Glint and Glare Assessment

Cobden Solar Farm

Bison Energy Company

August 2021

Contents

1. Introduction

1.1. Overview

Bison Energy proposes to construct and operate a 5MW Renewable Energy Facility (Solar Facility) 181 Cobden-Terang Road, Cobden at the corner of Cobden-Terang Road, and Cobden-South Ecklin Road. This facility is to comprise the installation of solar photovoltaic panels mounted in arrays on single-axis trackers, cabling from the solar arrays to panel inverter and substation and connection to the local electricity network.

As part of the planning permit application a Glint and Glare assessment must be undertaken to determine the likely impact of glint and glare from the proposed development on nearby sensitive receptors and identify appropriate, feasible and reasonable mitigation strategies if required.

This Assessment has been prepared by Engineers Patrick Lau and Ming Zhang of Bison Energy with input from planning and urban design consultants Habitat Planning. This report details the key inputs, methodology and the results of this glare assessment.

The objectives of this study are as follows:

- Carry out an analysis of glare from the proposed single axis tracking system;
- Identify observation points surrounding the proposed solar facility
- Identify and summarise potential glare impacts at various observation points;
- Recommend any mitigation to reduce glare issues

1.2. Glint and Glare

Glint refers to the momentary flash of bright light that can be caused by the reflectivity of solar panels and glare refers to the continuous source of light and is generally associated with stationary objects. Glint and glare from PV panels can have potential safety or amenity impacts to surrounding sensitive receivers, including potential to impair observers through inducing an after image.

The Solar Energy Facilities Design and Development Guideline require proponents to prepare a glint and glare assessment using an accepted methodology based on best practice.

1.3. PV Panels Reflectivity

As construction of PV panels primarily utilises glass and steel there is a perception of glint and glare from the reflectivity of solar panels. This leads to potential issues of distractions to motorists, aircraft and eye damage.

Generally, solar panels will not create significant glint or glare compared with other surfaces. PV panels are designed to collect sunlight to convert to energy and therefore absorb the majority of light received. The panels are designed using anti-reflective coatings during manufacture to reduce reflection and will typically absorb 80-90% of the light received.

PV panels are also generally less reflective than other naturally occurring elements such as soils and crops and have been found to be generally less reflective that general rural environments and far less reflective that open water[1].

The angle of incidence of the sunlight is also relevant in considering the reflection of solar development. A fixed axis solar facility will have panels that do not move throughout the day and therefore the angle incidence varies with the time of day. A tracking system, such as that proposed for this development, will follow the sun through the day and can have the angle of incidence reduced. It is also possible to 'back track' panels at certain periods of the day to reduce potential impacts.

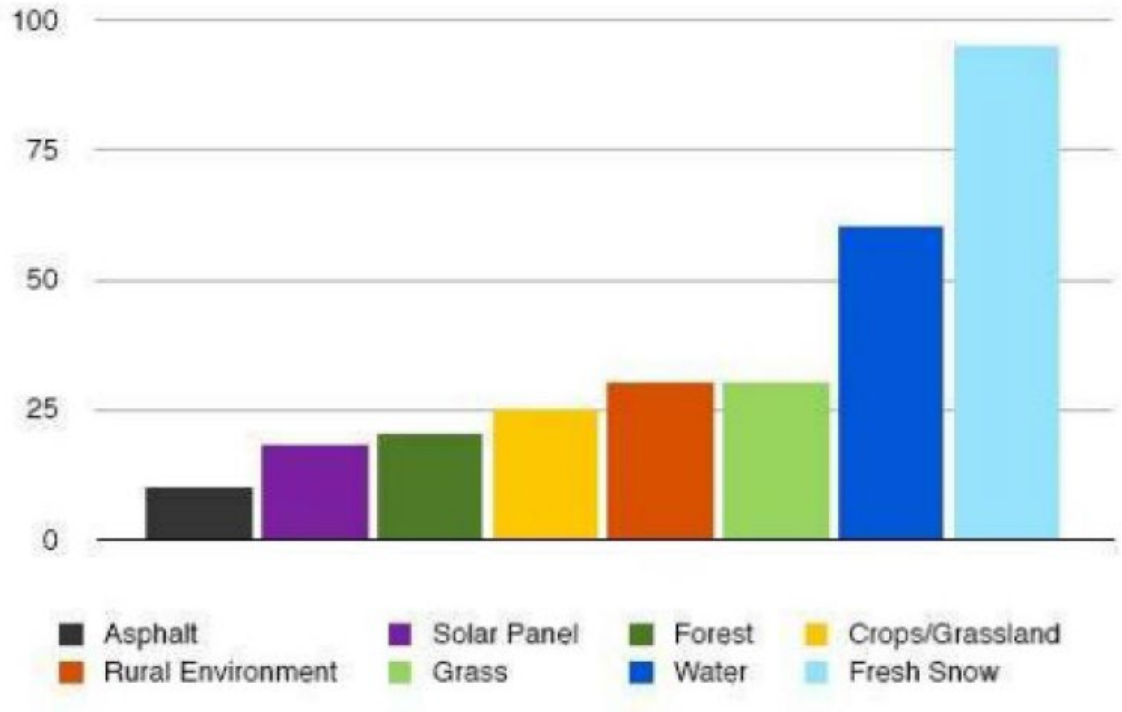

Figure 1 Comparative reflection analysis of PV panels to other surfaces (Spaven Consulting 2011, p.5)

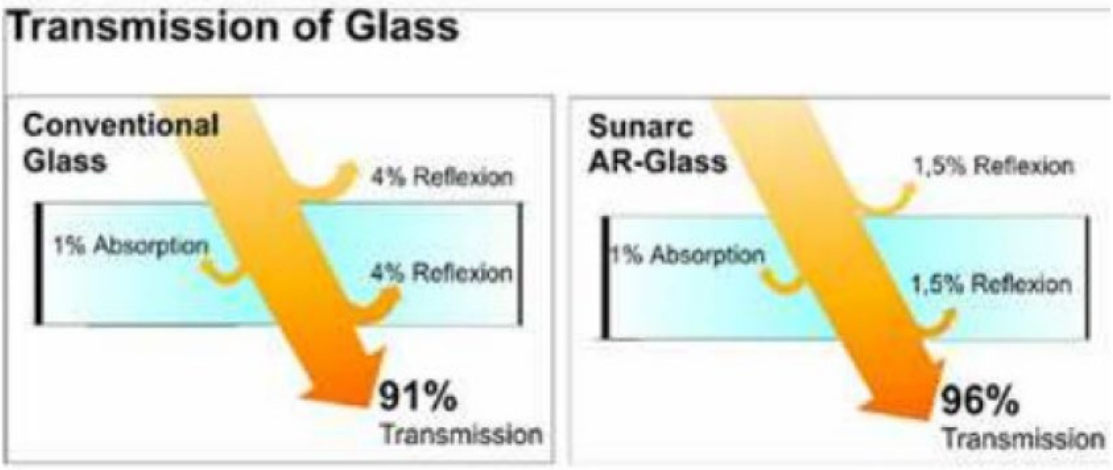

Figure 2 Reflective values of conventional glass and typical treated glass (Spaven Consulting 2011, p.5)

2. Subject Site

2.1. Site description

The lot forms an irregular shape with a 618.25 metre frontage along Cobden-South Ecklin Road to the east and approximately 759.92 metres along Cobden-Terang Road to the north. The land has a total area of 22.26 hectares.

The subject site is a rural property containing cleared paddocks with some strips of planted trees existing around some of the boundary and internal fences. The land has been traditionally used for agricultural cropping purposes and an existing dam, associated with this use, occupies some of the central portion. Primary access is provided via a farm gate towards the south west corner of the land, and secondary existing access is provided at the site's northern boundary at the interface with Cobden-Terang Road, via another gate.

The land is relatively flat, although it experiences some minor undulation and a slight downslope in the north-west to south-east direction.

The proposed lease area itself is represented by cleared and gently undulating land. It has an average slope of 1.2% and very minor change in grade from west to south. A primary drainage line and farm dam runs through the northeast corner of the lot.

Vegetation throughout the land is minimal aside from small stands of planted vegetation running along the internal fence lines forming windbreaks. The ground layer is otherwise highly modified from its previous agricultural functions.

2.2. Development area

The proposed renewable energy facility is to occupy the eastern portion of the subject site towards Cobden-Terang Road. It will retain frontage to each road, through a 515 metre frontage along Cobden-South Ecklin Road and a 336 metre frontage along Cobden-Terang Road.

3. Glint and Glare Assessment Methodology

The assessment methodology in this instance is based on guidance documents for Solar Facility design, studies in relation to glint and glare along with industry best practice modelling. The broad methodology followed for this study comprises:

- collate key data and model inputs for solar farm based on specifications and design
- identify primary receptors in the area surrounding the site;
- consider visibility of the panels from the receptor's location and whether or not panels are likely to be visible
- plot the location of all receptors in a Solar Glare Analyses Tool and input data for the proposed facility to model the expected impacts
- based on modelling, determine whether a reflection can occur to receptors and the extent/period of impact;
- determine whether a significant detrimental impact is expected.
- Recommend appropriate mitigation measures as required

3.1. Modelling Tool

This study has used the Glare Gauge modelling tool by ForgeSolar. This is an industry standard technical modelling tool, which utilises the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratories, to assess the potential glare to receptors around solar arrays. This tool is required by a number of international authorities including the United States Federal Aviation Administration for glint and glare analyses near airports, and it recognised by the UK Civil Aviation Authority, and the Australian Government Civil Aviation Safety Authority.

The Glare Gauge tool uses an interactive Google Maps interface to plot the arrangement of arrays and the location of sensitive receptors including static observation points, routes and flight paths. The elevation of the panels and receptors are automatically captured using ground elevation data of the respective locations. The modelling for consideration of this development utilises the specification and data of the proposed PV panels to be installed, the location of the panels relative to the receptors and the proposed angle of tilt for the panels.

If glare is found, the tool calculates the likelihood of the glare source to present a potential ocular hazard ranging from temporary after-image to retinal burn. The results are presented in a plot and graphs that specifies when glare will occur throughout the year and its duration, with colour codes indicating the potential ocular hazard. These hazard ratings are presented in the following section.

3.2. Glare Hazard Rating

The SGHAT defines three levels of ocular hazard as a result of glare. The hazards are defined as low, moderate or high, depending on the potential to impact vision through producing glare with a potential for afterimage. The following definitions are provided for the glare hazard levels referred to in this report.

No glare	No Glare - No glare predicted.
Green	**Low potential hazard** – Glare is present, however only a low potential for a temporary after-image. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 5** of this report.
Yellow	**Moderate potential hazard** -Glare present with the potential to leave temporary after-image of the glare. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 5** of this report.
High	**High potential hazard** – Glare is present with potential for permanent eye damage. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 5** of this report.

3.3. Model inputs

The proposed solar array associated with the Cobden solar facility will consist of panels fixed on single axis tracking. To accurately determine the potential glare impact of the array, the following array details were input into the GlareGuage tool.

Input	Unit	Value
Time zone	UTC	UTC +10
Peak DNI	kW/m^2	1000
PV Panel surface material	-	Smooth glass with anti-reflective coating
Tracking axis tilt	Degrees	0
Resting angle	Degrees	0
Orientation of tracking axis	Degrees	180
Offset angle of panel	Degrees	0
Maximum tracking angle	Degrees	60
Height above ground	Metres	2

3.4. Identification of Receptors

In addition to the array inputs outlined above, the locations of the identified receptors were plotted into the GlareGuage tool on the same Google Maps interface. These receptors were input from within a capture area of a radius of approximately 2 kilometres around the location of the proposed facility.

A number of Observation Points (OP's) were identified within proximity to the site. These sites represent fixed locations where glint and glare could have an ongoing impact. These OP's consisted entirely of dwellings surrounding dwellings, including those in adjacent properties and were measured from a height of 1.5 metres above the ground for a typical viewing angle. There is also no technical limit to the distance at which reflections could occur. However, the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances. In this case, a total of 37 OP's were recorded surrounding the sit at a radius of approximately 2 kilometres, as was deemed appropriate.

Figure 3 below illustrates the location of the OP's within proximity of the site.

