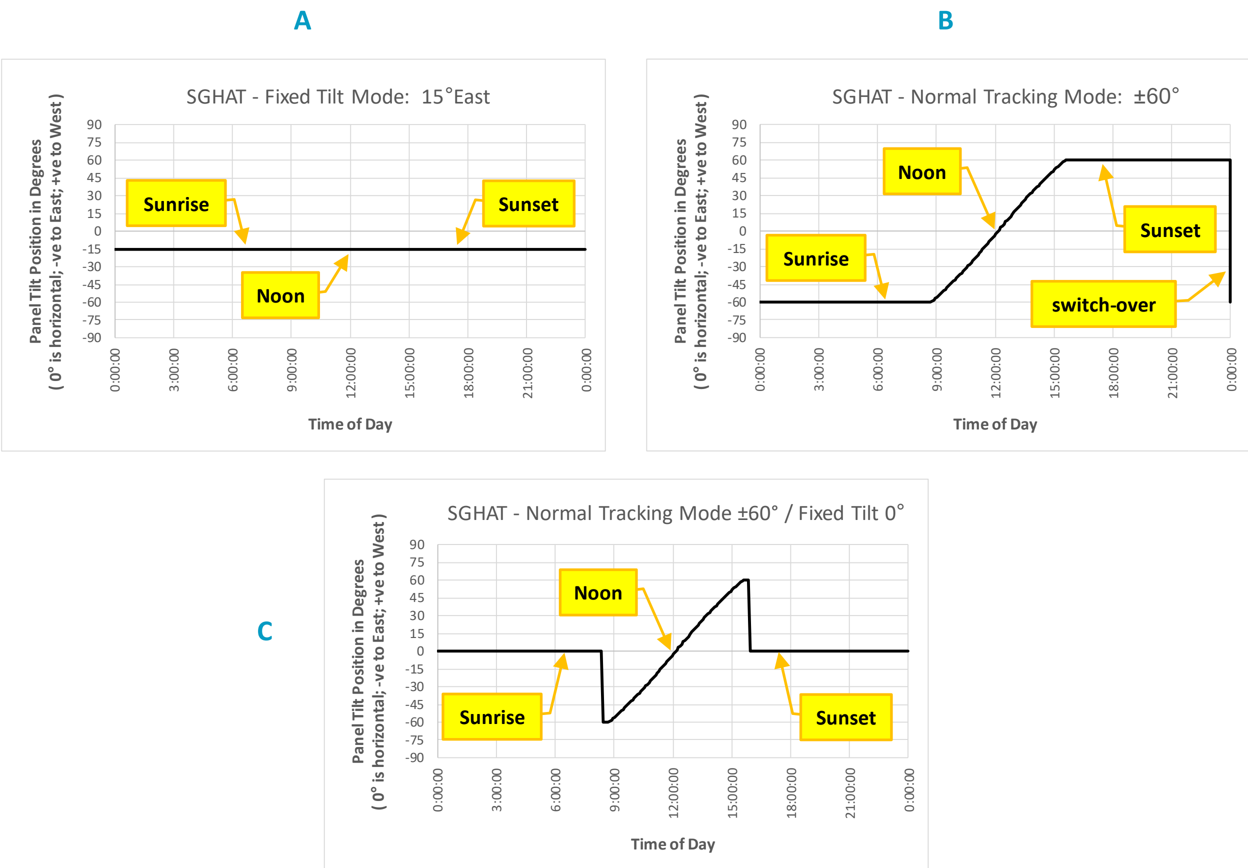
- When an oncoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (i.e. low "incident" angle), reflectivity is minimal, less than 5% for all solar panel surface types.
- It is only when an incoming solar ray strikes the panel at large "incidence" angles, i.e. closer to parallel to the panel, that reflectivity values increase. When this happens, reflections become noticeable and potentially at "glare" level for all solar panel surface types.
- However, for very high incidence angle, it would almost always be the case that an observer (motorist, train driver, resident, etc) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

3.3 Modelling Real-World Tracking Axis Operational Modes

Commercially available software tools, e.g. SGHAT for Aviation Glare, are typically capable of modelling solar farm panel positions in one of three modes – as shown in **Figure 6**.

- **Figure 6-A: Fixed Tilt:** in this mode, all panels are assumed to remain at a user-defined fixed angle all day long, e.g. horizontal, 5°North, 15°East, 10°West, etc. Such a situation would typically occur during construction or during maintenance periods.
- **Figure 6-B: Normal Tracking:** in this mode, panels move between maximum tilt angles once the sun is above the relevant altitude angle (e.g. an altitude angle of 30° for ±60° single-axis trackers). They remain at the maximum tilt angles at all other times, switching over during the night.
- **Figure 6-C: Normal Tracking / Fixed Tilt Stowed:** in this mode, panels move during the middle part of the day in "normal tracking" mode, but then move (essentially instantaneously) to any user-defined fixed tilt angle at all other times; in the example shown, the panels move to a horizontal position (i.e. 0°) outside of "normal tracking" hours.

Figure 6 SGHAT Panel Mode Simulation Options



"Back-Tracking" Mode

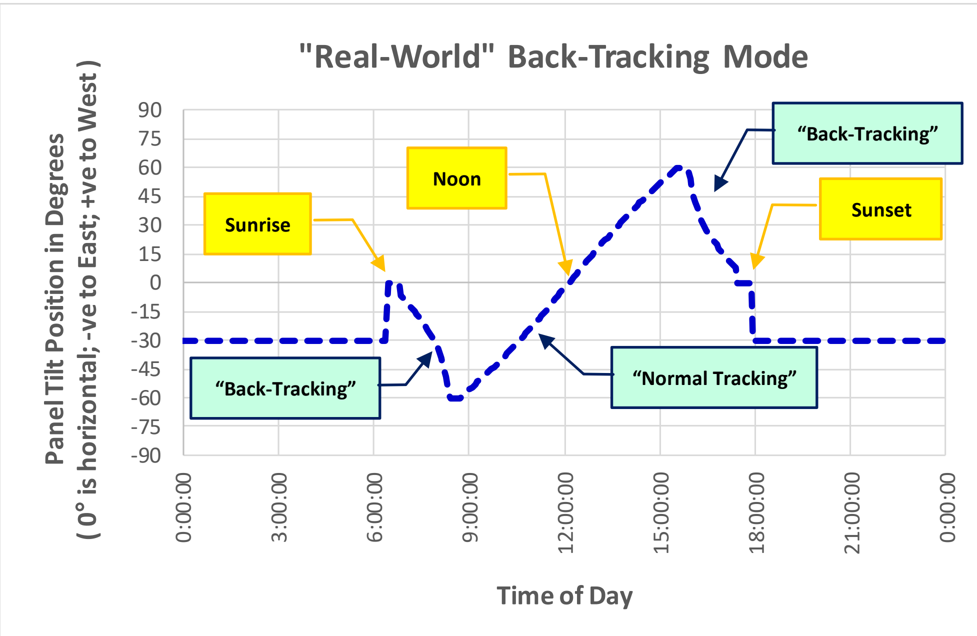
Most recently, sophisticated "back-tracking" operational modes have been developed, typically by the manufacturers of the tracking systems on which the solar panels are mounted:

- Algorithms are developed (usually fine-tuned during the commissioning stage of a solar facility) aimed at minimising inter-row shading in the early morning and late afternoon. These algorithms are based on the location of a solar facility (i.e. its latitude), topography, panel row spacing, etc.
- They typically involve constantly re-positioning panels to "just" avoid inter-row shading in the early morning and late afternoon, with panels starting and ending in a more-or-less horizontal position, which can typically last about 10-15 minutes at the start and end of the day.
- During these early morning and late afternoon shade-avoidance periods, panel motion is referred to as being in "back-tracking" mode.
- During the remaining hours in the middle of the day, solar panels follow the simplified "normal tracking" mode, i.e. moving between their maximum (say ±60°) tilt positions.
- There is typically a transition period between the two tracking modes (again approximately 10-15 minutes), calculated according to the local site tracking system algorithms.

A real-world example of a "back-tracking" mode is shown in **Figure 7**. In this example, the sun reached an altitude angle of 30° in the morning at around 8:30am and again in the afternoon at around 3:45pm.

- Between around 8:30am and 3:45pm, the panels operated in "normal tracking" mode, i.e. from -60° (facing East) to +60° (facing West).
- From sunrise till 8:30am and from 3:45pm to sunset, the panels operated in "back-tracking" mode, starting at sunrise and ending at sunset in a horizontal position (0°).
- Overnight, the panels were "stowed" in a fixed (in this case, -30°) position to minimise wind loading and ensure any moisture (dew or rain) did not pool on the panels overnight, causing soiling.

Figure 7 Example 24-Hour "Back-Tracking" Operational Mode (around equinox)



Commercially available software programs (e.g. SGHAT) have not evolved yet to deal with sophisticated "back-tracking" operational modes of the type shown in **Figure 7**. They can only simulate solar farm panel positions in the three simplified modes shown in **Figure 6**.

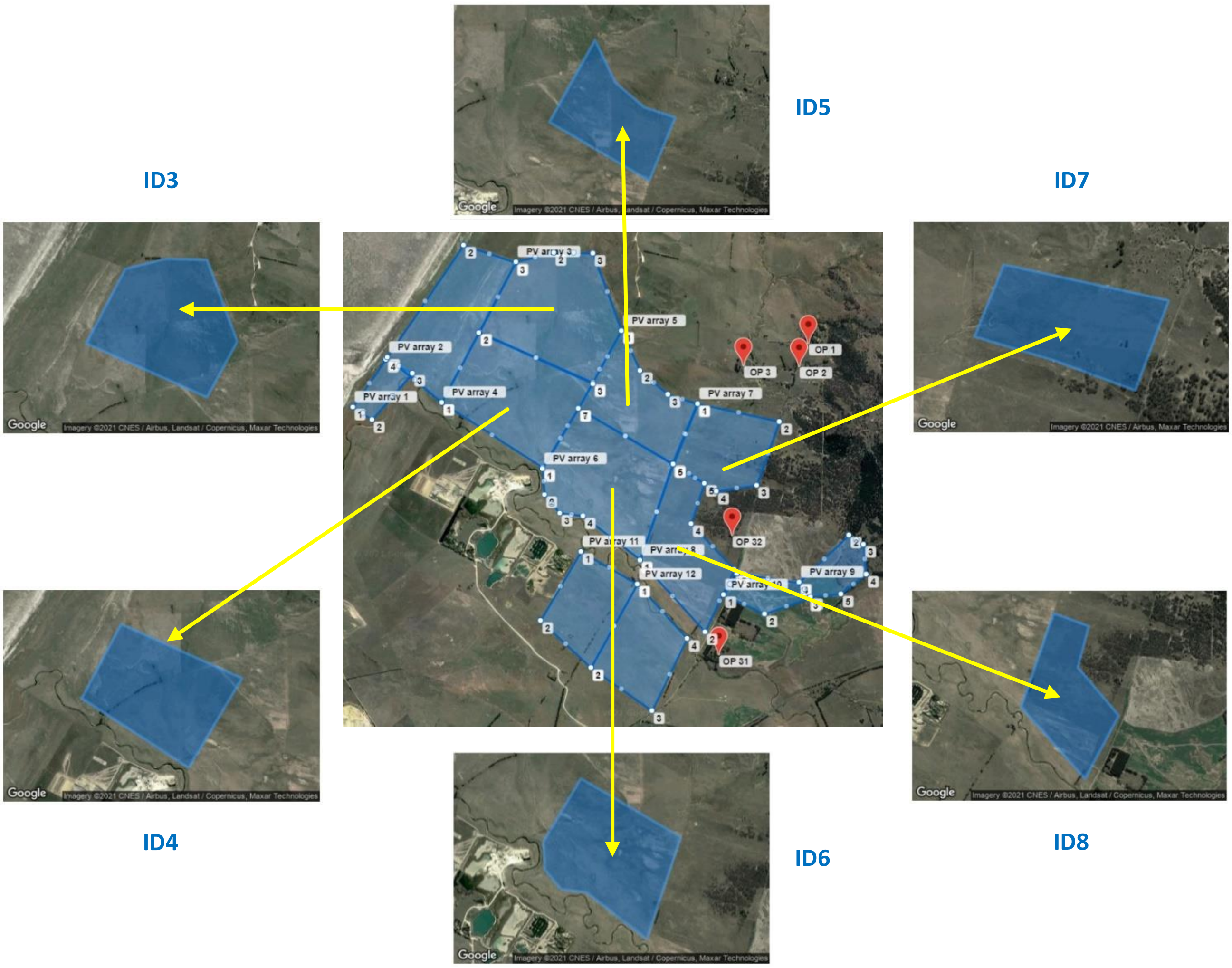
It will be appreciated therefore that care must be taken when comparing the glare predictions of simplified SGHAT-type simulation modes, such as those shown in **Figure 6**, with possible real-world reflectivity behaviour of operational panel modes as shown in **Figure 7**.