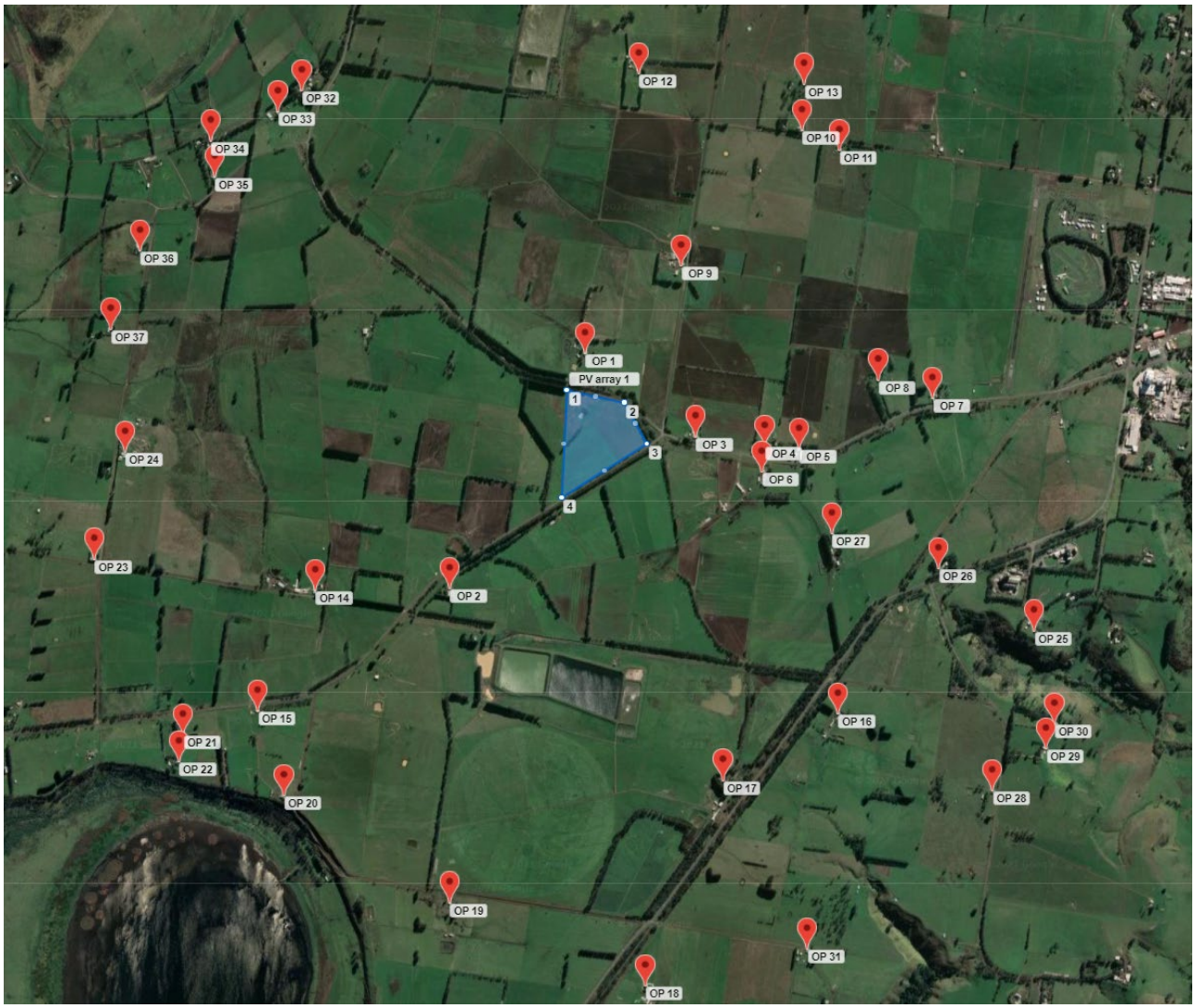

Figure 3 Observation points assessed for glint and glare within the immediate context of the subject site

All surrounding routes were recorded for input into the GlareGuage tool similar to the OP's. These included Cobden-Terang Road, Cobden-South Ecklin Road and any other roads or tracks within the surrounds. The height above ground was also input as 1.5 metres, considered a typical viewing height for individuals in vehicles travelling these routes. In addition, two flight paths are identified on approach to the runway of the Cobden airport.

The routes and flight paths are indicated below in **Figure 4**.

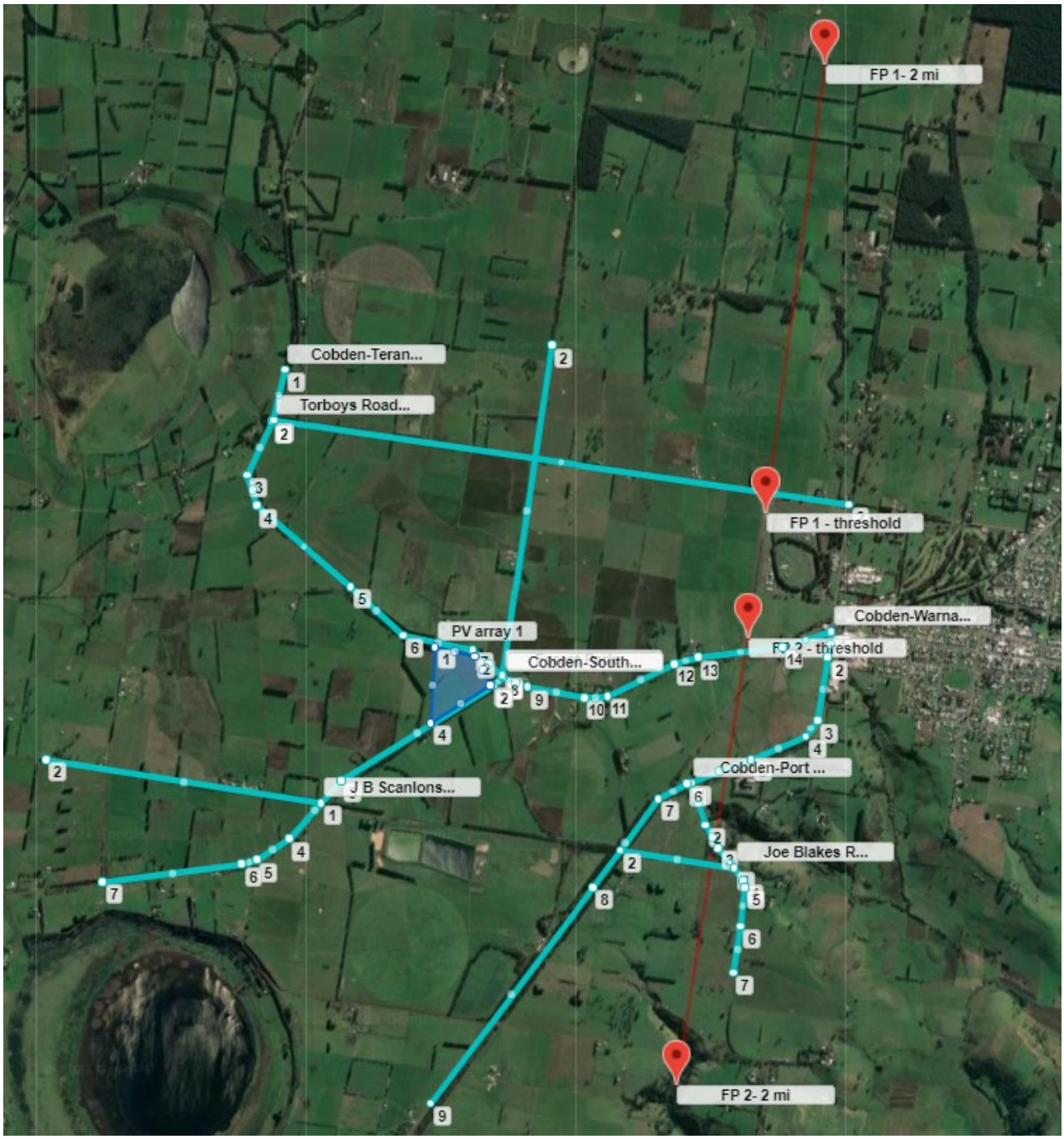

Figure 4 Routes and flight paths assessed for glint and glare within the immediate context of the subject site

3.5. Assessment of Impacts

As discussed, an assessment of the potential impact of the proposal has been undertaken using the GlareGuage Tool. The tool enables the proposed solar facility to be mapped along with relevant data inputs and then uses the data to consider the potential for temporary after-image or more significant retinal burn. The chart presented at **Figure 5** represents the possible severity of glare at receptor locations.

In summary, the red glare refers to potential for permanent eye damage from the observation location, yellow glare indicates the potential for after image effects and green glare refers to low potential for after image impacts.

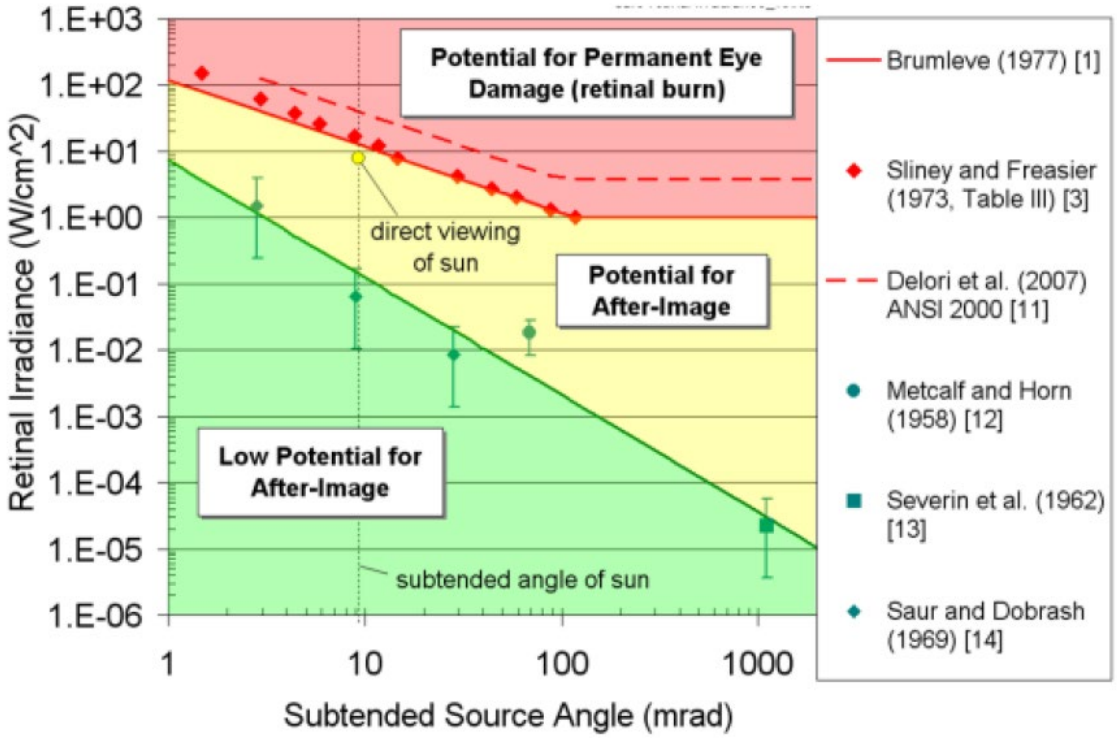

Figure 5 Summary of potential glare impact with regard to total minutes of glare for receptor

The assessment relies on identifying the potential sensitive receptors surrounding the development and assessing the potential impacts on the receptors. The modelling for consideration of this development utilises the specification and data of the proposed PV panels to be installed, the location of the panels relative to the receptors and the proposed angle tilt for the panels.

4. Results

Of the 37 dwellings assessed, eight were calculated to receive "yellow glare" for being subject to glare with potential after image. All eight of these dwellings were located within the cluster of nearby houses located to the east of the PV array along Cobden-Terang Road. OP 6 receives the highest exposure with 2,627 minutes of yellow glare anticipated per year. The remaining dwellings in this cluster were subject to glare ranging from 342 minutes up to 2,496 minutes of glare per year.

Except for the Cobden-South Ecklin Road route and Hallyburtons Road, all other routes were subject to some yellow glare impacts. Cobden-Terang Road received the highest glare, with 3,473 minutes of yearly yellow glare. Other routes ranged from yearly exposure between 35 minutes and 616 minutes.

Flight paths associated with the Cobden Aerodrome were also assessed for glare impacts. None of the flight paths to the Cobden Aerodrome are affected by yellow glare. Only Flight Path 1 (FP1), which the northern approach to the aerodrome, was subject to glare and received 83 minutes of "green glare" per year.

A summary of the receptors which recorded glare, is provided in the following table. Note that receptors that did not record any glare are not included in this table.

Table 1 Summary of results

Receptor	Green Glare (min/year)	Yellow Glare (min/year)
Fight Path 1	83	0
OP 3	0	2496
OP 4	7	1894
OP 5	63	1485
OP 6	2	2627
OP 7	622	451
OP 8	455	1028
OP 26	894	342
OP 27	277	2240
Cobden-Port Campbell road	19	35
Cobden-Terang Road	49	3473
Cobden-Warnambool Road	1040	616
Forest Park Road	0	275
Torboys Road and Hallyburtons Road	1660	0

5. Recommended Mitigation

The results indicate that a number of the OP's and some of the routes will experience glare, with many results indicating that they will be subject to glare with low-moderate potential afterimage. A cluster of dwellings, and the Cobden-Terang Road, to the east of the site are subject to some moderate glare impacts, however views in this direction are already largely screened by perimeter vegetation. Based on site inspection and views taken from the site, it is considered unlikely that levels of glare will actually be realised to those locations given the vegetation screening already established.

However, landscaping is proposed to the perimeter of the site to infill open sections along the south and north boundaries which will contribute to minimising potential for impacts from glare at these modelled locations. This landscaping is to be provided in the form of perimeter plantings as detailed by the submitted landscape plans.

Additionally, a temporary screening mesh treatment is able to be installed along the south east boundary while perimeter landscaping is established at this frontage.

A summary of the recommended mitigation measures is provided in the following table

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Table 2 Summary of impact and mitigation

Receptor	Glare Rating	Extent	Existing mitigation	Recommended Mitigation
Fight Path 1	**Low** Green Glare with low potential for after image	For up to 5 minutes between 7:00pm to 8:00pm during December	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan. Install mesh fencing around perimeter on northern and eastern interfaces.
OP 3	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 5:00pm and 8:00pm from January to June and from July to December	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.
OP 4	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 5:00pm and 8:00pm from February to May and from August to November	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.
OP 5	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 5:00pm and 8:00pm from February and May and from August to November	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.
OP 6	**Moderate** Yellow Glare with potential for after image	For up to 20 minutes between 5:00pm and 7:00pm from March to June and from July to November	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.

OP 7	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 6:00pm and 8:00pm from February to April and from September to November	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.
OP 8	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 6:00pm and 8:00pm from February to April and from September to November	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.
OP 26	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 5:00pm and 6:00pm from April to June and from July to September	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.
OP 27	**Moderate** Yellow Glare with potential for after image	For up to 20 minutes between 5:00pm and 7:00pm from April to October	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.
Cobden-Port Campbell road	**Moderate** Yellow Glare with potential for after image	For up to 2 minutes between 5:00pm and 6:00pm from April and September	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.
Cobden-Terang Road	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 4:00pm and 8:00pm all year excluding December	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.
Cobden-Warnambool Road	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 4:00pm and 7:00pm from April and September	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.

Forest Park Road	**Moderate** Yellow Glare with potential for after image	For up to 15 minutes between 7:00pm and 8:00pm from December and January	Existing established vegetation including established trees.	Install mesh fencing around perimeter on northern and eastern interfaces.
Torboys Road and Hallyburtons Road	**Low** Green Glare with low potential for after image	For up to 20 minutes between 6:00pm and 8:00pm from October and March	Existing established vegetation including established trees.	New perimeter plantings on northern and eastern boundaries in accordance with landscape plan.

6. Conclusion

Overall, the assessment determines that the glare generated by the proposal is acceptable and can be adequately mitigated. All receptors that were affected by glare were located to the east of the proposed array. These include all affected observation points, and segments of affected routes and flight paths. The eastern, northern and southern boundaries are provided with existing vegetation which will provide an appropriate level of screening. Additionally, there will be landscaping within the works area itself along these borders, to provide an added level of screening to all affected receptors.

Recommendations for the receptors where glare impacts are deemed most substantial are described in the following section.

6.1. Recommendations

The affected receptors were all located within a radius extending to the east, as they were subject to reflected glare from the evening sun. Given the existing vegetation located along each boundary and the internal space providing opportunity for additional landscaping, these receptors can be buffered from the source of the glare.

It is noted that a limitation of the Glare Gauge analyses tool is that it does not incorporate vegetation as a variable through its modelling of glare impacts. As there is already substantial vegetation along the northern, and eastern boundaries, along with landscape vegetation before preceding most receptors, glare is considered heavily buffered. The vegetation along these boundaries are indicated in the following figure below.

Notwithstanding, it is recommended that screening plantings is provided within the boundary of the subject, using a range of large trees of a mature height of at least 20 metres high to establish a dense overstorey and small trees/shrubs, and groundcover plantings along the entire portion of the perimeters of the eastern and northern boundaries. This will ensure that, once established, the height of the solar panels will be completely screened by a natural barrier that will sufficiently mitigate any glare that any of the subjected receptors may receive. Native species should be chosen for the purpose of contributing to the habitat of local fauna, such as local large Eucalyptus species (eg. *E. camuldulensis, E. luecoxylen*), and smaller *Acacia* species (*A. dealbata, A. pycantha*). The plantings should occur over a planting strip of at least 5 metres deep, to ensure that appropriate densities are established to block any glare.

In the interim period of establishment for of the proposed vegetation plantings, it is recommended that the proposal include the installation of glare mitigation screening in the form of a screened mesh applied to the internal security fence along the eastern and northern boundaries. This screening should extend to the height of the proposed fence. The screen is to remain in place, and be maintained as required, until landscaping has developed to the height of security fencing.

Figure 6 View facing southwest towards the site across the intersection of Cobden-Terang Road and Cobden-South Ecklin Road. This image demonstrate the significant vegetation already established to screen views of the panels from land to the east.

Figure 7 View facing southeast along Cobden-Terang Road

Figure 8 View facing south along Cobden-South Ecklin Road

Appendix A: Glare Gauge Glint and Glare Assessment

Cobden Solar Facility

Cobden-temp-0

Created April 15, 2021
Updated April 15, 2021
Time-step 1 minute
Timezone offset UTC10
Site ID 52521.9413

Project type Advanced
Project status: active
Category 1 MW to 5 MW

Misc. Analysis Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodologies:

- Observation point: **Version 2**
- 2-Mile Flight Path: **Version 2**
- Route: **Version 2**

Summary of Results Glare with potential for temporary after-image predicted

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	SA tracking	SA tracking	5,356	16,736	-

Component Data

PV Array(s)

Total PV footprint area: 137,298 m^2

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 0.0 deg
Footprint area: 137,298 m^2
Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.328063	143.030474	140.28	2.00	142.28
2	-38.328641	143.033787	139.18	2.00	141.18
3	-38.330475	143.035075	139.82	2.00	141.82
4	-38.332899	143.030182	142.47	2.00	144.47

2-Mile Flight Path Receptor(s)

Name: FP 1
Description:
Threshold height : 15 m
Direction: 187.5 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	-38.319457	143.057459	143.36	15.24	158.60
2-mile point	-38.290792	143.062281	202.44	124.84	327.28

Name: FP 2
Description:
Threshold height : 15 m
Direction: 9.1 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	-38.327432	143.055962	138.34	15.24	153.58
2-mile point	-38.355981	143.050126	97.86	224.40	322.27

Route Receptor(s)

Name: Cobden-Port Campbell Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.336764	143.051354	139.66	1.50	141.16
2	-38.339453	143.052560	135.33	1.50	136.83
3	-38.340904	143.053547	136.31	1.50	137.81
4	-38.343004	143.055672	141.00	1.50	142.50
5	-38.343374	143.055752	142.10	1.50	143.60
6	-38.345872	143.055387	138.51	1.50	140.01
7	-38.348861	143.054811	135.47	1.50	136.97

Name: Cobden-South Ecklin Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.330007	143.036054	139.23	1.50	140.73
2	-38.330579	143.035179	139.88	1.50	141.38
3	-38.336603	143.022849	141.90	1.50	143.40
4	-38.340339	143.018633	142.19	1.50	143.69
5	-38.341626	143.015955	144.05	1.50	145.55
6	-38.341921	143.014796	143.40	1.50	144.90
7	-38.343090	143.003486	146.03	1.50	147.53

Name: Cobden-Terang Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.310338	143.018293	142.86	1.50	144.36
2	-38.313638	143.017263	143.43	1.50	144.93
3	-38.317073	143.015203	139.70	1.50	141.20
4	-38.319026	143.016018	135.05	1.50	136.55
5	-38.324245	143.023657	138.64	1.50	140.14
6	-38.327308	143.027906	139.87	1.50	141.37
7	-38.328247	143.033595	139.00	1.50	140.50
8	-38.330035	143.036110	139.04	1.50	140.54
9	-38.330603	143.038042	140.00	1.50	141.50
10	-38.331298	143.042653	141.08	1.50	142.58
11	-38.331243	143.044573	141.14	1.50	142.64
12	-38.329111	143.049945	141.40	1.50	142.90
13	-38.328724	143.051913	140.62	1.50	142.12
14	-38.328023	143.058789	138.64	1.50	140.14
15	-38.327081	143.062694	138.29	1.50	139.79

Name: Cobden-Warnambool Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.327097	143.062799	138.61	1.50	140.11
2	-38.328747	143.062520	137.47	1.50	138.97
3	-38.332772	143.061653	138.54	1.50	140.04
4	-38.333773	143.060676	139.07	1.50	140.57
5	-38.335232	143.056251	139.81	1.50	141.31
6	-38.336781	143.050995	139.11	1.50	140.61
7	-38.337725	143.048717	141.91	1.50	143.41
8	-38.343429	143.043379	139.06	1.50	140.56
9	-38.357177	143.030182	139.45	1.50	140.95

Name: Forest Park Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.329901	143.035986	139.46	1.50	140.96
2	-38.308779	143.039977	149.77	1.50	151.27

Name: J B Scanlons Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.338012	143.021246	142.18	1.50	143.68
2	-38.335280	142.998855	135.57	1.50	137.07

Name: Joe Blakes Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.342217	143.054854	137.56	1.50	139.06
2	-38.341064	143.045627	139.58	1.50	141.08

Name: Torboys Road and Hallyburtons Road
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-38.313570	143.017389	143.67	1.50	145.17
2	-38.318979	143.064265	145.45	1.50	146.95

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	-38.326431	143.031538	139.78	1.50	141.28
OP 2	-38.337009	143.023753	144.75	1.50	146.25
OP 3	-38.330180	143.037867	140.00	1.50	141.50
OP 4	-38.330599	143.041864	140.96	1.50	142.46
OP 5	-38.330760	143.043820	140.36	1.50	141.86
OP 6	-38.331770	143.041701	143.72	1.50	145.22
OP 7	-38.328471	143.051528	142.09	1.50	143.59
OP 8	-38.327626	143.048372	144.47	1.50	145.97
OP 9	-38.322451	143.037048	139.82	1.50	141.32
OP 10	-38.316373	143.044018	143.73	1.50	145.23
OP 11	-38.317277	143.046169	143.53	1.50	145.03
OP 12	-38.313820	143.034621	143.60	1.50	145.10
OP 13	-38.314300	143.044137	145.20	1.50	146.70
OP 14	-38.337127	143.016023	137.07	1.50	138.57
OP 15	-38.342518	143.012723	145.44	1.50	146.94
OP 16	-38.342649	143.046073	143.44	1.50	144.94
OP 17	-38.345655	143.039467	141.71	1.50	143.21
OP 18	-38.354908	143.035011	139.66	1.50	141.16
OP 19	-38.351174	143.023735	147.54	1.50	149.04
OP 20	-38.346381	143.014229	149.88	1.50	151.38
OP 21	-38.343613	143.008426	147.93	1.50	149.43
OP 22	-38.344822	143.008161	149.09	1.50	150.59
OP 23	-38.335708	143.003320	140.36	1.50	141.86
OP 24	-38.330890	143.005080	135.69	1.50	137.19
OP 25	-38.338922	143.057338	134.17	1.50	135.67
OP 26	-38.336135	143.051884	140.16	1.50	141.66
OP 27	-38.334557	143.045736	145.55	1.50	147.05
OP 28	-38.346132	143.054965	138.00	1.50	139.50
OP 29	-38.344241	143.058027	134.92	1.50	136.42
OP 30	-38.343124	143.058532	132.43	1.50	133.93
OP 31	-38.353258	143.044314	138.01	1.50	139.51
OP 32	-38.314600	143.015239	143.41	1.50	144.91
OP 33	-38.315545	143.013865	141.99	1.50	143.49
OP 34	-38.316839	143.010038	136.67	1.50	138.17
OP 35	-38.318472	143.010226	136.62	1.50	138.12
OP 36	-38.321789	143.005949	133.17	1.50	134.67
OP 37	-38.325336	143.004255	132.63	1.50	134.13

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV array 1	SA tracking	SA tracking	5,356	16,736	-	-

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	300	76	2	1	11	54	30	2	0	42	198	265
pv-array-1 (yellow)	4	214	313	165	426	403	444	273	185	374	6	11

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 potential temporary after-image

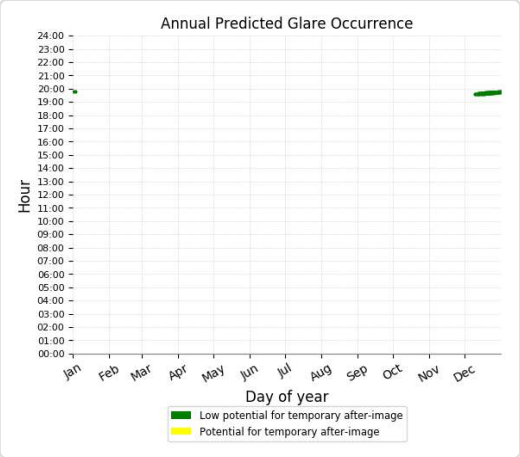
Component	Green glare (min)	Yellow glare (min)
FP: FP 1	83	0
FP: FP 2	0	0
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	2496
OP: OP 4	7	1894
OP: OP 5	63	1485
OP: OP 6	2	2627
OP: OP 7	622	451
OP: OP 8	455	1028
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	894	342
OP: OP 27	377	2240