3.4 Solar Facility Analysis Array Zones

At the commencement of this glare study, the facility boundary was divided into 12 array zones as shown in **Figure 8**. This preliminary break-up was made on the basis of the irregular shape of the Project's "maximal" footprint (refer **Figure 1**), as well as reflecting the variation in elevation in different parts of the facility (ranging from just below RL680m to over RL700m).

In the development of the current design footprint of the proposed facility (refer **Figure 2**), Panel Arrays 1, 2, 9, 10, 11 and 12 were eliminated. Accordingly, Panel Arrays ID 3-8 were retained for subsequent detailed analysis - refer **Figure 8**. It is noted that the panel areas proposed for the currently design footprint (refer **Figure 2**) lie within the analysis array zones shown in **Figure 8**.

Figure 8 Blind Creek Solar Farm Analysis Zones – Panel Array Zone ID Identifiers



4 GLARE IMPACT – AVIATION GLARE

4.1 Nearest Aerodrome(s)

The nearest airports and aerodromes to the site are shown in **Figure 9**:

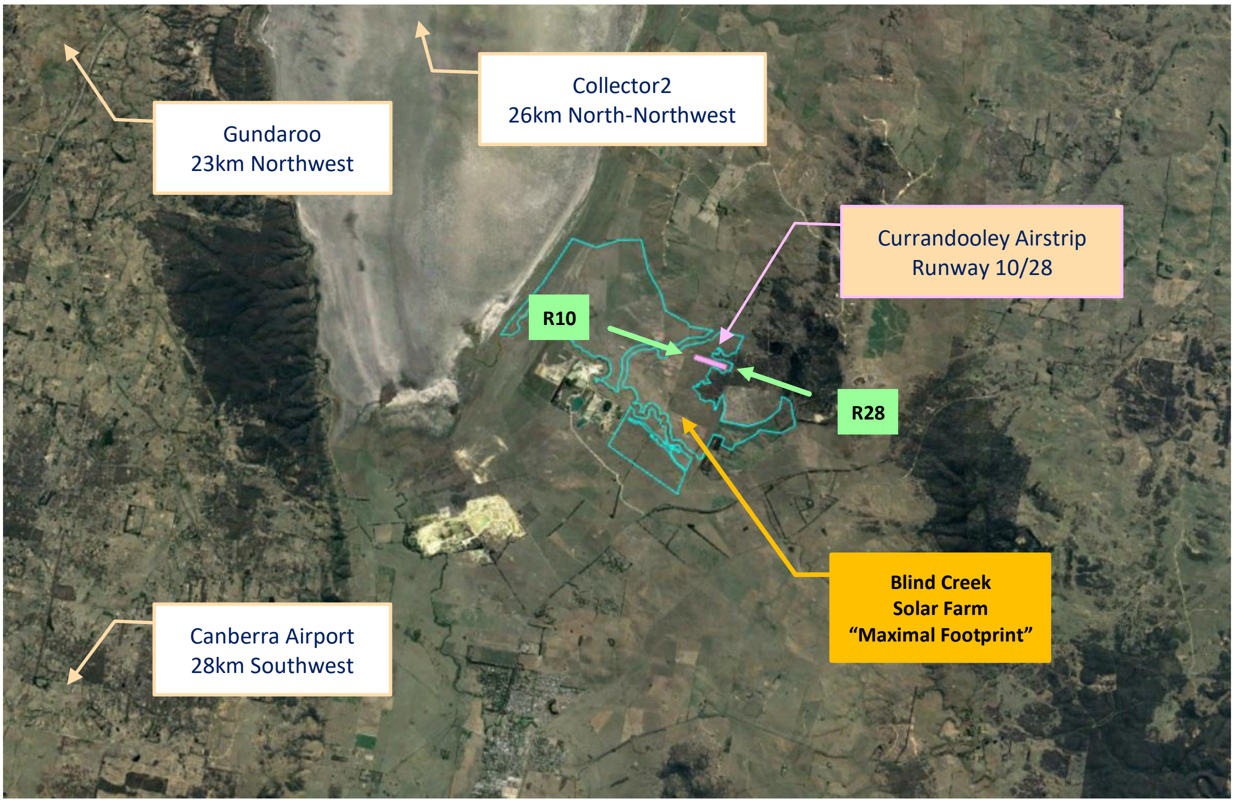
- Gundaroo 23 km northwest of the site
- Collector2 26 km north-northwest of the site
- Canberra 28 km southwest of the site

Due to the distances involved, the Project would not pose a potential glare issue for these aerodromes.

There is also an existing private airstrip, "Currandooley Airstrip", classified by CASA as an "Aircraft Landing Area", within the Project boundary – refer **Figure 1**. The airstrip is presumably serviced by GA aircraft and other contracted services, e.g. crop dusting aircraft.

- The airstrip's unmarked grass runway, Runway 10/28, is just over 700 m long and is oriented roughly east-southeast / west-northwest.
- Aircraft using Runway 28, i.e. approaching from the east-southeast, would have a direct line of sight towards the Project and potential associated reflections.
- Aircraft using Runway 10, i.e. approaching from the west-northwest, would also have a direct line of sight towards the Project and potential associated reflections.

Figure 9 Nearest Aerodrome(s) and Airstrips to Project Site



4.2 Aviation Sector Reflective Glare – Analysis Tool and Criteria

The impact of solar PV systems on aviation activity is something that solar developers today are addressing more and more often, given the (global) proliferation of solar projects, in particular those located either within or around airport precincts.

US FAA - SGHAT

In relation to the potential impact of solar PV systems on aviation activity, guidance is available from the US FAA which regulates and oversees all aspects of American civil aviation. The FAA issued a Technical Guidance Policy in 2010 and a subsequent (over-riding) Interim Policy in 2013. The Technical Guidance Policy was updated in 2018.

- FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., November 2010.
- FAA, *"Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports"*, Federal Register, Oct. 23, 2013.
- FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., Version 1.1, April 2018.

In support of the above, the FAA contracted Sandia Labs to develop their **Solar Glare Hazard Analysis Tool** (SGHAT) software as the standard tool for measuring the potential ocular impact of any proposed solar facility on a federally obligated airport. SGHAT utilises the Solar Glare Ocular Hazard Plot to determine and assess the potential for glare. SGHAT is described in the following references:

- Ho, C.K., Ghanbari, C.M. and Diver, R.B., "Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation", J. Solar Engineering, August 2011, Vol.133, 031021-1 to 031021-9.
- Ho, C.K. & Sims, C., "Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v2.0", Sandia National Laboratories, Albuquerque, NM. August 2013.

Australia's CASA (Civil Aviation Safety Authority) recommends SGHAT for aviation glare assessments related to solar facilities located near aerodromes.

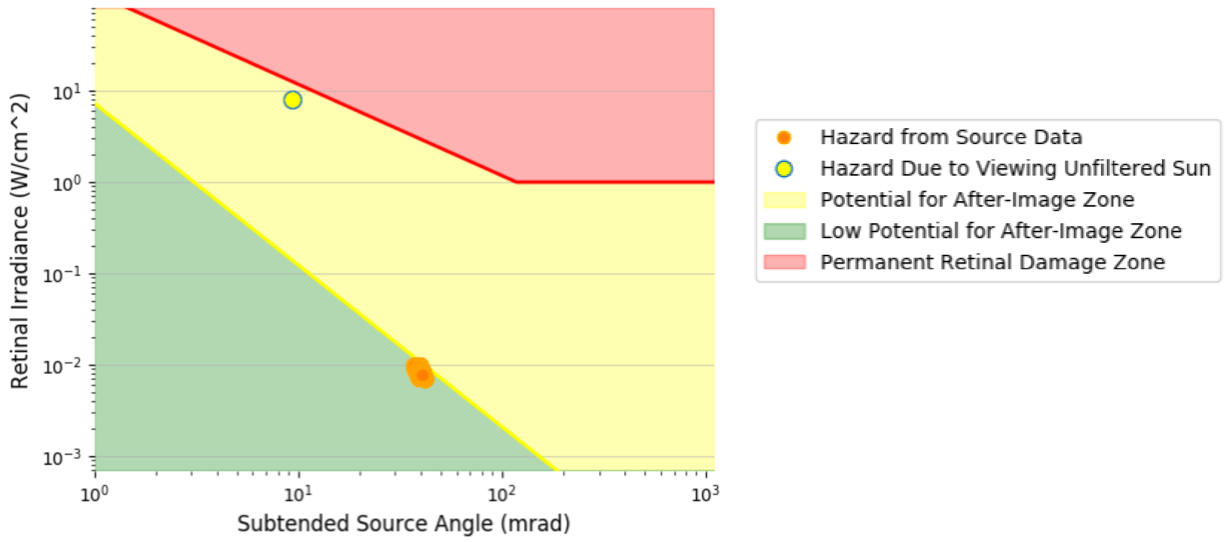
A sample Solar Glare Ocular Hazard Plot is shown in **Figure 10**.

The analysis contained in this plot is derived from solar simulations that extend over the ENTIRE CALENDAR YEAR in 1-MINUTE intervals, sunrise to sunset.

The SGHAT criteria state that a proposed solar facility should satisfy the following:

- Airport Traffic Control Tower (ATCT) cab: NO Glare
- Final approach paths for landing aircraft: Glare to NOT exceed "Low Potential for After-Image"
- SGHAT assessments should take into account planned (i.e. future) ATCTs and runways in glare studies.

Figure 10 Example Solar Glare Ocular Hazard Plot (SGHAT Software Output)



In **Figure 10**, the following is noted:

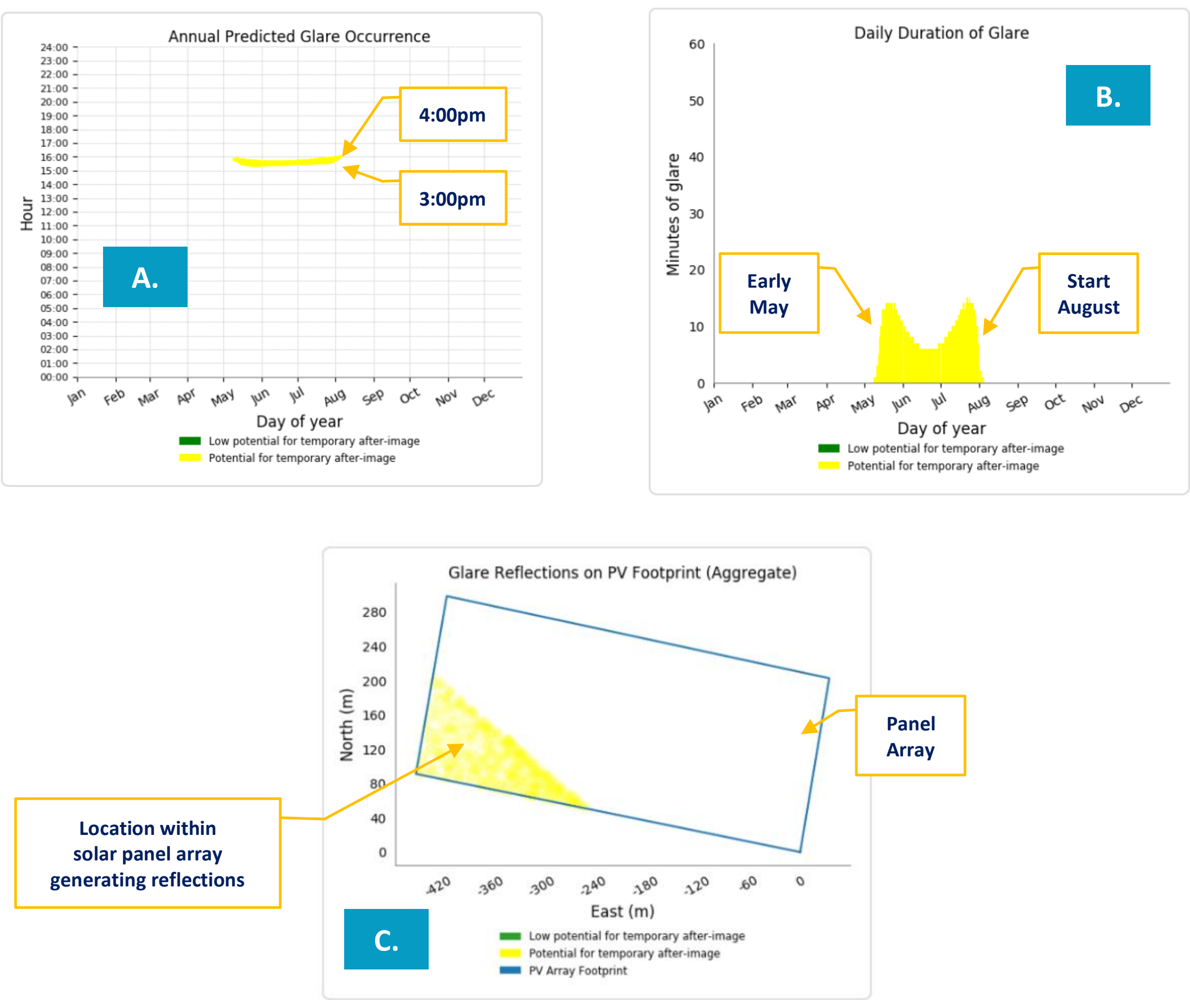
- SGHAT ocular impact is a function of both the "retinal irradiance" (i.e. the light seen by the eye) and "subtended source angle" (i.e. how wide an arc of view the light appears to be arriving from).
- SGHAT ocular impact falls into three categories:
  . GREEN: low potential to cause "after-image"
  . YELLOW: potential to cause temporary "after-image"
  . RED: potential to cause retinal burn (permanent eye damage)
- "After Image" is the term applied to a common retinal phenomenon that most people have experienced at some point or other, such as the effect that occurs when a photo with flash is taken in front of a person who then sees spots in front of their eyes for a few seconds. A more extreme example of "after-image" occurs when staring at the sun. "After-image" (also known as "photo bleaching") occurs because of the de-activation of the cells at the back of the eye's retina when subjected to a very bright light.
- The SGHAT plot provides an indication of the relative intensity of both the incoming reflection and the sources of light itself (i.e. the sun).
  . The occurrence of glare is shown in the plot as a series of orange circles, one circle for each minute that a reflection is visible.
  . A reference point is also shown in each SGHAT plot, the yellow circle with the green outline, representing the hazard level of viewing the sun without filtering, i.e. staring at the sun.
- In **Figure 10**, it can be seen that the reflection visible by the receiver is roughly 1,000 times less intense than the light from the sun.
- Finally, in relation to PV Solar facilities, it is important to note that the third SGHAT Ocular Plot "RED" category is **not possible**, since PV modules DO NOT FOCUS reflected sunlight.

Additional Information Available with the SGHAT Analysis Tool

In addition to the above “assessment” output, the SGHAT software package also produces information which reveals the extent of visibility of reflections at any chosen receiver position, regardless of whether the reflections constitute a glare condition or not – an example is shown in **Figure 11**.

- **Figure 11-A**: shows the am/pm time periods when reflections occur at a specific position throughout the year, in this case typically between around 3:30 pm and 4:00 pm.
- **Figure 11-B**: shows the months during the year and the minutes per day when reflections occur at a specific position, in this case from early-May to the start of August, for periods ranging up to 13 minutes per day.
- As noted above, this information is made possible because the SGHAT analysis covers the entire solar annual cycle in 1-minute intervals to ascertain any potential impacts on surrounding receivers.
- Finally, **Figure 11-C** shows WHERE within the solar farm panel array the reflection rays of interest are emanating from, in this case from panels near the southwest corner.

Figure 11 Example Solar Glare Output Plots (SGHAT Software Output)



4.3 SGHAT Analysis

Status of Currandooley Airstrip

As noted in **Section 2**, the footprint of the Project has been undergoing refinement reflecting the outcomes of various site investigations (native vegetation, heritage, etc) and the assessment of any constraints and their impact.

On the basis of these constraints, and other considerations involving land usage optimisation, SLR has been advised that the privately-owned Currandooley Airstrip will almost certainly be de-commissioned to make way for solar panels, to be contained within Panel Array ID7 – refer **Figure 8**.

Reflecting the above, an SGHAT analysis of the airstrip was nevertheless carried out in the (highly unlikely) scenario that the airstrip is preserved in the final (to be constructed) design.

Details of the analysis and the associated outcomes are provided in **Appendix B**.

The outcome of the SGHAT analysis suggest that, if a Back-Tracking solution is chosen for the facility, tracking controls focussed on individual panel arrays could enable virtually all-year-round use of Currandooley Airstrip at any time of day for both runways – refer **Appendix B** for details.

It is noted again however that Currandooley Airstrip will almost certainly be de-commissioned to make way for the proposed facility and, as such, aviation glare issues are non-existent in relation to the current proposal.

5 GLARE IMPACT – ROAD AND RAIL DISABILITY GLARE

5.1 Surrounding Road and Rail Network

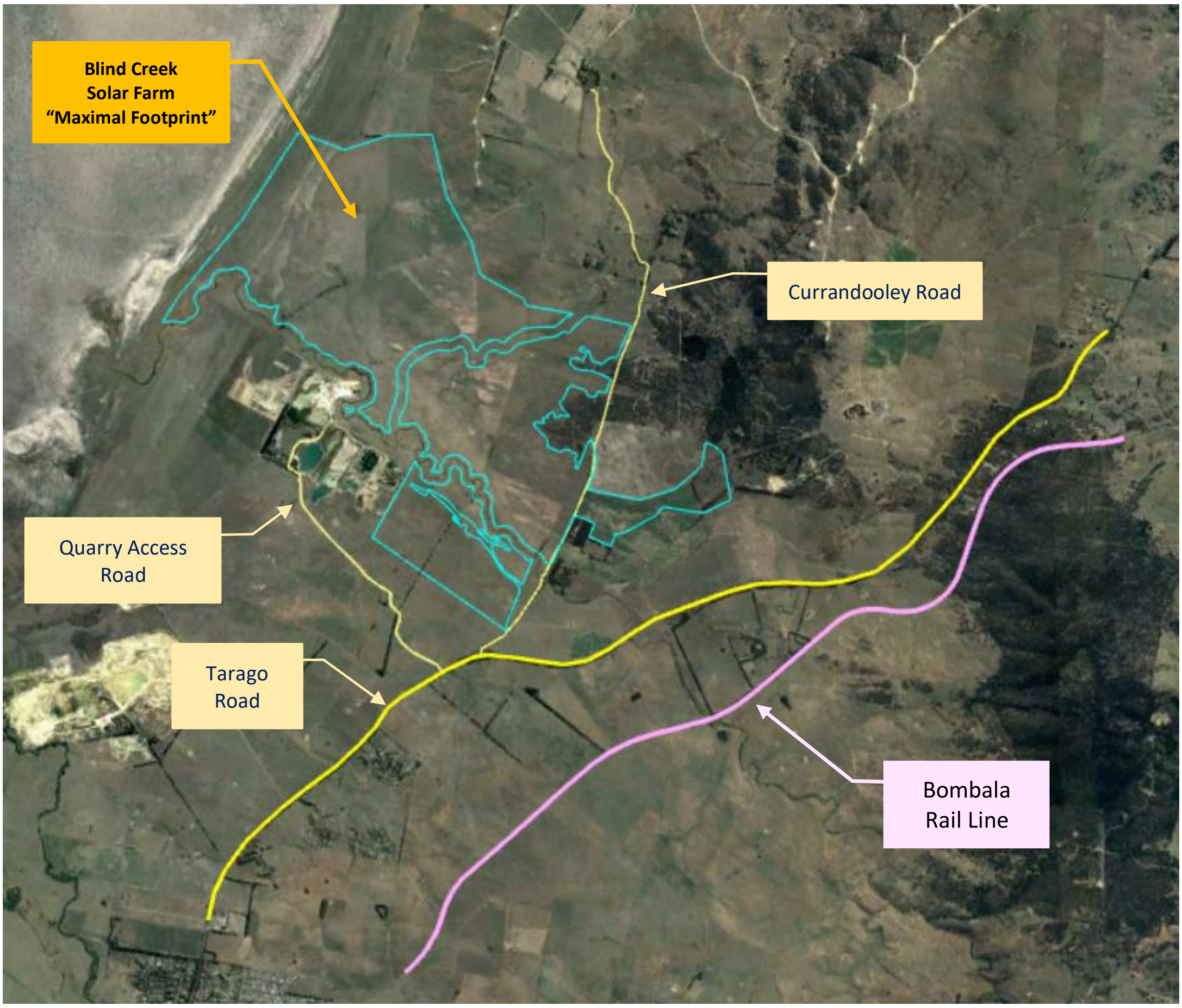
The “major” and “minor” road thoroughfares in the immediate vicinity of the Project are shown in **Figure 12**:

- Tarago Road - eastbound and westbound “major”
- Currandooley Road - northbound and southbound “minor”
- Quarry Access Road – northbound and southbound “minor”

The rail lines in the immediate vicinity of the Project are also shown in **Figure 12**:

- Bombala Rail Line - eastbound and westbound

Figure 12 Surrounding Road and Rail Network



5.2 Motorist and Rail Operator "Disability" Glare – Analysis Tool and Criteria

The criteria commonly used by Australian Local Government Authorities to assess the acceptability or otherwise of potential adverse reflections from glazed façade systems onto surrounding roadways and pedestrian crossings utilise the so-called **Threshold Increment** (TI) Value of the reflection condition.

TI Value Definition

AS/NZS 4282:2019 and CI.E. 140-2019 define the Threshold Increment (TI) as:

> *"the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare."*

The TI Value is calculated as the ratio of "veiling" luminance (e.g. from a reflection) to the overall average background ("adaptation") luminance, with the necessary constant and exponent parameters shown below …

$$\mathrm{TI}\,\% = 65\frac{L_v}{{L_{ad}}^{0.8}} \qquad 0.05 < L_{ad} < 5.0$$

$$\mathrm{TI}\,\% = 95\frac{L_v}{{L_{ad}}^{1.05}} \qquad L_{ad} > 5.0$$

where:

- L_v = veiling luminance from a source of interest (eg reflection) – Cd/m^2
- L_{ad} = so-called "adaptation" luminance (total background) – Cd/m^2
- The motorist eye height is taken to be 1.5 m above the road surface; their line of sight is taken to be 1° down relative to the plane of the road surface and the windshield (windscreen) cut-off angle can be assumed to be 20° above the horizontal.

TI Value Acceptability Criteria

Roads

The acceptability criteria adopted by Australian Local Government Authorities to assess the acceptability or otherwise of potential adverse reflections on roadways and pedestrian crossings utilise the above TI Value of the reflection condition (refer above for calculation equations).

For (Motorist) Traffic Disability Glare, the TI Value should remain:

- Below 10% for major roads
- Below 20% for minor roads

For Pedestrian Discomfort Glare, the TI Value should remain:

- Below 2% at critical locations such as pedestrian crossings
- Below 3% for other locations

Note: the Pedestrian Discomfort Glare TI Value criteria provide a possible benchmarking tool for the assessment of potential nuisance glare at surrounding residential receivers, albeit noting that these criteria were developed for building façade reflections to be applied to relatively short distances (say less than 1 km).

Rail

Almost all Australian Rail Authorities have guidelines covering glare in general (i.e. not specific to solar PV panel glare) aimed at avoiding discomfort/distraction to train operators and obscuring train signals. Most guidelines refer either to Table 2.10 of AS 1158.3.1 for the TI Value criterion and/or Table 3.2 of AS 1158.4 for the Cd (Candela) criterion associated with the control of glare.

For Rail Traffic Disability Glare, the relevant criteria are:

- The TI Value should remain below 20% (this is the same as per “minor” roads)
- The Cd Value at 70° incidence should remain below 6,000.

5.3 TI Value Analysis and Results

Important factors influencing the potential for road and rail disability glare include:

- Any difference in elevation between the motorist or rail operator and the solar panel array;
- The potential for solar reflections of concern to be obstructed by intervening terrain and topography as well as dense vegetation; and
- The difference between the line of sight of a driver (i.e. in the direction of the road or rail line) and the line of sight relative to incoming reflections. Significant TI values can only occur when this difference is modest. In some cases, e.g. when traffic is moving away from the line of incoming reflections, such reflections become essentially invisible – this would apply for example to traffic on Tarago Road travelling northeastwards after passing to the east of the Project.