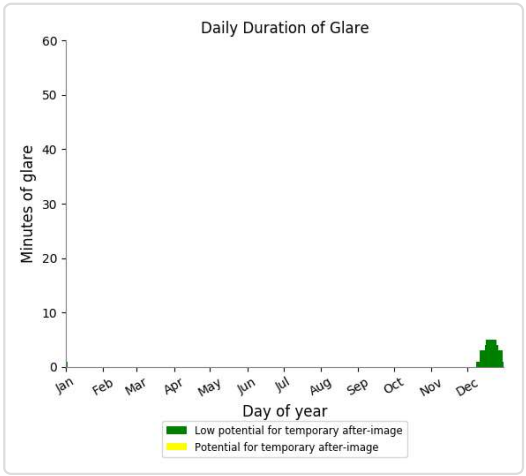
OP: OP 28	0	0
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
Route: Cobden-Port Campbell Road	11	37
Route: Cobden-South Ecklin Road	0	0
Route: Cobden-Terang Road	75	3343
Route: Cobden-Warnambool Road	1107	518
Route: Forest Park Road	0	275
Route: J B Scanlons Road	0	0
Route: Joe Blakes Road	0	0
Route: Torboys Road and Hallyburtons Road	1660	0

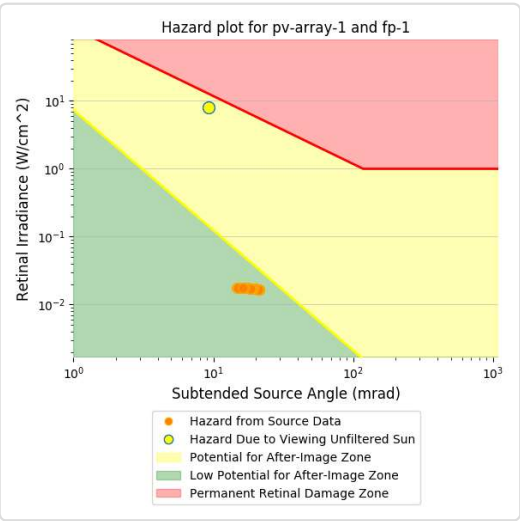
PV array 1 - Receptor (FP 1)

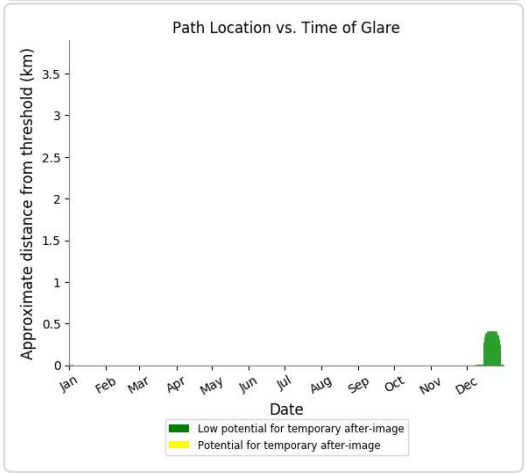
PV array is expected to produce the following glare for observers on this flight path:

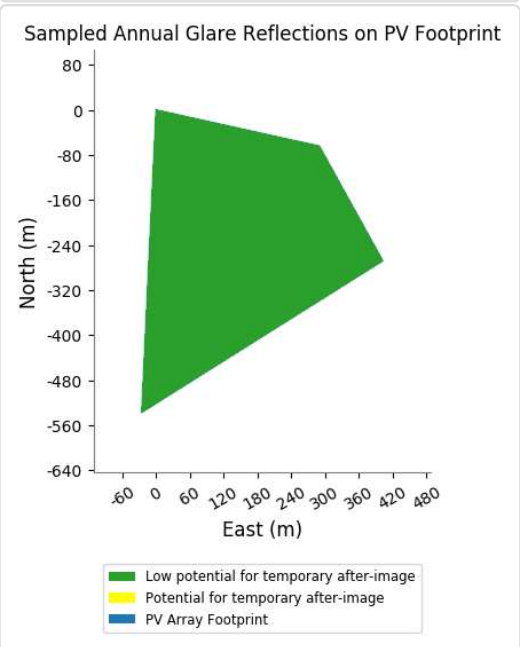
- 83 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

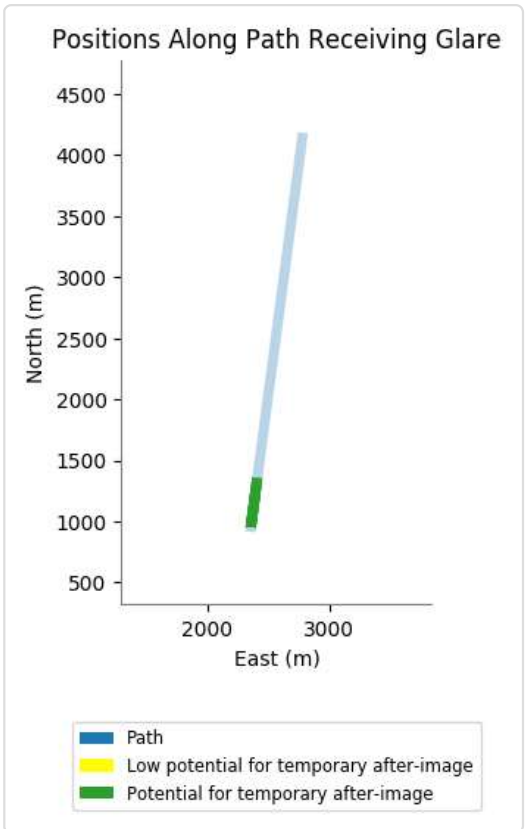












PV array 1 - Receptor (FP 2)

No glare found

PV array 1 - OP Receptor (OP 1)

No glare found

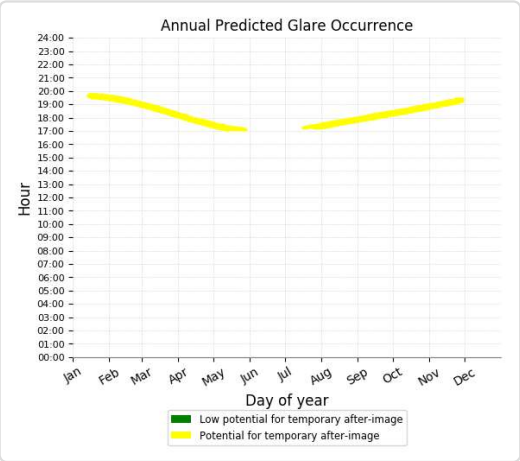
PV array 1 - OP Receptor (OP 2)

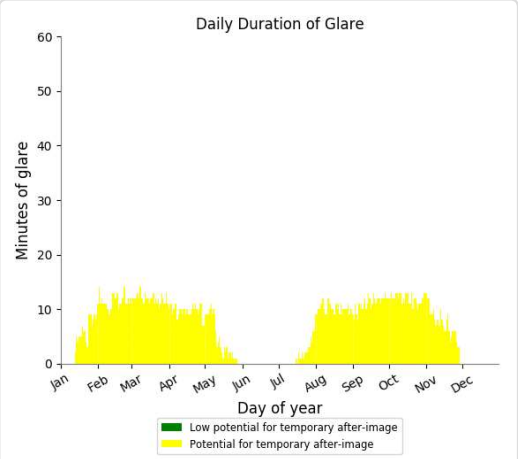
No glare found

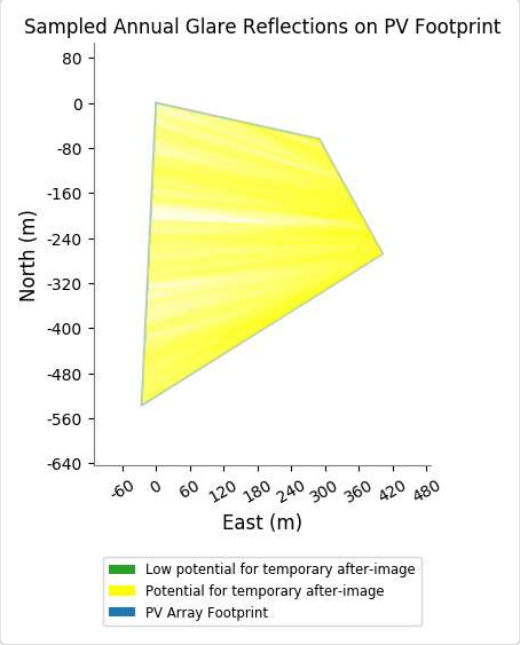
PV array 1 - OP Receptor (OP 3)

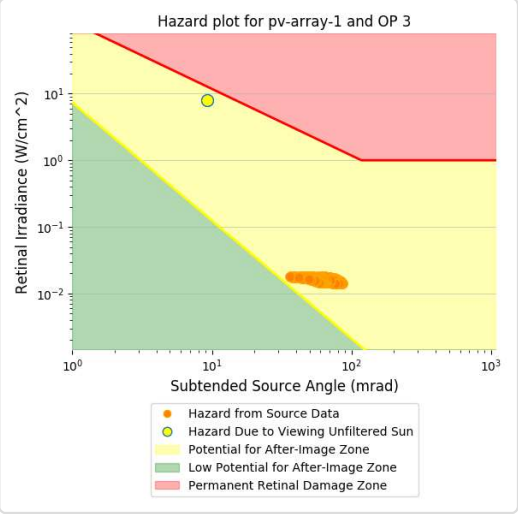
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,496 minutes of "yellow" glare with potential to cause temporary after-image.





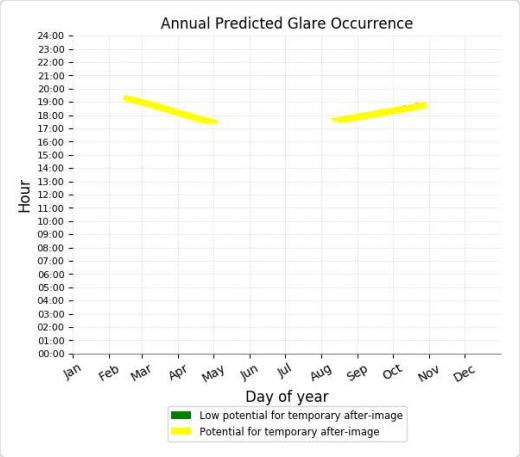


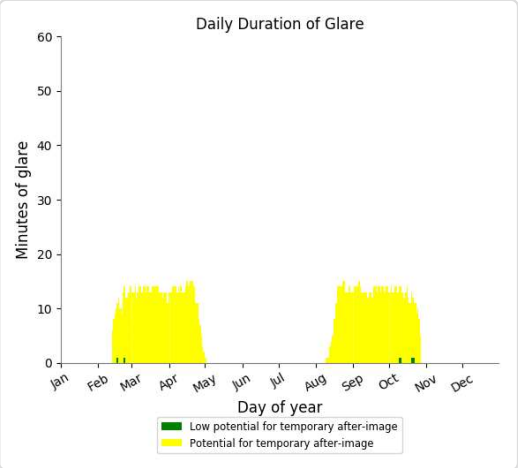


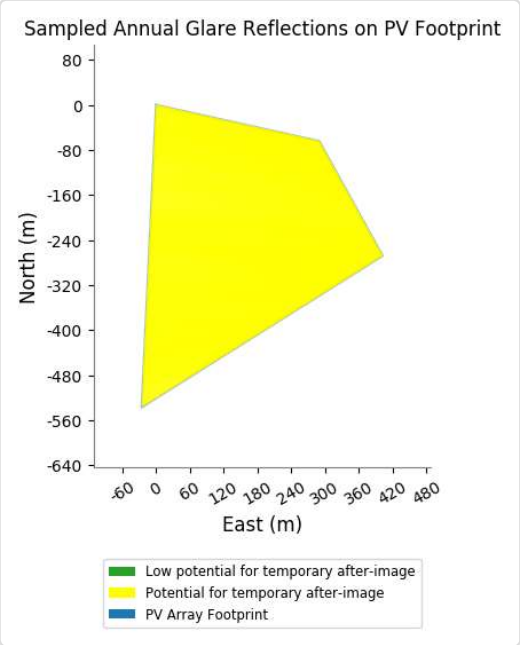
PV array 1 - OP Receptor (OP 4)

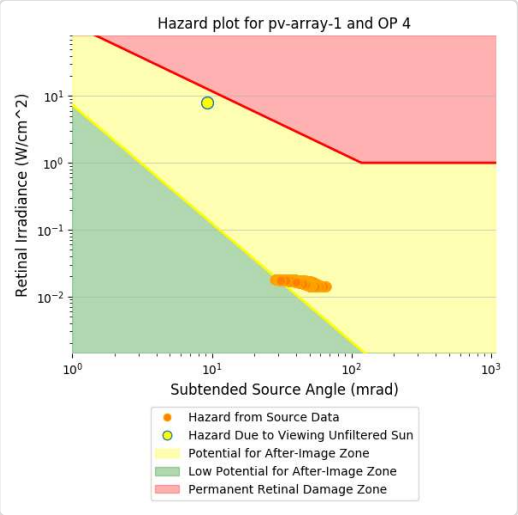
PV array is expected to produce the following glare for receptors at this location:

- 7 minutes of "green" glare with low potential to cause temporary after-image.
- 1,894 minutes of "yellow" glare with potential to cause temporary after-image.