SLR has undertaken TI Value calculations for the roadways and rail line shown in **Figure 12**.

Calculation locations were varied along the relevant carriageways, focussing on positions where the difference between the line of sight of drivers and the angle of potential incoming solar reflected rays was at a minimum.

A summary of the TI Value analysis for all panel scenarios is presented as follows:

- **Table 2** Tarago Road: All Modes (Normal Tracking & Fixed Tilt)
- **Table 3** Currandooley Road: All Modes (Normal Tracking & Fixed Tilt)
- **Table 4** Quarry Access Road: All Modes (Normal Tracking & Fixed Tilt)
- **Table 5** Bombala Rail Line: All Modes (Normal Tracking & Fixed Tilt)

Table 2 TI Value Analysis Results – TARAGO ROAD

PV Array ID (refer Fig.8)	Mode					
	Normal Tracking	FIXED 20°West	FIXED 10°West	FLAT	FIXED 10°East	FIXED 20°East
PV Array 3	Nil	Nil	Nil	Nil	Nil	Nil
PV Array 4		Nil	Nil	Nil	Nil	Nil
PV Array 5		Nil	Nil	Nil	Nil	Nil
PV Array 6		Nil	Nil	Nil	Nil	Nil
PV Array 7		Nil	Nil	Nil	Nil	Nil
PV Array 8		TImax < 10	Nil	Nil	Nil	Nil

Table 3 TI Value Analysis Results – CURRANDOOLEY ROAD

PV Array ID (refer Fig.8)	Mode					
	Normal Tracking	FIXED 20°West	FIXED 10°West	FLAT	FIXED 10°East	FIXED 20°East
PV Array 3	Nil	Nil	Nil	Nil	Nil	Nil
PV Array 4		Nil	Nil	Nil	Nil	Nil
PV Array 5		Nil	Nil	TImax ~20	TImax < 20	TImax < 20
PV Array 6		Nil	Nil	TImax < 20	TImax ~20	TImax < 20
PV Array 7		Nil	Nil	TImax ~20	TImax ~20	TImax ~20
PV Array 8		Nil	Nil	TImax ~20	TImax ~20	TImax ~20

Table 4 TI Value Analysis Results – QUARRY ACCESS ROAD

PV Array ID (refer Fig.8)	Mode					
	Normal Tracking	FIXED 20°West	FIXED 10°West	FLAT	FIXED 10°East	FIXED 20°East
PV Array 3	Nil	Nil	Nil	Nil	Nil	Nil
PV Array 4		Nil	Nil	Nil	Nil	Nil
PV Array 5		Nil	Nil	Nil	Nil	Nil
PV Array 6		Nil	Nil	Nil	Nil	Nil
PV Array 7		Nil	Nil	Nil	Nil	Nil
PV Array 8		Nil	Nil	Nil	Nil	Nil

Table 5 TI Value Analysis Results – BOMBALA RAIL LINE

PV Array ID (refer Fig.8)	Mode					
	Normal Tracking	FIXED 20°West	FIXED 10°West	FLAT	FIXED 10°East	FIXED 20°East
PV Array 3	Nil	Nil	Nil	Nil	Nil	Nil
PV Array 4		Nil	Nil	Nil	TImax < 20	TImax < 20
PV Array 5		Nil	Nil	TImax < 20	TImax < 20	TImax < 20
PV Array 6		Nil	Nil	TImax < 20	TImax < 20	TImax < 20
PV Array 7		Nil	Nil	Nil	TImax < 20	TImax < 20
PV Array 8		Nil	Nil	TImax < 20	TImax < 20	TImax < 20

Summary of Motorist and Rail Operator Disability Glare

Tarago Road

- TI Values are non-existent for Normal Tracking ±62° Mode
- TI Values for all other Fixed Tilt Modes are within the criteria.

Currandooley Road

- TI Values are non-existent for Normal Tracking ±62° Mode.
- TI Values were registered from PV Arrays 5, 6, 7 and 8 for the Fixed Tilt Modes: Flat (0°), 10°East and 20°East. For these array/tilt combinations, reflections would be visible on Currandooley Road travelling northwards, along the section of roadway passing very close to PV Array 8. Worst-case predicted TI Values are close to the limiting TI Value criterion of 20.
- The above reflections on Currandooley Road would be visible in the late afternoon and would typically last 5 minutes on average, with a maximum of 10-12 minutes for several days of the year.
- Elimination of these reflections on Currandooley Road could be achieved via a vertical barrier along the eastern edges of PV Arrays 7 and 8. The barrier could be of any reasonable "solid" form, including vegetation, and would need to be at or above the same height as the top height of the panels within their tracking arc.
- Alternatively, avoiding very low panel angles with PV Arrays 5-8 would also eliminate glare potential along Currandooley Road.

Quarry Access Road

- TI Values are non-existent for ALL modes - Normal Tracking ±62° and Fixed Tilt modes.

Bombala Rail Line

- TI Values are non-existent for the Normal Tracking ±62° Mode.
- TI Values for all other Fixed Tilt modes are within the criteria.

Motorist and Rail Operator Disability Glare Mitigation Recommendations

Table 6 summaries the mitigation options that would ensure that all surrounding road and rail carriageways do not experience glare impact from the facility.

- No mitigation is required for PV Arrays 3-4.
- The remaining potential glare conditions (PV Arrays 5-8) can be addressed via perimeter barriers (e.g. vegetation) along the eastern edges of Panel Arrays 7 and 8, OR panel operational options, e.g. ensuring that horizontal or near horizontal panels angles are avoided for PV Arrays 5-8. The precise limiting tilt angle should be confirmed during commissioning.

Table 6 TI Value Analysis Results – ROAD & RAIL DISABILITY GLARE

<table>
<tr><th rowspan="2">PV Array ID
(refer Fig.5)</th><th colspan="4">ACTION on Road or Rail Carriageway to Eliminate Glare</th></tr>
<tr><th>Currandooley Road</th><th>Tarago Road</th><th>Quarry Access Road</th><th>Bombala Rail Line</th></tr>
<tr><td>PV Arrays
3 and 4</td><td>No mitigation needed for ANY operational mode:
Normal Tracking
Back-Tracking
Fixed Tilt Modes</td><td colspan="3" rowspan="2">No mitigation needed for ANY operational mode:
Normal Tracking
Back-Tracking
Fixed Tilt Modes</td></tr>
<tr><td>PV Arrays
5, 6, 7 and 8</td><td>PV Arrays 7 & 8
Perimeter Barriers
OR
Avoid low angle
Fixed Tilt EAST</td></tr>
</table>

In relation to the use of “Back-Tracking”, the above recommendations can be interpretated as follows:

- Uninhibited Back-Tracking can be allowed for PV Arrays 3-4.
- If vegetation screening is not provided along the perimeters of the solar facility running close to Currandooley Road, Back-Tracking for PV Arrays 5-8 should avoid the essentially flat tilt occurrence at the end of each day.

6 RESIDENTIAL "NUISANCE" GLARE

6.1 Residential Receivers Surrounding the Project

For this study, a set of ID reference numbers and associated locations (lat,long) of 110 surrounding residential receivers, as shown in **Figure 13**, was provided to SLR.

It is noted that the separation distance of many of these receivers from the nearest boundary of the Project exceeds the normal assessment distance (typically a maximum of 5 km) for glint and glare studies. The separation distance is even greater for many receivers taking into account the current proposed location of the solar panel arrays within the Project boundary (refer **Figure 2**).

Figure 13 Surrounding Residential Receivers

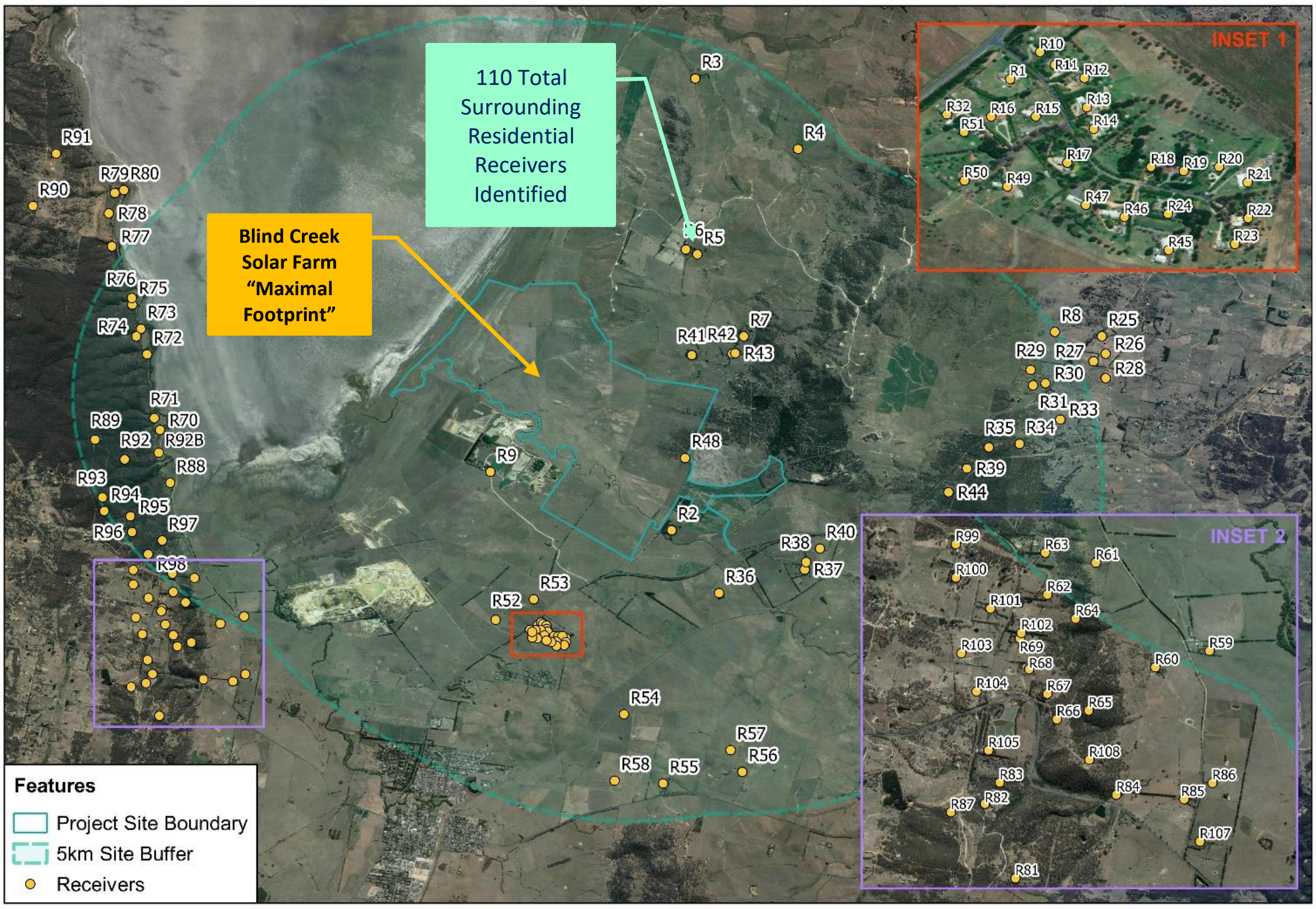


Table 7 lists the ID number, latitude and longitude of the 110 receivers shown in **Figure 13**.

Table 7 Representative Receivers: Position (Lat-Long)

Receiver ID	Latitude (deg)	Longitude (deg)	Receiver ID	Latitude (deg)	Longitude (deg)
R1	-35.22047244	149.4632238	R56	-35.24573089	149.4985643
R2	-35.20400163	149.4863556	R57	-35.2419619	149.4965359
R3	-35.12600803	149.4904404	R58	-35.24724927	149.4765106
R4	-35.1381688	149.5081785	R59	-35.21888669	149.4125447
R5	-35.15634351	149.4907932	R60	-35.22012812	149.4084619
R6	-35.15551419	149.4888189	R61	-35.21223943	149.4039826
R7	-35.17051449	149.498811	R62	-35.21464569	149.4003242
R8	-35.16974192	149.5525202	R63	-35.21148379	149.4001669
R9	-35.1939079	149.4550757	R64	-35.21646223	149.4024475
R10	-35.2199207	149.4638325	R65	-35.22338189	149.4034382
R11	-35.22018416	149.4641373	R66	-35.22405	149.4010368
R12	-35.22045028	149.464739	R67	-35.22212616	149.4003255
R13	-35.2210495	149.4647889	R68	-35.22027683	149.3989523
R14	-35.2214903	149.4649295	R69	-35.21796745	149.3982558
R15	-35.22123605	149.4637451	R70	-35.18667279	149.3980362
R16	-35.22123721	149.4628335	R71	-35.18464038	149.39705
R17	-35.22217985	149.4643885	R72	-35.17362706	149.3958001
R18	-35.22226681	149.4660979	R73	-35.16921982	149.3947479
R19	-35.22234883	149.4667682	R74	-35.17051578	149.3939444
R20	-35.22226459	149.4674866	R75	-35.16503551	149.3932457
R21	-35.22258329	149.4680687	R76	-35.16390418	149.3931711
R22	-35.22331378	149.4680802	R77	-35.1549796	149.3897239
R23	-35.22384124	149.4678099	R78	-35.14927569	149.3891879
R24	-35.22322534	149.4664449	R79	-35.14576707	149.3902231
R25	-35.17050997	149.560638	R80	-35.14526075	149.3917942
R26	-35.1735278	149.5612889	R81	-35.23603704	149.3979177
R27	-35.17482486	149.5591895	R82	-35.23041408	149.3956153
R28	-35.177738	149.5612939	R83	-35.2288176	149.3967326
R29	-35.17630207	149.5483391	R84	-35.22974044	149.4055284
R30	-35.17861869	149.550896	R85	-35.23007592	149.4106339
R31	-35.17897704	149.5487511	R86	-35.22884671	149.4127669
R32	-35.22119468	149.4619311	R87	-35.23105419	149.3930482
R33	-35.18488027	149.553452	R88	-35.19581023	149.3997861
R34	-35.18907105	149.5464306	R89	-35.18835296	149.3868204
R35	-35.18967521	149.541122	R90	-35.14800602	149.3761096
R36	-35.2148547	149.4945519	R91	-35.13897303	149.3801003
R37	-35.21079546	149.5093304	R92	-35.19175959	149.3919349

Receiver ID	Latitude (deg)	Longitude (deg)	Receiver ID	Latitude (deg)	Longitude (deg)
R38	-35.2095065	149.5095747	R92B	-35.19061000	149.3978100
R39	-35.19332982	149.5373415	R93	-35.19832915	149.3881145
R40	-35.20716106	149.511969	R94	-35.2006827	149.3884056
R41	-35.17376139	149.4898414	R95	-35.2015896	149.3929268
R42	-35.17351314	149.4968262	R96	-35.20431299	149.3931977
R43	-35.17343311	149.4973323	R97	-35.20576093	149.3984127
R44	-35.19744168	149.5341524	R98	-35.20813585	149.3959778
R45	-35.22396452	149.4664567	R99	-35.21085019	149.3934243
R46	-35.22328695	149.4655563	R100	-35.21336464	149.3934371
R47	-35.22304211	149.4647644	R101	-35.21569157	149.3960344
R48	-35.19153134	149.4886882	R102	-35.21753908	149.3983592
R49	-35.22266586	149.4631629	R103	-35.2190676	149.3938446
R50	-35.22254445	149.4622899	R104	-35.22195363	149.3949817
R51	-35.22155292	149.4622812	R105	-35.22638939	149.3958875
R52	-35.21947152	149.4559745	R106	-35.1952326	149.5117639
R53	-35.21591898	149.4625561	R107	-35.2332681	149.411823
R54	-35.23576761	149.4781369	R108	-35.2270997	149.4034816
R55	-35.24772182	149.4848938	R109	-35.20730297	149.3991721

6.2 Nearest Representative Receivers Surrounding the Project

From the 110 receivers listed in **Table 7**, a subset of "representative" receivers was chosen for subsequent review, primarily on the basis of the following considerations:

- Receivers located very close to each other were grouped under one or two representative receivers at the closest and most exposed location for the group.
- For example, the group of residences lying to the southeast of the proposed facility within the "Buckingham" residential zone were represented by two receivers with the best exposure to the facility.
- Using the solar ray data shown in **Figure 4**, receivers located in areas where incoming reflections are not possible during the entire calendar year were also excluded.
- For example, receivers located to the north of the facility were excluded, given that incoming solar rays from angles greater than 119.1° East and 119.1° West do not occur at the latitude of the proposed facility – refer **Table 1**. This excluded receiver R3 for example.

6.3 Project Assessment Receivers

From the representative receivers discussed in **Section 6.2**, 15 "assessment" receivers were subsequently selected for detailed analysis, refer **Figure 14**, based on the following considerations:

- Receivers obstructed from any view of the solar facility's footprint by topography (i.e. intervening hills, etc) were excluded from the analysis. This impacted a significant number of residences located to the east of the site.
- Receivers shielded from the solar facility's provisional footprint by extensive, dense, intervening vegetation, trees, etc, were also excluded from the analysis.

Figure 14 Project "Assessment" Receiver Location Map

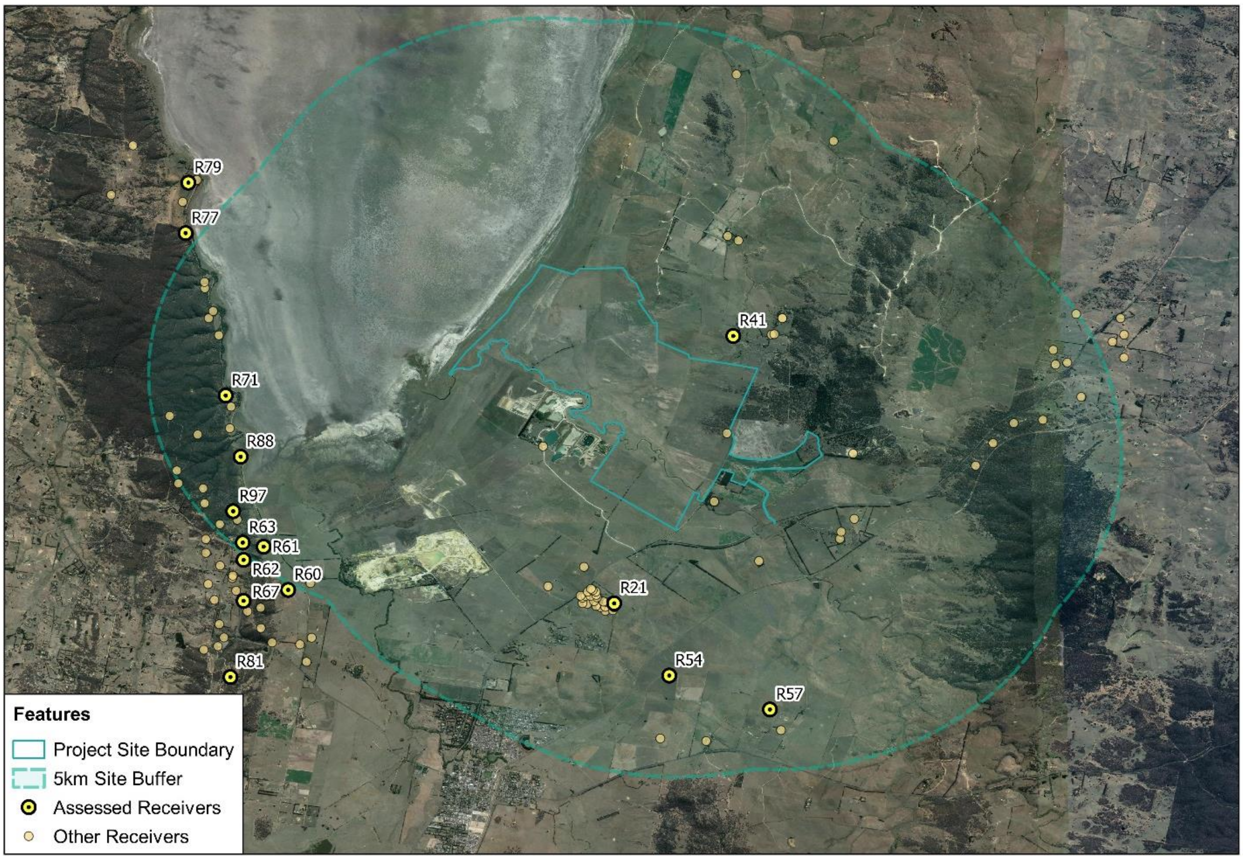


Table 8 lists the ID number, latitude and longitude of the 15 assessment receivers shown in **Figure 14**.

Table 8 Project Assessment Receivers

Receiver ID	Related Receivers	Latitude (deg)	Longitude (deg)
R41	R6	-35.17376139	149.48984140
R21	R45, R23, R22, R46, R24, R18, R19, R20	-35.22258329	149.46806870
R54	R58	-35.23576761	149.47813690
R57	R55, R56	-35.24196190	149.49653590
R79	R78, R80	-35.14576707	149.39022310
R77		-35.15497960	149.38972390
R71	R70, R92B	-35.18464038	149.39705000
R88		-35.19581023	149.39978610
R97	R99, R98, R96	-35.20576093	149.39841270
R63	R64, R69, R100, R101, R102	-35.21148379	149.40016690
R61	R64, R69, R100, R101, R102	-35.21223943	149.40398260
R62	R64, R69, R100, R101, R102	-35.21464569	149.40032420
R60		-35.22012812	149.40846190
R67	R66, R65, R104, R68, R103	-35.22212616	149.40032550
R81		-35.23603704	149.39791770

6.4 Residential “Nuisance” Glare – Analysis Tool and Criteria

Instances of documented nuisance glare associated with solar PV panels (grid-scale, industrial or residential) and nearby residential receivers have been relatively infrequent globally, especially given the widespread and rapid increase in the take-up of residential solar panels in Australia and elsewhere.

There are currently no national or state guidelines in Australia governing the acceptability or otherwise of residential nuisance glare specific to solar PV.

Existing guidance that exists in relation to solar panels from state governments typically covers installation audits and compliance checks. Additional guidance in relation to compliance with Australia Standards is provided by:

Clean Energy Council
Website: https://www.cleanenergycouncil.org.au/industry/products/modules

To assist in addressing residential nuisance glare, reference has been made of the concepts used for glare acceptability criteria outlined in the preceding sections, in particular the TI Value Pedestrian Discomfort Glare criteria as a possible indicator of potential nuisance glare.

6.5 TI Value Analysis and Results

TI Value calculations were made for the representative receivers shown in **Figure 14**.

- The calculations were based on a receiver looking directly towards the facility.
- The calculations conservatively assumed NO intervening "blocking" topography (e.g. from small, elevated earth mounding), NO vegetation and NO other physical barriers, such as perimeter fencing, etc.

The results of the Residential Receiver TI Value computations are shown in **Tables 9 to 13**.

- **Table 9** Fixed Tilt 20°WEST All Assessment Receivers / All PV Arrays
- **Table 10** Fixed Tilt 10°WEST All Assessment Receivers / All PV Arrays
- **Table 11** Fixed Tilt FLAT All Assessment Receivers / All PV Arrays
- **Table 12** Fixed Tilt 10°EAST All Assessment Receivers / All PV Arrays
- **Table 13** Fixed Tilt 20°EAST All Assessment Receivers / All PV Arrays

In these tables:

- Boxes which are shaded [ ] indicate that a reflection from the particular PV Array may be "visible" at some time throughout the year. For these cases, the TI Values are significantly less than 1.
- Boxes which contain the symbol ● indicate potential TI Values in the range TI=1 to TI=3.
- Boxes which contain the symbol ● also indicate the time of day of the occurrence: "EM" = early morning, "LA" = late afternoon

Table 9 TI Value Results – FIXED TILT 20°WEST

Receiver ID	PV Array ID#					
	3	4	5	6	7	8
R41						
R21						
R54						
R57						
R79						
R77						
R71	· (EM)					
R88	· (EM)					
R97	· (EM)	· (EM)				
R63	· (EM)	· (EM)				
R61	· (EM)	· (EM)				
R62	· (EM)	· (EM)				
R60	· (EM)	· (EM)				
R67	· (EM)	· (EM)		· (EM)		
R81		· (EM)		· (EM)		

Table 10 TI Value Results – FIXED TILT 10°WEST

Receiver ID	PV Array ID#					
	3	4	5	6	7	8
R41						
R21						
R54						
R57						
R79	· (EM)					
R77	· (EM)					
R71	· (EM)	·		· (EM)		
R88	· (EM)					
R97	· (EM)	· (EM)	· (EM)	· (EM)		
R63	· (EM)	· (EM)	· (EM)	· (EM)		
R61	· (EM)	· (EM)	· (EM)	· (EM)		
R62	· (EM)	· (EM)	· (EM)	· (EM)		
R60	· (EM)		· (EM)	· (EM)		·
R67	· (EM)	· (EM)	· (EM)	· (EM)		
R81		· (EM)		· (EM)		

Table 11 TI Value Results – FIXED TILT 0° (Horizontal)

Receiver ID	PV Array ID#					
	3	4	5	6	7	8
R41	· (LA)	· (LA)	· (LA)	· (LA)		
R21						
R54						
R57						
R79	· (EM)					
R77	· (EM)					
R71	· (EM)					
R88	· (EM)			· (EM)		
R97	· (EM)	· (EM)		· (EM)		
R63	· (EM)	· (EM)		· (EM)		
R61	· (EM)	· (EM)		· (EM)		
R62		· (EM)		· (EM)		
R60						
R67				· (EM)		
R81						

Table 12 TI Value Results – FIXED TILT 10°EAST

Receiver ID	PV Array ID#					
	3	4	5	6	7	8
R41	· (LA)	· (LA)	· (LA)			
R21						
R54						
R57						
R79						
R77						
R71						
R88						
R97						
R63						
R61						
R62						
R60						
R67						
R81						

Table 13 TI Value Results – FIXED TILT 20°EAST

Receiver ID	PV Array ID#					
	3	4	5	6	7	8
R41	· (LA)	· (LA)	· (LA)			
R21						
R54						
R57						
R79						
R77						
R71						
R88						
R97						
R63						
R61						
R62						
R60						
R67						
R81						

General Observations

Note that for these results:

- NO allowance was made for any OBSTRUCTION from vegetation surrounding the residence
- NO allowance was made for the DURATION of the reflections

Given the multitude of array-mode-receiver combinations, an attempt has been made to coalesce the data into summary groups allowing for meaningful recommendations regarding mitigation.