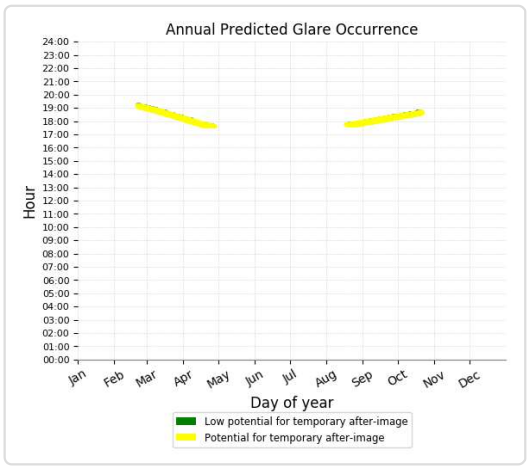


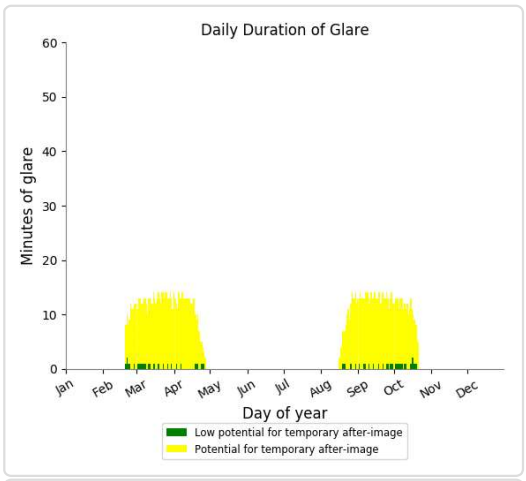


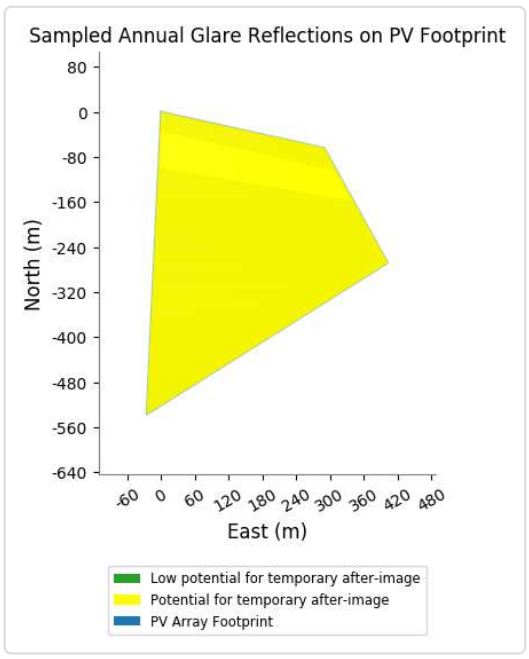
PV array 1 - OP Receptor (OP 5)

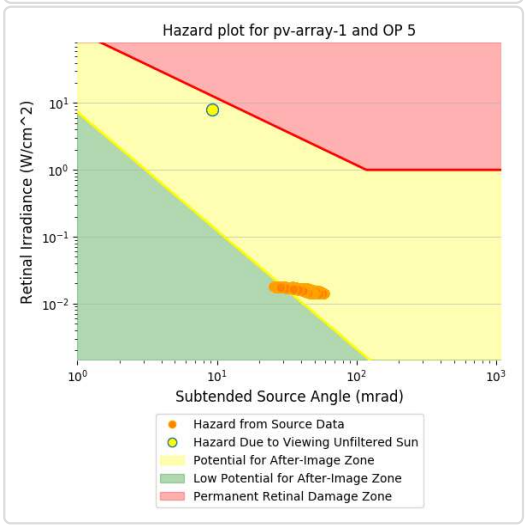
PV array is expected to produce the following glare for receptors at this location:

- 63 minutes of "green" glare with low potential to cause temporary after-image.
- 1,485 minutes of "yellow" glare with potential to cause temporary after-image.





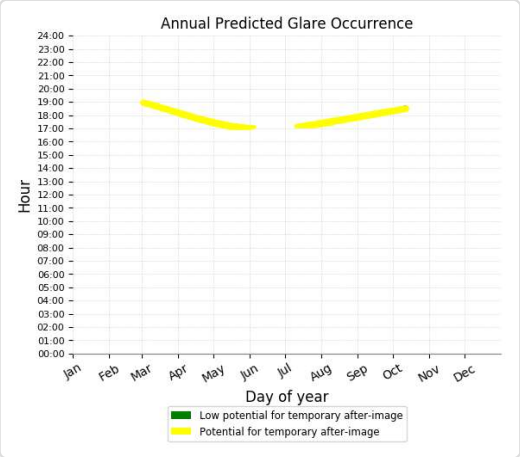


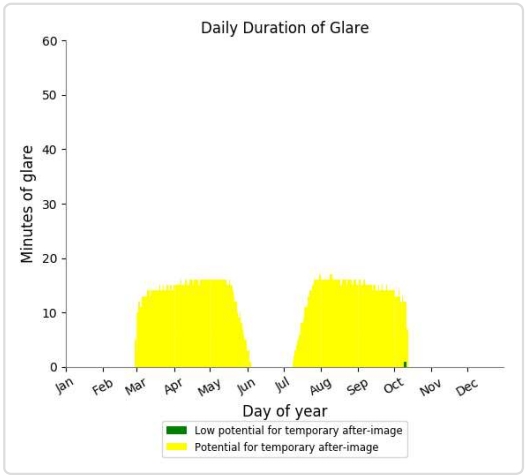


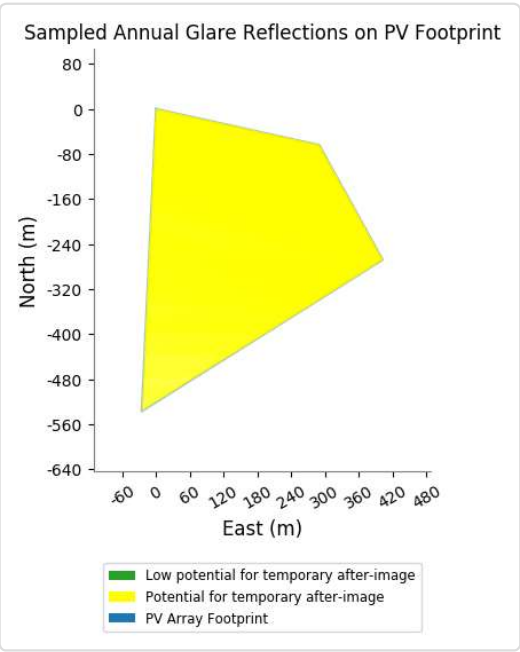
PV array 1 - OP Receptor (OP 6)

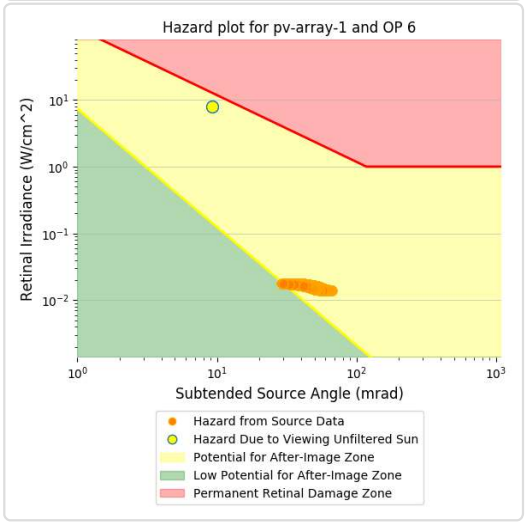
PV array is expected to produce the following glare for receptors at this location:

- 2 minutes of "green" glare with low potential to cause temporary after-image.
- 2,627 minutes of "yellow" glare with potential to cause temporary after-image.





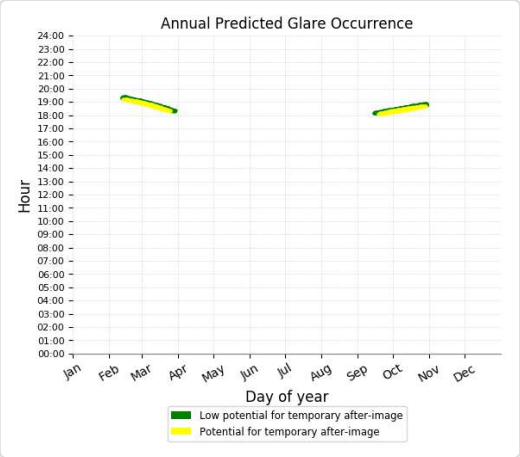


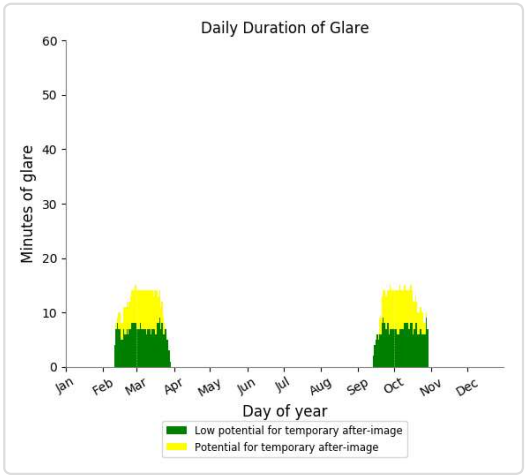


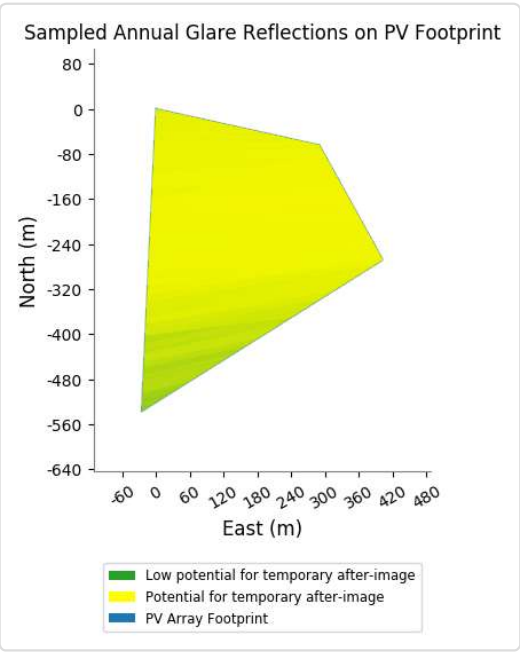
PV array 1 - OP Receptor (OP 7)

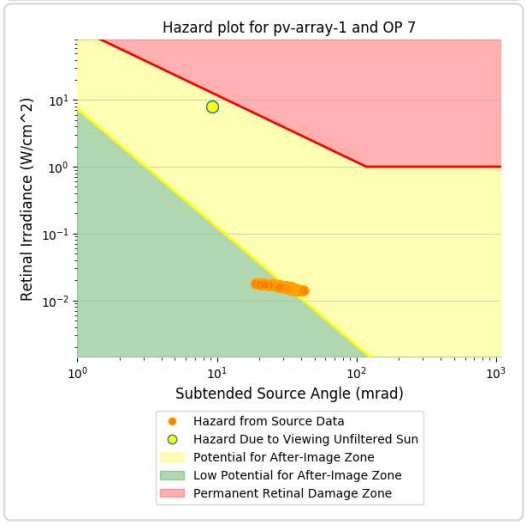
PV array is expected to produce the following glare for receptors at this location:

- 622 minutes of "green" glare with low potential to cause temporary after-image.
- 451 minutes of "yellow" glare with potential to cause temporary after-image.