"Fixed Tilt East" Modes

- Based on a simple numerical count of array-mode-receiver combinations, the FIXED TILT EAST modes appear to have minimal impact on surrounding receivers.
- The TI Value occurrences at the relevant receiver occur in the LATE AFTERNOON, for about a month around the equinox periods of the year and lasting an average of around 10 minutes per day.
- It is noted that a LATE AFTERNOON Fixed Tilt East Mode reflection may be possible under a construction or maintenance scenario, but NOT under "Normal" Tracking or standard "Back-Tracking", i.e. the typical operational modes of the proposed facility.

"Fixed Tilt West" Modes

- The FIXED TILT WEST modes have the potential to create visible reflections at a number of surrounding receivers.
- The TI Value occurrences at the relevant receivers occur in the EARLY MORNING, typically around the winter solstice period and lasting an average of around 10 minutes per day
- It is noted that an EARLY MORNING Fixed Tilt WEST Mode reflection may be possible under a construction or maintenance scenario, but NOT under "Normal" Tracking or standard "Back-Tracking", i.e. the typical operational modes of the proposed facility.

"Fixed Tilt HORIZONTAL" Mode

- The FIXED TILT HORIZONTAL mode has the potential to create visible reflections on a number of surrounding receivers, with similar reflection visibility to the Fixed Tilt East and West Mode results.
- In the case of receivers located to the EAST of the facility, reflections may be visible in the LATE AFTERNOON. In the case of receivers located to the WEST of the facility, reflections may be visible in the EARLY MORNING.
- It is noted that a Fixed Tilt HORIZONTAL Mode reflection is NOT possible under "Normal" Tracking, but may be possible under a construction or maintenance scenario, and under standard "Back-Tracking" at sunrise and sunset, depending upon how long the array panels are allowed to remain horizontal before commencing their "back-tracking" motion.

"Visibility" versus "Glare" in Reflections

It is a common misconception that the mere "visibility" of a solar panel reflection necessarily implies "glare".

To gain an appreciation of the "visibility" versus "glare nuisance" potential of solar panel reflections from a residential receiver point of view, the following analogue is considered.

Figure 15 shows two photographs taken from the western shoreline of Lake George on 8 April 2021 at approximately 8:00 am. Part of the lake looking towards the northeast exhibited ponding thanks to several days of rain just before and had visible reflections generated by the morning sun.

- The photos in **Figure 15** show both the incoming solar rays and the small band of ponding reflection.
- The refractive index of water is similar to that of solar panel glass (assuming no special anti-reflective coating). Accordingly, reflections from either surface would have similar magnitude.
- The photos show that the "glare" from the direct solar rays from the sun was considerably stronger than the light source from the ponding reflection, in fact orders of magnitude higher.

The reflection conditions projected in **Tables 9-13** would exhibit similar characteristics to the ponding reflections shown in **Figure 15**.

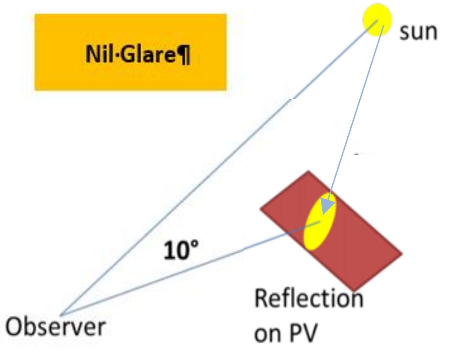
Figure 15 Analogue Reflection Condition for Comparison to Solar Reflections and Glare Potential

Finally, the following should also be considered:

In **Section 3.2** it was noted that for very high incidence angle, it would almost always be the case that an observer (e.g. resident) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

In fact, this latter condition has evolved into a globally adopted "acceptability" condition for the existence of residential nuisance glare, namely that a glare condition can only exist if the angle difference between an incoming solar ray and its associated reflection is greater than 10° – refer **Figure 16**.

Figure 16 Nil Glare Condition Applicable to Residential Nuisance Glare



An example of this can be seen in the **Figure 15** photographs, where the “glare” from the direct solar rays is several orders of magnitude greater in intensity than the reflections from the lake.

6.6 Conclusions

The analysis of potential Residential Nuisance Glare can be summarised as follows:

Normal Tracking

- Residential receivers surrounding the facility will experience no perception of reflections for Normal Tracking Mode.

Fixed Tilt Horizontal and Very Low Angle Tilt Modes – Construction and/or Maintenance

- Visibility of reflections from the proposed facility may be possible at several surrounding receivers under Horizontal or Very Low-Angle, Fixed Tilt Modes which do not vary during the day, i.e. during construction and/or extended maintenance periods.
- Given the distances involved, especially for the “western” receivers which are located more than 5 km from the nearest solar array panels, the small angle difference between incoming solar rays and their accompanying reflections means that the mere visibility of reflections would not be considered a “glare” condition – refer **Figure 16**.
- Nevertheless, visible reflections could be entirely eliminated at all surrounding receivers (during construction and/or maintenance) if panels are left in a tilt position that is no less than 25° (East or West).

Fixed Tilt Horizontal and Low Angle Tilt Modes – Back-Tracking

- During standard Back-Tracking, reflections from the proposed facility will NOT be visible as long as very low tilt angles, EITHER EAST or WEST, are avoided. The precise limiting angle should be established during commissioning.
- In other words, standard Back-Tracking can be accommodated at the site as long the panel arrays avoid being in an essentially horizontal position at the start and end of the day.

7 GLARE IMPACT – INDUSTRIAL MACHINERY DISABILITY GLARE

7.1 Surrounding Industrial Operations

Two industrial-scale operations are located in the immediate vicinity of the Project:

- Bungendore Sand Mine is located to the immediate southwest of the Project – refer **Figure 17**.
- Paragalli Sands is located just to the east of the eastern most perimeter of the Project.

Figure 17 Bungendore Sand Mine Views

7.2 Industrial Machinery Operator Disability Glare – Analysis Tool and Criteria

There are currently no Australian guidelines (national or state) governing the acceptability or otherwise of reflective glare for industrial site critical operations. Instead, the concepts used for acceptability criteria in the preceding sections, in particular Road and Rail Disability Glare, can assist when dealing with this issue.

The issue most commonly arises in relation to mining operations where machinery operators can be located in elevated locations, e.g. dragline operations, where a line of sight may be possible to a solar facility located in close proximity.

Ports with their observation towers are another potential source of elevated receivers of interest if located adjacent to a solar facility.

7.3 Industrial Machinery Operator Disability Glare – Analysis and Results

In relation to the two sand quarries of interest, their operations have the following attributes:

- Typically, extraction occurs to depths of around 4 m to 5 m, using front end loaders, a 30 t excavator and mobile screens as well as a screen/washing plant – refer **Figure 17** (Bungendore Sand Mine).
- None of the machinery or trucks used on these sites would have the operator at above 3.5 m above ground level.

Paragalli Sands

- In the case of Paragalli Sands, there is existing vegetation around the perimeter of the licence area that would block any view of the proposed solar facility.
- There is also a hill between the quarry and the solar array.
- Accordingly, there is no opportunity for glare potential at this operation.

Bungendore Sand Mine

- In the case of Bungendore Sand Mine, a representative receiver was located in the vicinity of this operation – refer **Section 6**.
- Any potential for glare has therefore been covered using this receiver as the representative point for the sand mine.

8 NIGHT-TIME ILLUMINATION GLARE

8.1 Night-Time Illumination Glare – Criteria

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by AS 4282-2019.

The adverse effects of light spill from outdoor lighting are influenced by a number of factors:

- The topology of the area. Light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- The surrounding area. Hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.
- Pre-existing lighting in the area. Light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, e.g. in cities. The same lighting installation would be seen as far more bothersome in a less well-lit, quiet residential area.
- The zoning of the area. A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

Typical illuminance levels for a variety of circumstances are given in **Table 14** for comparison.

Table 14 Typical Illuminance Levels for Various Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

Recommended criteria of light technical parameters for the control of obtrusive lighting are given in **Table 14**.

The vertical illuminance limits for *curfew hours* apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties. The vertical illuminance criteria for *pre-curfew hours* apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.

Values given are for the direct component of illuminance, i.e. no reflected light is taken into account.

- Limits for luminous intensity for *curfew hours* apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained.
- Limits for luminous intensity for *pre-curfew* hours apply to each luminaire in the principal plane, for all angles at and above the control direction.

Table 15 Recommended Maximum Values of Light Technical Parameters (AS4282-2019)

Light Technical Parameter	Time of Operation	Zone "A4"	Zone "A3"	Zone "A2"	Zone "A1"	Zone "A0"
Illuminance in vertical plane (E_v)	Pre-curfew hours	25 lx	10 lx	**5 lx**	2 lx	ALARP [1]
	Curfew hours	5 lx	2 lx	**1 lx**	0.1 lx	1 lx
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	25,000 Cd	12,500 Cd	**7,500 Cd**	2,500 Cd	ALARP [1]
	Curfew hours	2,500 Cd	2,500 Cd	**1,000 Cd**	500 Cd	0 Cd

Zone A4 *"High District Brightness", eg town and city centres and other commercial areas; residential areas abutting commercial areas*

Zone A3 *"Medium District Brightness", eg suburban areas in towns and cities*

Zone A2 *"Low District Brightness", eg sparsely inhabited rural and semi-rural areas*

Zone A1 *"Dark", eg relatively uninhabited rural areas; no road lighting, unless specifically required by the relevant road controlling authority*

Zone A0 *"Intrinsically Dark", eg UNESCO Starlight Reserve; IDA Dark Sky Parks; major optical observatories; no road lighting, unless specifically required by the relevant road controlling authority*

Note 1 *ALARP = as low as reasonably practical (as close to zero as possible)*

The Project is located adjacent to the southeastern shoreline of Lake George north of Bungendore's "urbanised" area with the potential to impact on surrounding residential properties. These properties are generally also outside of the any township environs and would therefore be classed as being in Zone A2 "Low District Brightness" - refer **Table 15**.

The applicable limits for adverse spill light will depend on the time of operation for the lighting installation.

For the Project, it is possible that internal access roads and any equipment buildings in particular, will be operational 24/7, suggesting the application of the more restrictive limit relevant to *curfew hours*.

Accordingly:

- Light spill from the Project onto the facades of the surrounding residential dwellings should be kept **below 1 lux** during curfew hours.

Finally, it has been known for some time that night-time artificial lighting has the potential to disrupt the natural behaviour of nocturnal fauna species such as arboreal mammals, large forest owls and microbats. The standards mentioned above do not contain limiting lux levels in relation to the mitigation of such eco-lighting impacts.

Mitigation recommendations in relation to adverse eco-lighting therefore centre on feasible night-time lighting minimisation, bearing in mind the provision of appropriate health and safety and security conditions given the nature of the site. Biodiversity associated with the Project is discussed in the Flora and Fauna Assessment Report prepared for the Project. As far as is known, no adverse eco-lighting issues are apparent.

8.2 Night-Time Illumination Glare - Analysis

Although presently not fully defined, it is assumed that a limited area within the Blind Creek Solar Farm Project site will be set aside for an Operation and Maintenance buildings at the sub-station site located to the east of Currandooley Road, for emergency and security use, e.g. fire access routes and egress, etc, and that some of these may need to be operational 24/7. It is unknown at this stage what degree of night-time illumination is planned for these limited areas but the Proponent has advised that only on-demand lighting will be employed (i.e. during maintenance and security incidents). To be conservative, this issue is addressed in principle in this assessment.

The only potential for any future night-time illumination glare would be associated with the nearest thoroughfares and residential and other sensitive receivers to the Project. Consideration should also be given to the potential for adverse eco-lighting impacts on nocturnal fauna habitats in close proximity to the Project site, especially within any close-by native vegetation areas

The recommendations set out below are therefore made in the event that future 24/7 lighting is incorporated into the Project, to achieve the best lighting performance (taking into account safety considerations) while having a minimal impact on the surrounding properties, carriageways and nocturnal fauna.

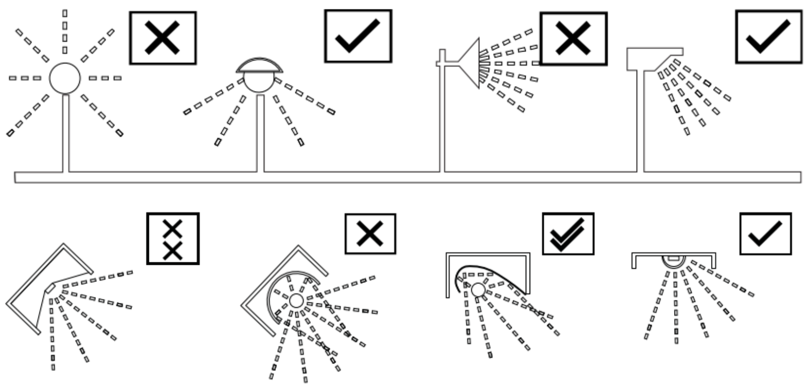
In terms of any future potential night-time lighting, the adopted goal of limiting night-time light spill to no more than **1 lux** falling on the nearby residential facades during curfew hours will be easily achieved given the distances to the nearest residential and other receivers, and in particular, the degree of vegetation and topography surrounding the sub-station precinct area.

Accordingly, the potential for any future nuisance glare should be non-existent.

AS4282-2019 *Control of the Obtrusive Effect of Outdoor Lighting* sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation.

- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, e.g. full cut-off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill-light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area - refer **Figure 18**.
- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Figure 18 Luminaire Design Features that Minimise Light Spill



9 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has been engaged to carry out a Reflective Glare assessment of the proposed Blind Creek Solar Farm (the "Project").

The following potential glare conditions have been considered:

- Daytime solar panel Reflective glare (and glint) and
- Night-time Illumination glare.

Aviation-Related Potential Glare

Quantitative analysis using the FAA-SGHAT (Solar Glare Hazard Analysis Tool) software tool has been used to assess potential glare impacts on Currandooley Airstrip, which lies within the proposed facility's site perimeter.

It is noted that Currandooley Airstrip will almost certainly be de-commissioned to make way for solar panels, to be contained within Panel Array ID7 – refer **Figure 8**. The SGHAT analysis of the airstrip was therefore carried out in the (highly unlikely) scenario that the airstrip is preserved in the final (to be constructed) design.

Appendix B of this report sets out options to enable all-year-round usage of the airstrip's Runways 10 and 28. These consist of either operational airstrip strategies (e.g. restricting landings for particular runways at a particular hour of the day for certain given months) or operational panel strategies, e.g. limiting the options for low angle fixed tilt modes, for either maintenance/construction purposes, or for the initial (morning) and final (evening) period of panel Back-Tracking should this mode be chosen for the facility.

Back-Tracking Software has the capability to operate different sections of a PV facility in varying modes, whereby some panel array groups operate in "full" Back-Tracking mode and others are directed to move to various fixed tilt position either at the start or end of the day, typically without significant loss of total facility output. It should therefore be possible, if a Back-Tracking solution is chosen for the facility, to implement tracking controls that would enable virtually all-year-round use of the Currandooley Airstrip at any time of day for both runways.

Alternatively, an operational management plan for airstrip operations could be developed, avoiding periods throughout the year (typically early morning and later afternoon) when potential aviation glare might occur.

It is noted again however that Currandooley Airstrip will almost certainly be de-commissioned to make way for the proposed facility and, as such, aviation glare issues are non-existent in relation to the current proposal.

Motorist and Rail Traffic Disability Glare

Nil glare is expected during normal ±62° tracking operations.

There is potential for visible reflections which can reach the nominated glare criteria along Currandooley Road if the panels are left parked in a horizontal position or with a slight eastwards tilt – which could occur during construction, maintenance and/or at the end of the day with "Back-Tracking".

Table 6 summarises the mitigation options for eliminating potential motorist disability glare, with combinations of operational mode restrictions and/or perimeter barriers (e.g. vegetation) to eliminate all potential glare conditions. The operational mode restriction would be to avoid an essentially flat panel angle for PV Arrays 5-8 at the end of the day. The precise limiting angle should be confirmed during commissioning.

There is NIL potential for glare along Tarago Road, the Quarry Access Road and Bombala Rail Line.

Residential Nuisance Glare

Reflections will not be visible by residential receivers surrounding the facility under normal ±62° tracking operations during which solar panels will track the sun.

If panels are left parked in a horizontal or near horizontal position, panel reflections from the proposed facility may be visible for short periods of time in the early morning or late afternoon for certain months of the year.

However, the potential for nuisance glare is considered low to minimal when considering the following factors: local obstruction to many receivers from surrounding vegetation and trees (not included in our analysis), the distances involved for "western" side receivers, and the low angle differences between incoming (direct) solar rays and their accompanying reflections.

Panel reflection visibility potential during the identified periods events can be effectively eliminated by the following measures:

. During Construction and/or Maintenance Periods, avoid low tilt angles either East or West.

. Under standard "Back-Tracking" operational mode, avoid essentially horizontal panel angles at the start and end of each day. The precise limiting angle should be established during commissioning.

Industrial Machinery Operator Glare

The study has concluded that there will be NIL glare in relation to the industrial operations occurring at the nearby Bungendore Sand Mine and Paragalli Sands operation.

Night-Time Illumination Glare

If 24/7 lighting is required at the facility for operational purposes, there should be negligible impact, assuming the lighting design is in accordance with AS 4282-2019 Control of the Obtrusive Effect of Outdoor Lighting. This would also address any potential adverse eco-lighting issues in relation to nocturnal fauna within and surrounding the site, although, as far as is known, no biodiversity issues have been identified in relation to the Project. Any future lighting design should also be checked against CASA's NASF Guidelines (E & F) in relation to Currandooley Airstrip operations if the airstrip is not de-commissioned and night-time flights are permitted.

Glare Mitigation Measures

The present analysis shows that many of the potential glare and/or visibility conditions identified are associated with circumstances involving solar panels being left in a horizontal or near-horizontal position.

In relation to construction and/or maintenance, Project commitments can be made and monitored to ensure that the successful EPC Contractor for the Project avoids any adverse parked-panel conditions associated with potential glare and/or visibility conditions.

In relation to operations, Back-Tracking software is capable of addressing all of the identified potential reflection glare and/or visibility during the operational phase of the Project, specifically, by avoiding the horizontal position of panels at the very start and end of each day.

When key Project decisions are finalised during detailed design (e.g. final panel selection, mounting details, etc), the present analysis should be re-visited to confirm the conclusions set out above, but only if key assumptions made in the analysis change significantly.

It is noted that on several previous solar glare studies carried out by SLR, the impact of a change in single-axis track orientation was evaluated for small deviations from a north-south direction, i.e. orientation changes of ±10°. In all cases, the glare analysis results for both normal tracking (typically ±60°) and fixed mode horizontal conditions were essentially the same. If no glare was predicted for a north-south tracker orientation, no glare was likely for a change in orientation of ±10°. Similarly, if glare was predicted for a north-south tracker orientation, glare would also be likely for a change in orientation of ±10°. This suggests that the overall outcomes of this study will remain the same with a modest (i.e. ±10°) change in tracker orientation.

Finally, the project is requesting flexibility to choose newly-improved '2P' style trackers, which stack two panels in portrait orientation across the tracker table instead of one panel, which has been the dominant architecture to date. This change results in less, but more widely-spaced, trackers which is desirable for agri-solar, and reduced impact on archaeology, hydrology and biodiversity. It does require a slightly higher height at full tilt of up to 5 m. SLR does not believe this change would materially alter the conclusions of this report.

APPENDIX A

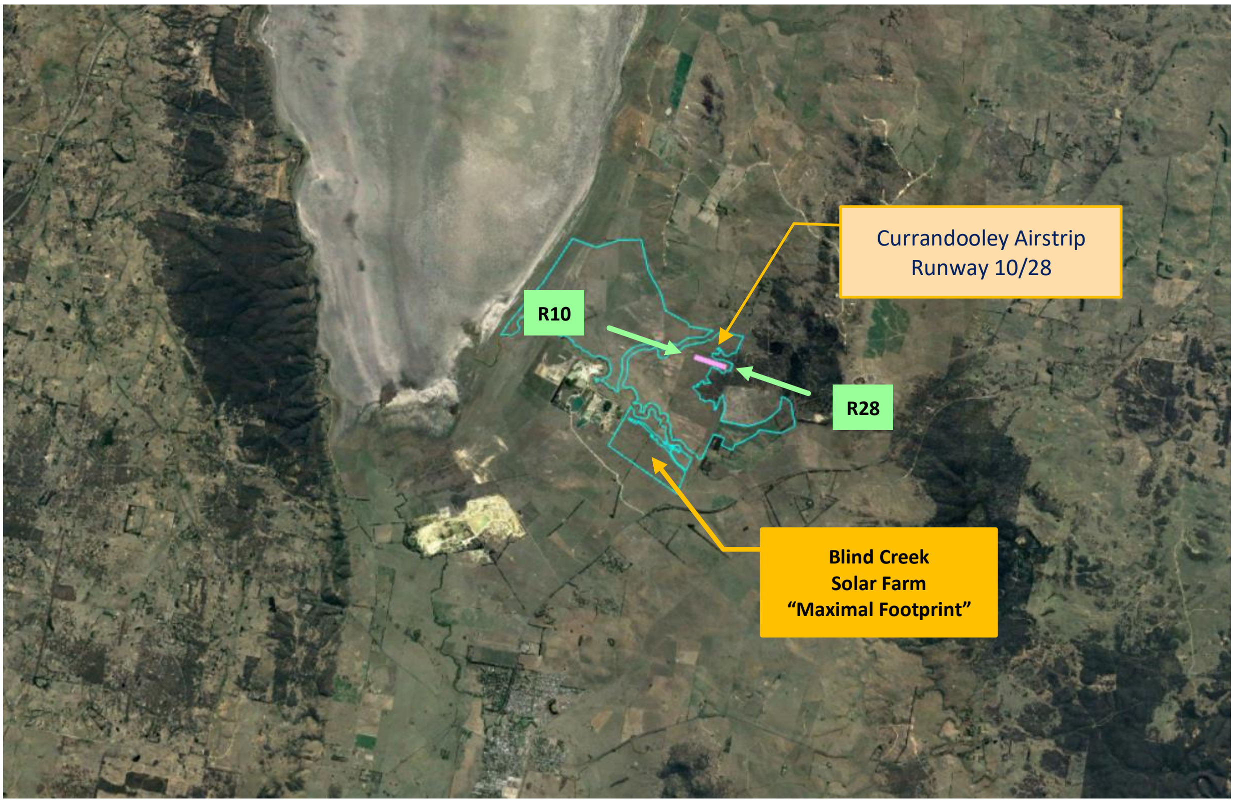
CURRANDOOLEY AIRSTRIP AVIATION GLARE ANALYSIS

Analysis Assumptions

SLR has carried out a quantitative analysis of Currandooley Airstrip using the Sandia Labs Solar Glare Hazard Analysis Tool (SGHAT) software tool to examine potential worst-case scenario flight path approaches and take-offs and their ability to create adverse and unacceptable glare (and glint) condition.