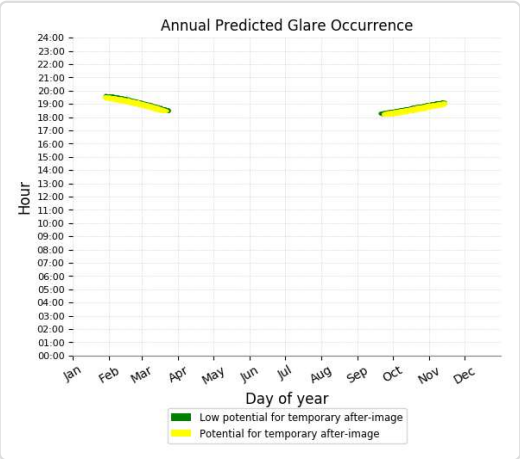


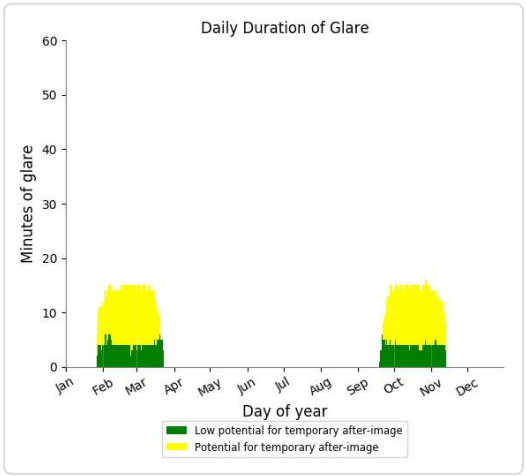


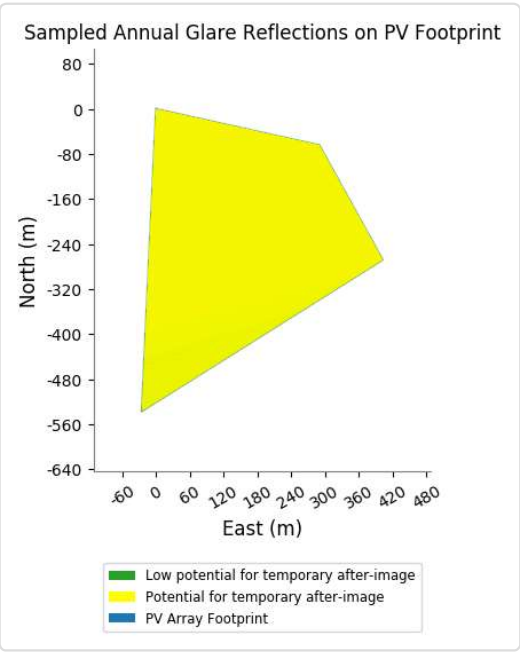
PV array 1 - OP Receptor (OP 8)

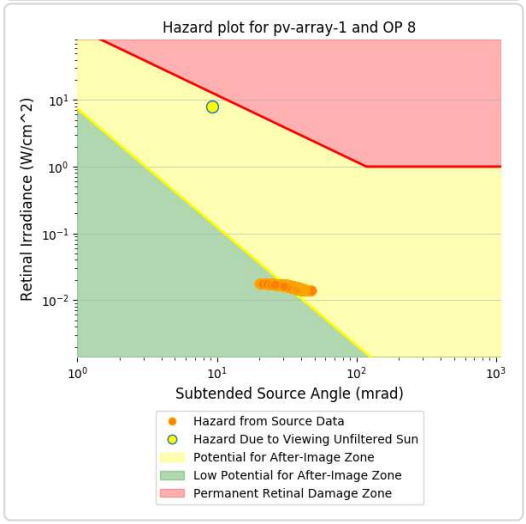
PV array is expected to produce the following glare for receptors at this location:

- 455 minutes of "green" glare with low potential to cause temporary after-image.
- 1,028 minutes of "yellow" glare with potential to cause temporary after-image.









PV array 1 - OP Receptor (OP 9)

No glare found

PV array 1 - OP Receptor (OP 10)

No glare found

PV array 1 - OP Receptor (OP 11)

No glare found

PV array 1 - OP Receptor (OP 12)

No glare found

PV array 1 - OP Receptor (OP 13)

No glare found

PV array 1 - OP Receptor (OP 14)

No glare found

PV array 1 - OP Receptor (OP 15)

No glare found

PV array 1 - OP Receptor (OP 16)

No glare found

PV array 1 - OP Receptor (OP 17)

No glare found

PV array 1 - OP Receptor (OP 18)

No glare found

PV array 1 - OP Receptor (OP 19)

No glare found

PV array 1 - OP Receptor (OP 20)

No glare found

PV array 1 - OP Receptor (OP 21)

No glare found

PV array 1 - OP Receptor (OP 22)

No glare found

PV array 1 - OP Receptor (OP 23)

No glare found

PV array 1 - OP Receptor (OP 24)

No glare found

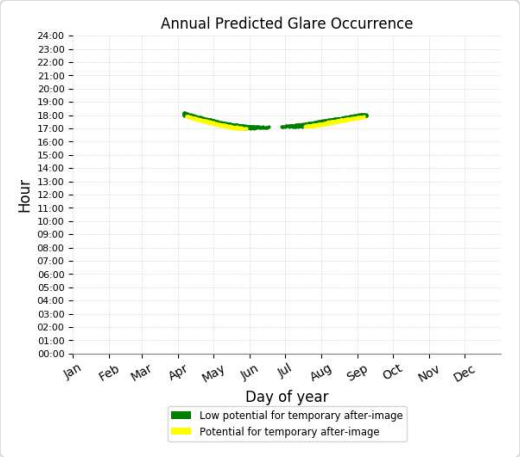
PV array 1 - OP Receptor (OP 25)

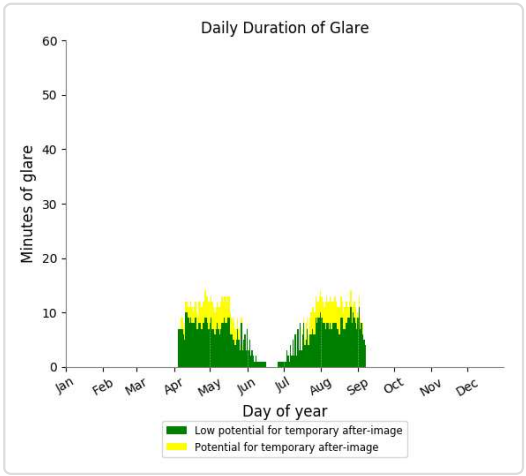
No glare found

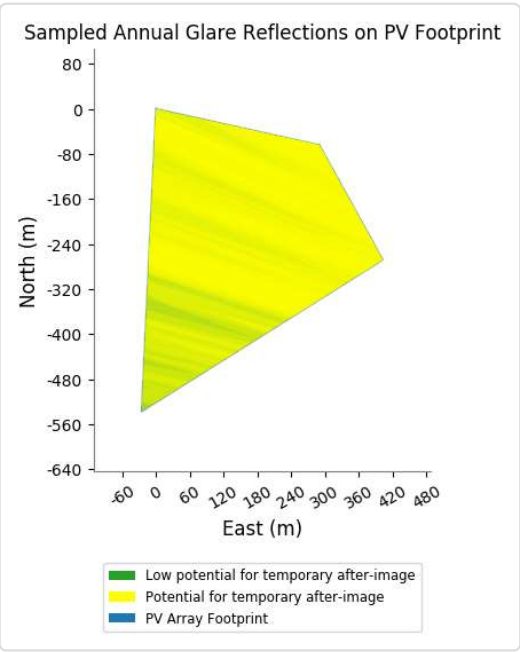
PV array 1 - OP Receptor (OP 26)

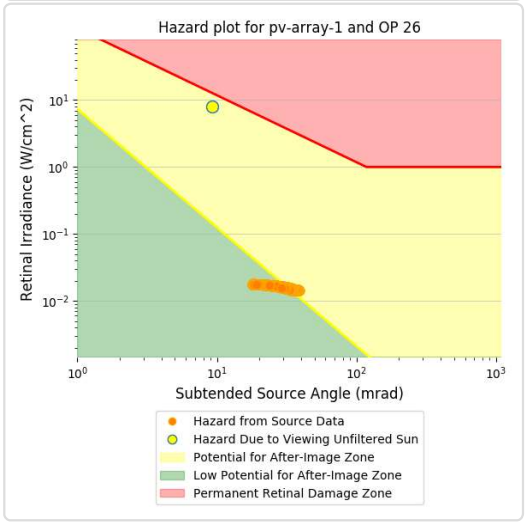
PV array is expected to produce the following glare for receptors at this location:

- 894 minutes of "green" glare with low potential to cause temporary after-image.
- 342 minutes of "yellow" glare with potential to cause temporary after-image.





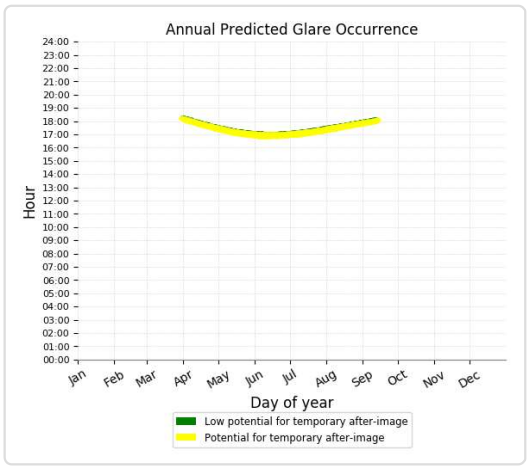


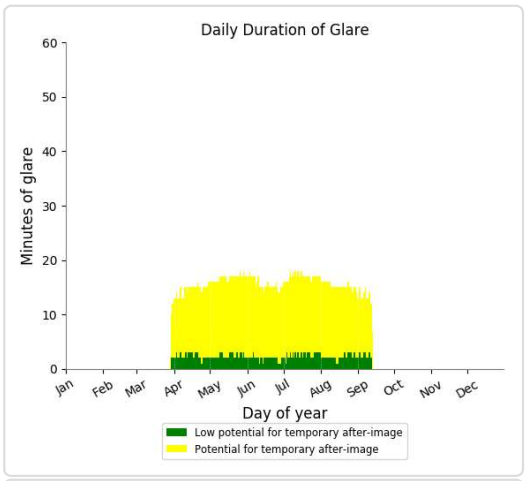


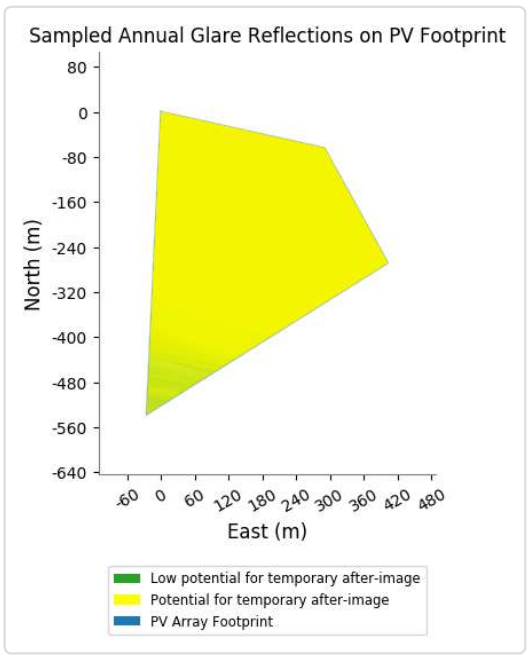
PV array 1 - OP Receptor (OP 27)

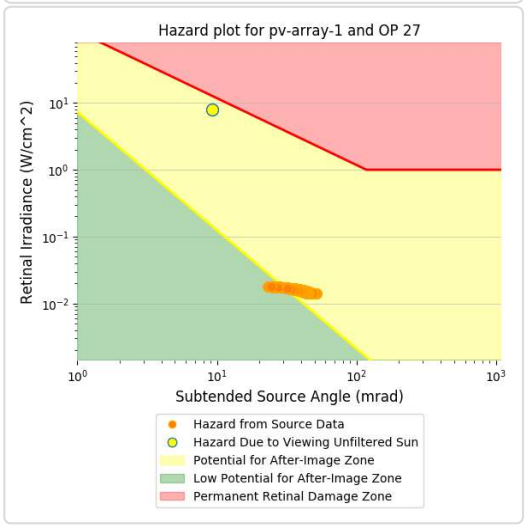
PV array is expected to produce the following glare for receptors at this location:

- 377 minutes of "green" glare with low potential to cause temporary after-image.
- 2,240 minutes of "yellow" glare with potential to cause temporary after-image.