The flights paths assessed for the Project are shown in **Figure B-1**.

Figure B-1 Currandooley Airstrip



SGHAT Modelling Assumptions:

- Both runway approaches shown above were examined.
- Landing flight paths are aligned with their respective runways.
- All aircraft landing flight paths are 2 miles in length, on a 3° glide angle (standard SGHAT protocol).
- The SGHAT analysis examines ALL possible solar angles throughout the year – in 1-minute intervals.
- The reflectivity of the PV panels was assumed to be the same as that shown in the standard solar glass shown in **Figure 11**.
- SGHAT simulations are run with two "height above threshold" values: 5m and 15m, to determine an overall worst-case result.

Panel Scenarios

A number of panel scenarios were assessed:

- "Normal Tracking": panels tilt ±62° about a north-south horizontal axis – this would be the normal operational mode for the solar farm;
- "Tracking + Stowed": panels tilt ±62° about a north-south horizontal axis and then rest for the remainder of the time at a fixed angle of 0°
- "Fixed Tilt": panels remain fixed at angles of 0° (horizontal), ±10°and ±20° – fixed tilt scenarios are possible under situations involving: shutdown, maintenance, pre-commissioning, etc.

SGHAT Results – Illustrative Examples

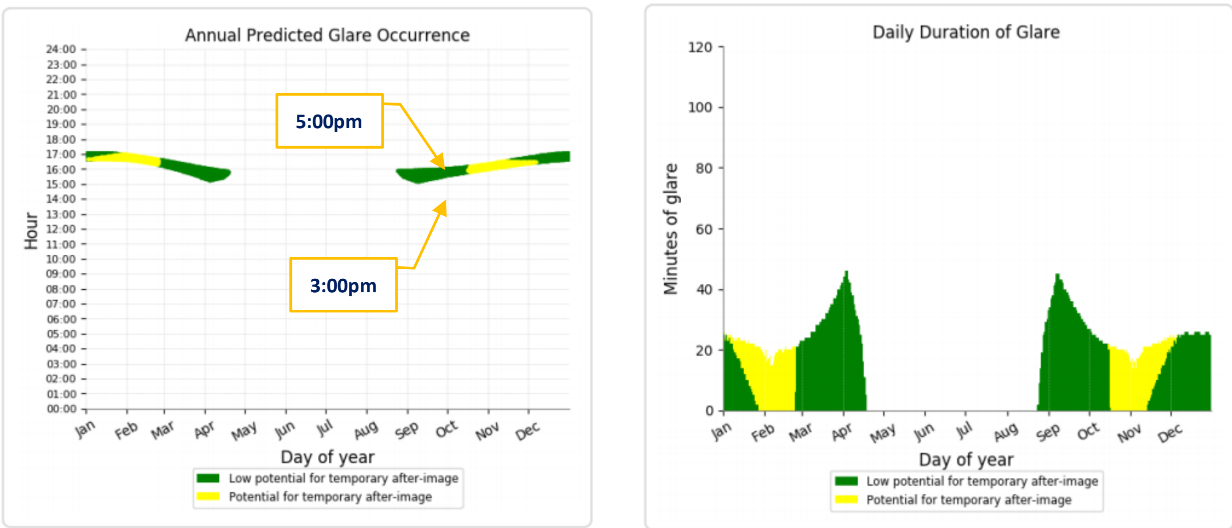
"NORMAL TRACKING ±62°"

Figure B-2 provides an illustrative example of the Aviation SGHAT results for:

Normal Tracking Mode / Runway 10 (aircraft approaching from the west) / PV Array 4 reflections

- Reflections will be visible for an 8-month period from late August to mid-April.
- "YELLOW" zone reflections are predicted for Jan-Feb and Oct-Nov.
- "YELLOW" zone reflections would occur in the afternoon and would be visible up to a maximum of 20 minutes per day.

Figure B-2 SGHAT Results: NORMAL TRACKING MODE, Runway 10, PV Array 4



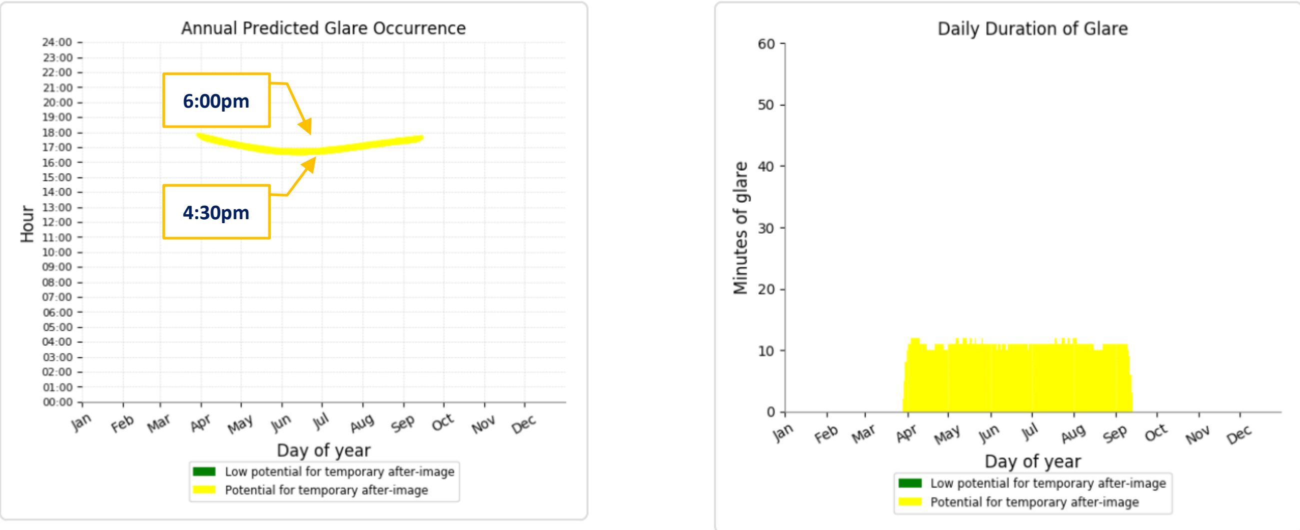
"FIXED TILT (Horizontal)"

Figure B-3 provides an illustrative example of the Aviation SGHAT results for:

FIXED TILT (Flat) Mode / Runway 10 (aircraft approaching from the east) / PV Array 5 reflections

- Reflections will be visible for a 5.5-month period from April to mid-September.
- "YELLOW" zone reflections are predicted during this entire period.
- "YELLOW" zone reflections would occur in the late afternoon and would be visible up to a maximum of 11 minutes per day.

Figure B-3 SGHAT Results: FIXED TILT MODE (Horizontal), Runway 30, PV Array 9



Results Summary

A summary of the SGHAT analysis for all scenarios for all facility arrays for the two flight paths, Runway 12 and Runway 30, is presented as follows:

- **Table B-4** Normal Tracking ±62° Mode Runway 12
- **Table B-5** Normal Tracking ±62° Mode Runway 30
- **Table B-6** ALL FIXED TILT Modes Runway 12
- **Table B-7** ALL FIXED TILT Modes Runway 30

Tables B-4 to B-7 show the total number of minutes in a year that solar panel reflections would be potentially visible within any relevant SGHAT "zone" (refer **Figure 10**).

It will be recalled that solar panel reflections are acceptable according to the FAA-SGHAT protocol if there are NO "Yellow" Zone or "Red" Zone results for aircraft flight landing paths.

Table B-4 SGHAT Analysis Results – Normal Tracking Mode – Runway 10 (West Approach)

PV Array ID (refer Fig.8)	SGHAT Results for "NORMAL TRACKING" ±62° Scenario		
	"Green" Zone	"Yellow" Zone	"Red" Zone
PV Array 3	-	-	-
PV Array 4	4,601	**1,496**	-
PV Array 5	2,173	-	-
PV Array 6	4,051	**765**	-
PV Array 7	-	-	-
PV Array 8	-	-	-

Table B-5 SGHAT Analysis Results – Normal Tracking Mode – Runway 28 (East Approach)

PV Array ID (refer Fig.8)	SGHAT Results for "NORMAL TRACKING" ±60° Scenario		
	"Green" Zone	"Yellow" Zone	"Red" Zone
PV Array 3	-	-	-
PV Array 4	-	-	-
PV Array 5	-	-	-
PV Array 6	-	-	-
PV Array 7	-	-	-
PV Array 8	-	-	-

Table B-6 SGHAT Analysis Results – ALL FIXED TILT Modes – Runway 10 (West Approach)

PV Array ID (refer Fig.8)	SGHAT Results for "FIXED TILT" Scenarios									
	20° West		10° West		0° (Horizontal)		10° East		20° East	
	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone
PV Array 3	-	-	-	-	-	-	-	-	-	-
PV Array 4	16,509	**937**	10,922	**11,686**	3,290	**25,716**	-	**17,240**	-	-
PV Array 5	16,175	**3,825**	6,990	**15,942**	915	**20,915**	-	**6,285**	-	-
PV Array 6	7,607	-	9,919	**3,808**	3,822	**18,495**	-	**14,238**	-	-
PV Array 7	932	**4,929**	-	**6,144**	-	**6,750**	-	-	-	-
PV Array 8	-	-	-	-	-	**553**	-	-	-	-

Table B-7 SGHAT Analysis Results – FIXED TILT Modes – Runway 28 (East Approach)

PV Array ID (refer Fig.8)	SGHAT Results for "FIXED TILT" Scenarios									
	20° West		10° West		0° (Horizontal)		10° East		20° East	
	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone	Green Zone	Yellow Zone
PV Array 3	-	-	-	-	-	197	-	220	14	143
PV Array 4	-	-	-	-	-	1,231	-	885	169	811
PV Array 5	-	-	-	-	-	1,828	-	2,046	201	2,013
PV Array 6	-	-	-	-	-	2,690	-	2,270	200	1,470
PV Array 7	-	-	-	-	-	1,377	-	2,689	80	3,174
PV Array 8	-	-	-	-	-	2,150	-	1,515	95	828

SGHAT Results Summary – NORMAL TRACKING + FIXED TILT Modes

"NORMAL TRACKING ±62°" Mode

- For Runway 10: the SGHAT analysis yields "YELLOW" Zone results, hence potential glare, for PV Arrays 4 and 6. Planes landing would be flying directly over these arrays on a westerly approach to the airstrip.
- For Runway 28: the SGHAT analysis yields NO "Yellow" or even "Green" Zone results, hence no glare.

ALL "FIXED TILT" Modes

- For Runway 10: the SGHAT analysis yields "YELLOW" Zone results, hence potential glare, for PV Arrays 4, 5, 6, 7, and 8 for the following Fixed Tilt Modes: 20°West, 10°West, Flat, 10°East. No "YELLOW zone results are indicated for a Fixed Tilt 20°East mode.
- For Runway 28: the SGHAT analysis yields "YELLOW" Zone results, hence potential glare, for PV Arrays 3 through to 8 for the following Fixed Tilt Modes: Flat, 10°East, 20°East. No "YELLOW zone results are indicated for a Fixed Tilt 10°West or 20°West mode.

Recommendations

If the solar facility is restricted to "Normal Tracking" mode only:

- Runway 10 could be used at ANY time of the day during the months of May, June and July, with restrictions placed on landings during the months of August to April between the hours of 4:00 pm to 6:00 pm, unless the panels in PV arrays 4 and 5 can be returned to a Fixed Tilt EAST position at or around 4:00 pm during the months of concern.
- Runway 28 could be used all-year-round.

If the panels within the solar facility need to be left in a fixed tilt mode (e.g. for maintenance, during construction, etc):

- Runway 10 could be used all-year-round if all panels in PV Arrays 4-8 are left in a Fixed Tilt 20°EAST position.

- Runway 28 could be used all-year-round if all panels in PV Arrays 3-8 are left in a Fixed Tilt WEST position of at least 10°.

Back-Tracking Software has the capability to operate different sections of a PV facility in varying modes, whereby some panel array groups operate in “full” Back-Tracking mode and others are directed to move to various fixed tilt position either at the start or end of the day, typically without significant loss of total facility output.

It should therefore be possible, if a Back-Tracking solution is chosen for the facility, to implement tracking controls that would enable virtually all-year-round use of the Currandooley Airstrip at any time of day for both runways. Alternatively, an operational management plan for airstrip operations could be developed, avoiding periods throughout the year (typically early morning and later afternoon) when potential aviation glare might occur.

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