PV array 1 - OP Receptor (OP 28)

No glare found

PV array 1 - OP Receptor (OP 29)

No glare found

PV array 1 - OP Receptor (OP 30)

No glare found

PV array 1 - OP Receptor (OP 31)

No glare found

PV array 1 - OP Receptor (OP 32)

No glare found

PV array 1 - OP Receptor (OP 33)

No glare found

PV array 1 - OP Receptor (OP 34)

No glare found

PV array 1 - OP Receptor (OP 35)

No glare found

PV array 1 - OP Receptor (OP 36)

No glare found

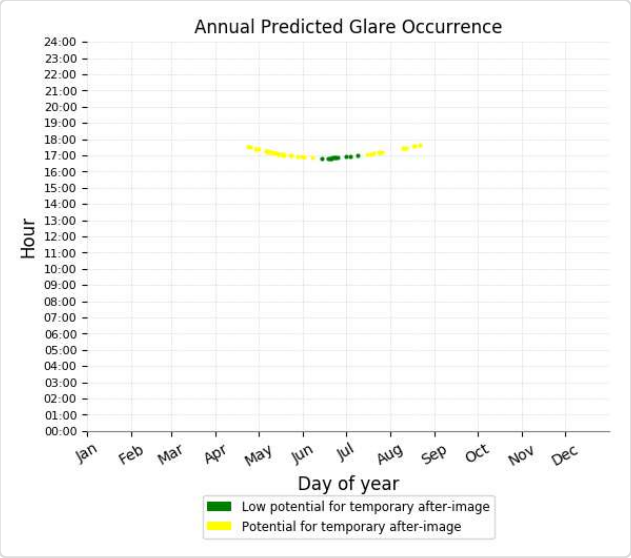
PV array 1 - OP Receptor (OP 37)

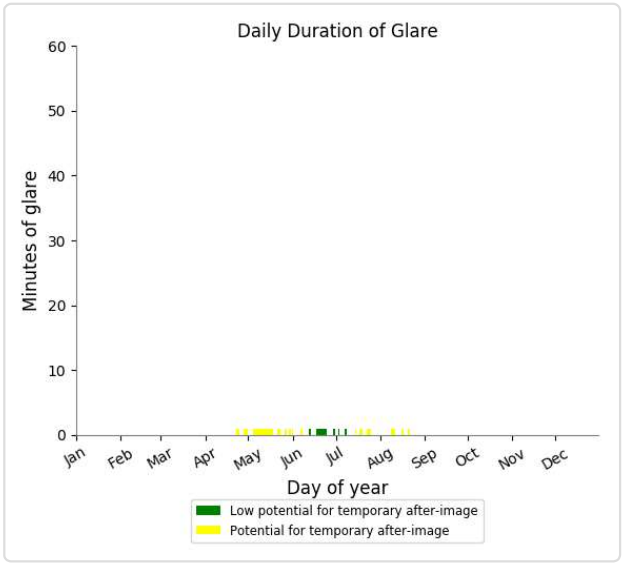
No glare found

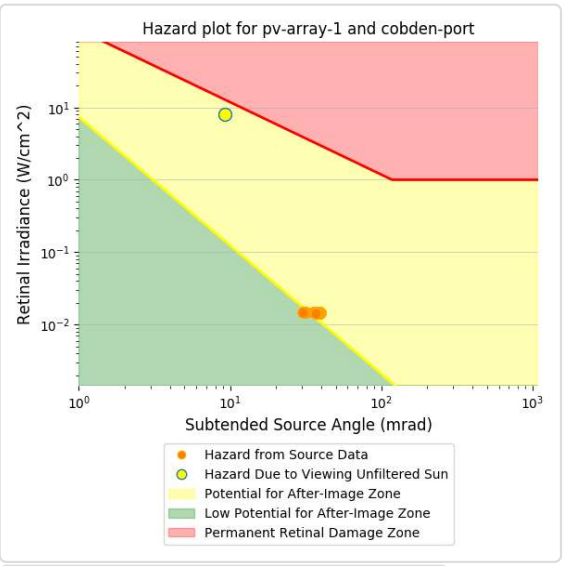
PV array 1 - Route Receptor (Cobden-Port Campbell Road)

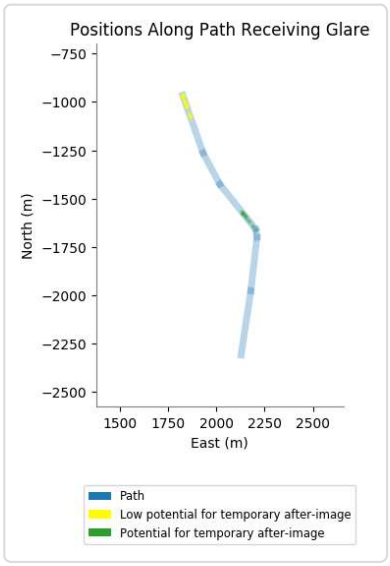
PV array is expected to produce the following glare for receptors at this location:

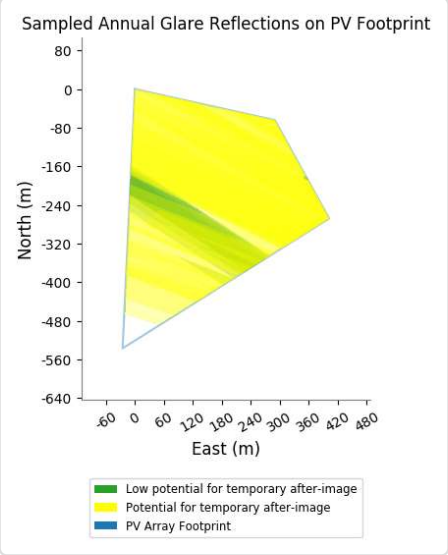
- 11 minutes of "green" glare with low potential to cause temporary after-image.
- 37 minutes of "yellow" glare with potential to cause temporary after-image.











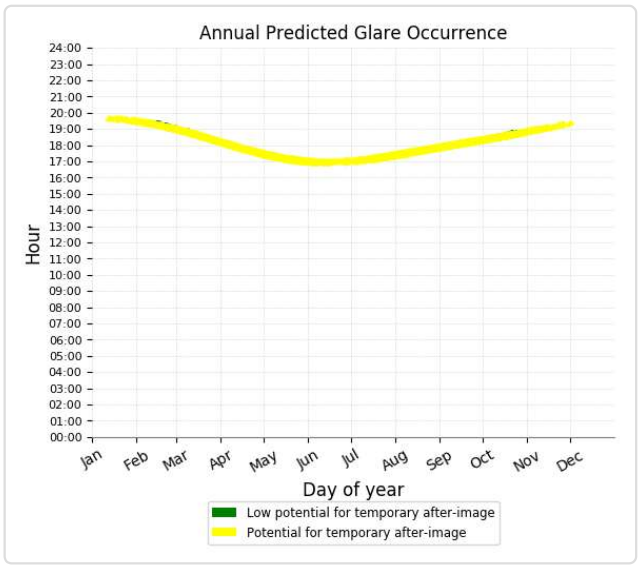
PV array 1 - Route Receptor (Cobden-South Ecklin Road)

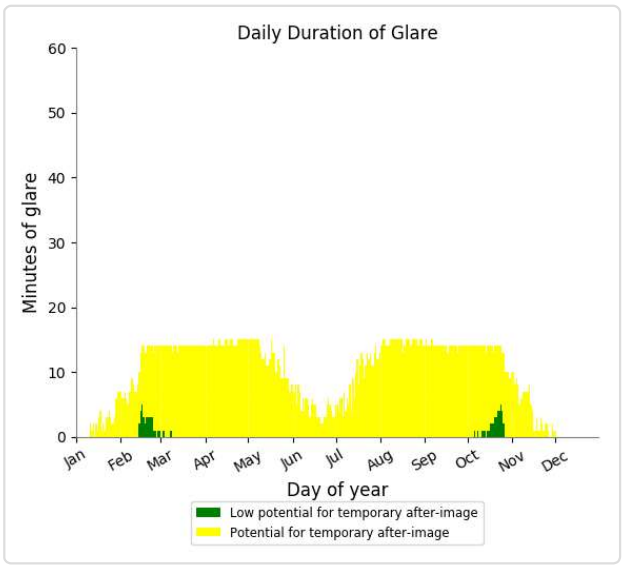
No glare found

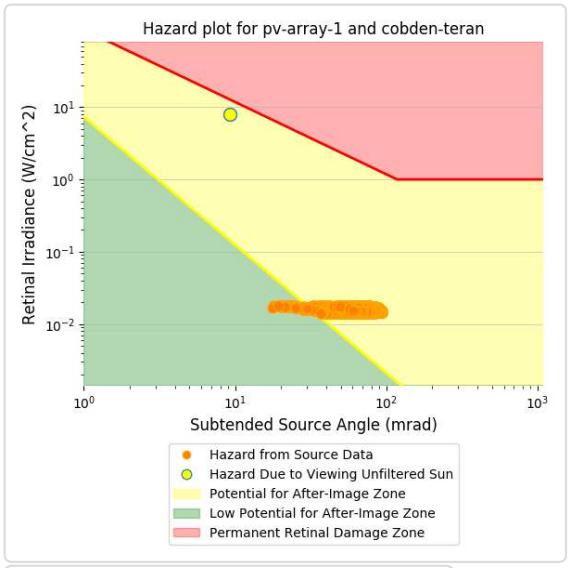
PV array 1 - Route Receptor (Cobden-Terang Road)

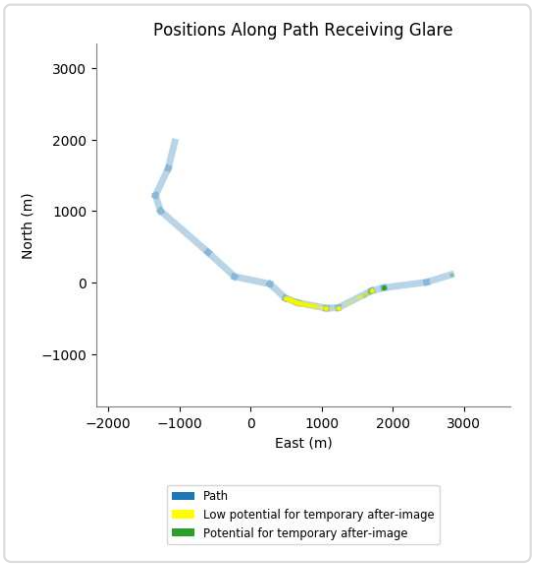
PV array is expected to produce the following glare for receptors at this location:

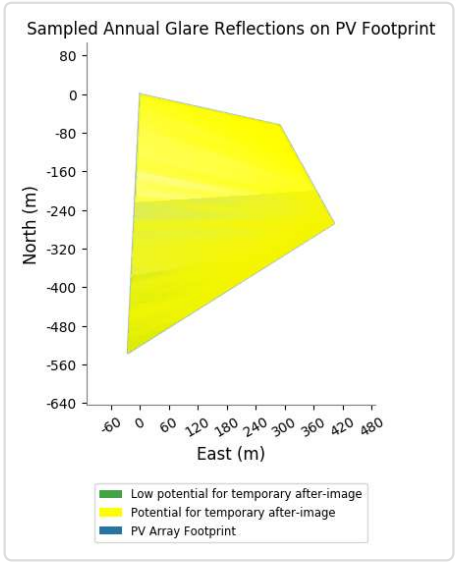
- 75 minutes of "green" glare with low potential to cause temporary after-image.
- 3,343 minutes of "yellow" glare with potential to cause temporary after-image.







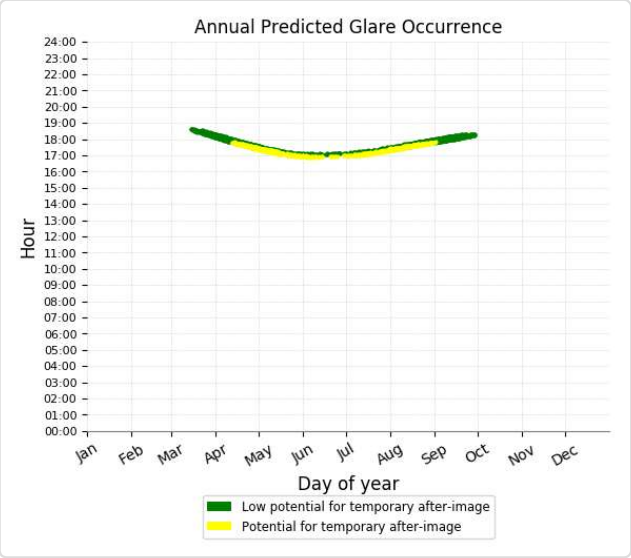


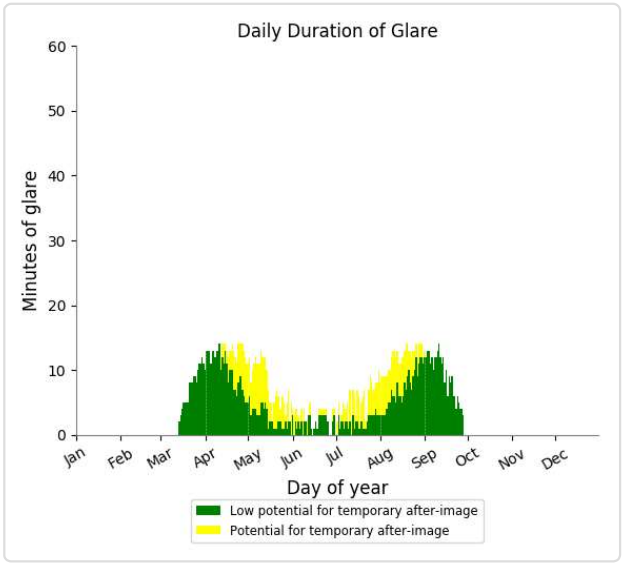


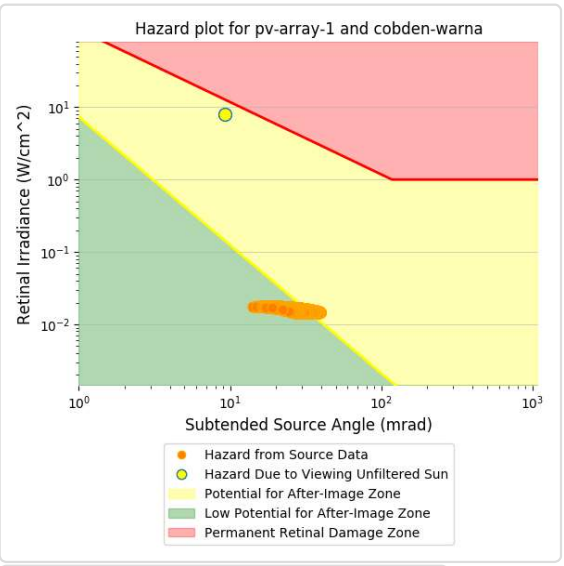
PV array 1 - Route Receptor (Cobden-Warnambool Road)

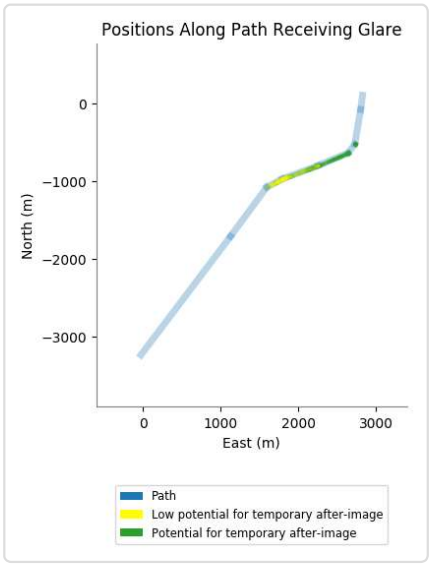
PV array is expected to produce the following glare for receptors at this location:

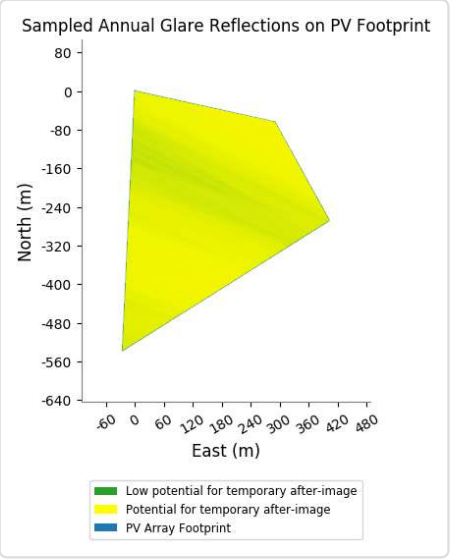
- 1,107 minutes of "green" glare with low potential to cause temporary after-image.
- 518 minutes of "yellow" glare with potential to cause temporary after-image.







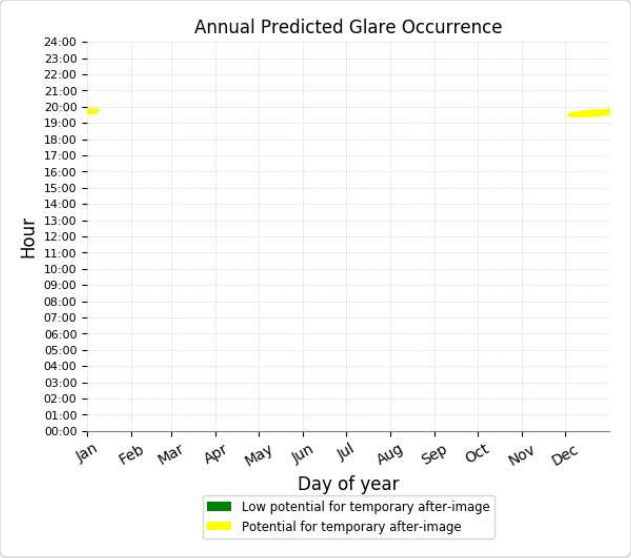


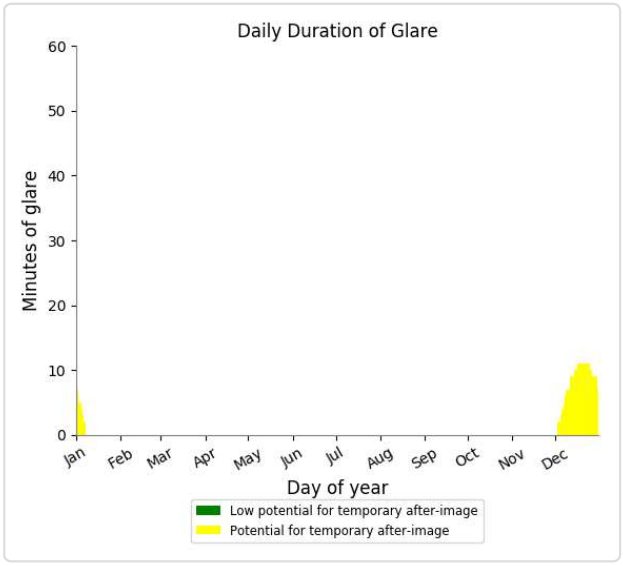


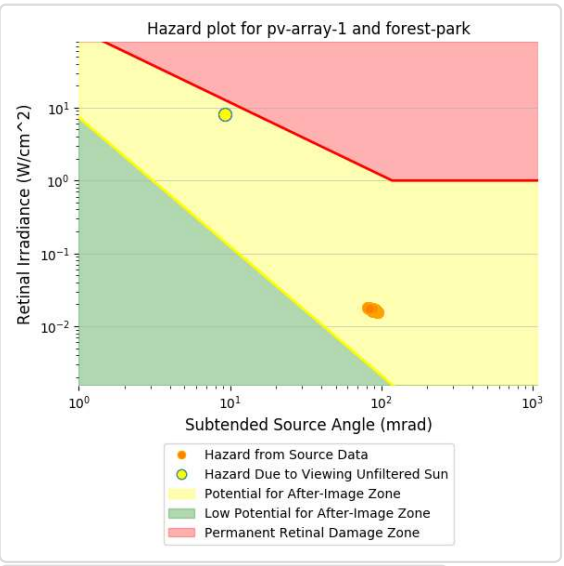
PV array 1 - Route Receptor (Forest Park Road)

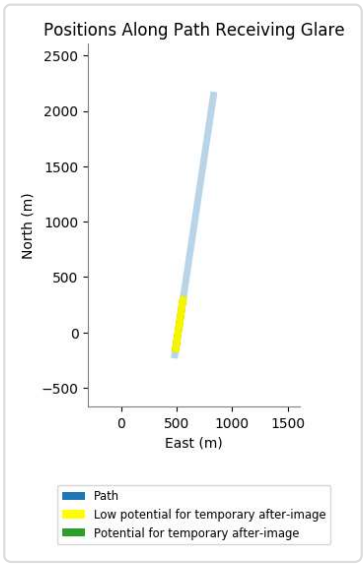
PV array is expected to produce the following glare for receptors at this location:

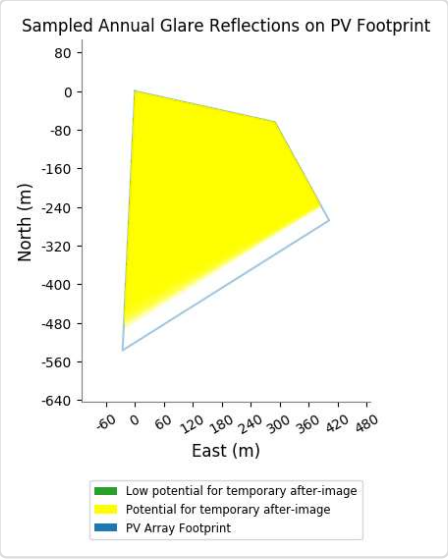
- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 275 minutes of "yellow" glare with potential to cause temporary after-image.











PV array 1 - Route Receptor (J B Scanlons Road)

No glare found

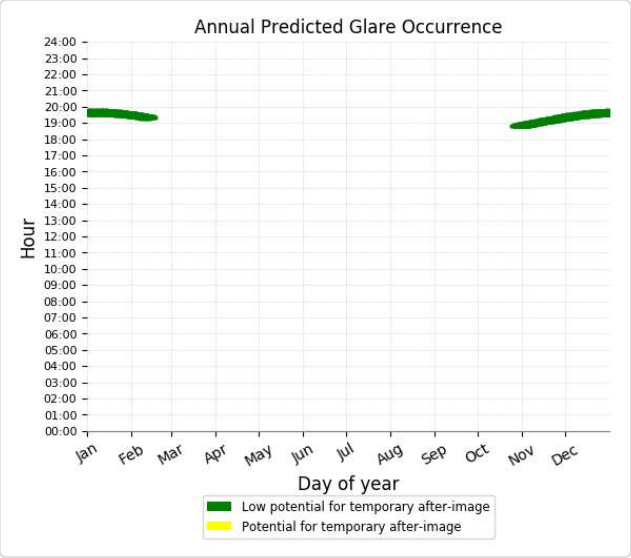
PV array 1 - Route Receptor (Joe Blakes Road)

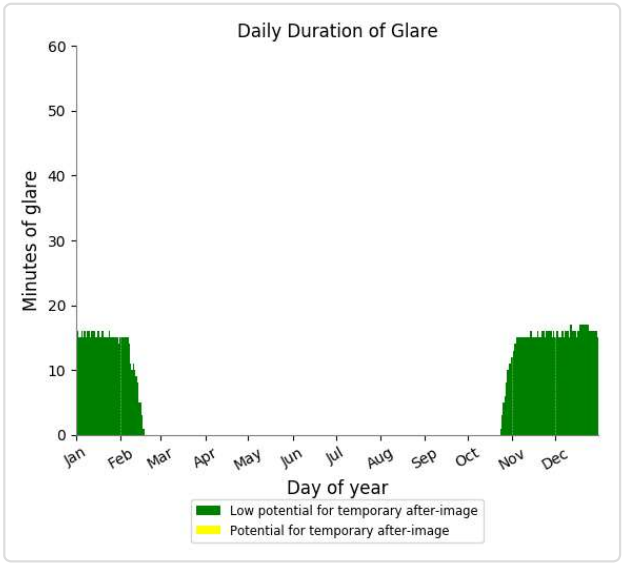
No glare found

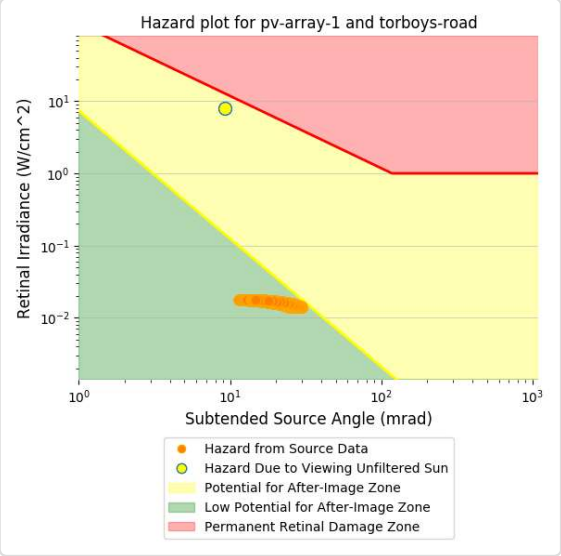
PV array 1 - Route Receptor (Torboys Road and Hallyburtons Road)

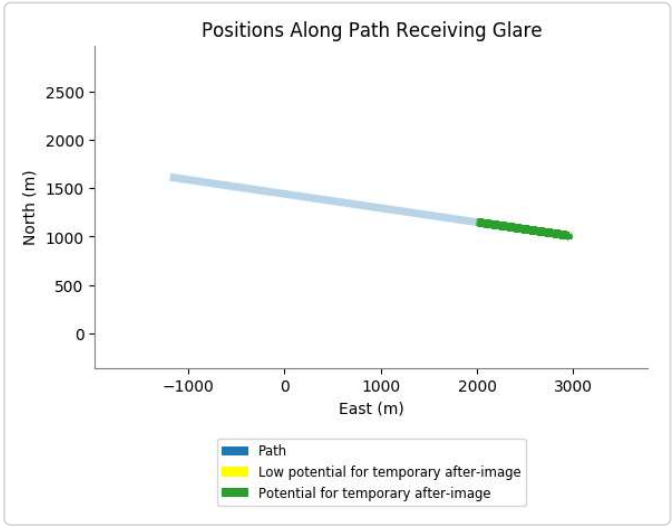
PV array is expected to produce the following glare for receptors at this location:

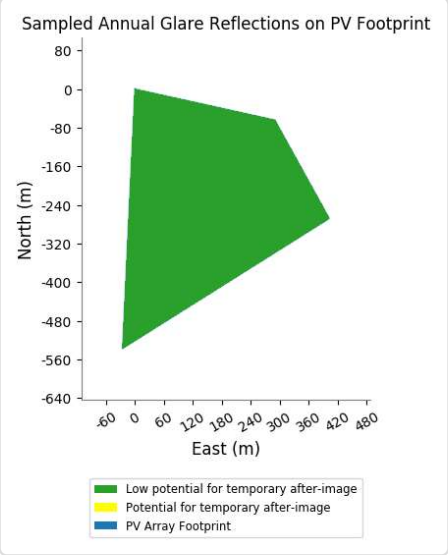
- 1,660 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.











Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results fc large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.