APPENDIX 8

Desktop Ecological Assessment

DESKTOP ECOLOGICAL ASSESSMENT

Prepared for Bungama Solar

Prepared by EBS Ecology

BUNGAMA SOLAR

www.bungamasolar.com.au

EPS ENERGY

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Bungama Solar

Desktop Ecological Assessment

Bungama Solar Desktop Ecological Assessment

14 May 2018

Version 2

Prepared by EBS Ecology for Bungama Solar 1 Pty Ltd

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Cover photograph: *Chenopod shrubland with Buffel Grass* (*Cenchrus ciliaris) along western boundary of the Project area*.

EBS Ecology
3/119 Hayward Avenue
Torrensville, South Australia 5031
t: 08 7127 5607
http://www.ebsecology.com.au
email: info@ebsecology.com.au

GLOSSARY AND ABBREVIATION OF TERMS

ALA	Atlas of Living Australia
BAM	Bushland Assessment Method
BDBSA	Biological Database of South Australia (maintained by DEW)
BS	Bungama Solar
DEW	Department of Environment and Water (formerly Department of Environment, Water and Natural Resources (DEWNR))
DotEE	Department of the Environment and Energy
EBS	EBS Ecology
EIS	Environmental Impact Statement
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographical Regionalisation of Australia
NPW Act	*National Parks and Wildlife Act 1972*
NV Act	*Native Vegetation Act 1991*
NVC	Native Vegetation Council
PMST	Protected Matters Search Tool (under the EPBC Act, maintained by DotEE)
Project	The proposed development of the solar farm at Bungama
Project area	The land where Bungama Solar is proposed to be constructed
PDI Act	*Planning, Development and Infrastructure Act 2016*
PSS	Point Scoring System – within the Scattered Tree Assessment Method
SEB	Significant Environmental Benefit
spp.	Species (plural)
ssp.	Subspecies
STAM	Scattered Tree Assessment Method
TEC	Threatened Ecological Community

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1 INTRODUCTION

EBS Ecology (EBS) was contracted by EPS Energy to conduct an ecological desktop assessment and field survey for the proposed development of the Bungama Solar (BS), South Australia. This report summarizes the findings of the ecological desktop assessment.

Any proposed clearance of native vegetation in South Australia (unless exempt under the *Native Vegetation Regulations 2017*) is to be assessed against the *Native Vegetation Act 1991* (NV Act) Principles of Clearance, and requires approval from the Native Vegetation Council (NVC). To ensure that EPS Energy is able to minimise environmental impacts and achieve legislative compliance requirements for the proposed works, a vegetation survey and fauna assessment is required to inform planning and development for the BS.

Initial investigations are necessary to determine if the proposed site is suitable for development and if the BS requires an application for clearance approvals, prepared by a NVC Accredited Consultant. Therefore, an ecological desktop assessment was conducted prior to the field survey.

The ecological desktop assessment involved searching Commonwealth and State databases to identify threatened flora and fauna species potentially occurring in the proposed BS development site, as well as relevant matters of national environmental significance and other matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *National Parks and Wildlife Act 1972* (NPW Act).

The ecological field survey methods were also confirmed during the desktop assessment, based on aerial imagery and vegetation mapping.

1.1 Objectives

The specific objectives of the ecological desktop assessment were to:

- Identify and highlight areas of concern within the nominated Project area, where any threatened flora and fauna species and/or threatened ecological communities (TECs) listed under Commonwealth and State legislation occur or have been historically recorded in the vicinity of the Project area, and areas determined as potential habitat for threatened flora and fauna;
- Determine the likelihood of occurrence of any threatened species, identified in database searches, within the Project area;
- Determine if the proposed works will likely impact any Commonwealth and State listed species to inform decisions on vegetation clearance approval;
- Identify any ‘show-stoppers’ areas/trees that must be avoided from a vegetation or fauna perspective where the impacts of the proposed BS development to the vegetation/habitat would be considered to be particularly adverse or significant; and
- Identify any introduced flora and fauna species, including plant diseases, which potentially occur or have been historically recorded in the vicinity of the Project area and may require control

during the project. The report will provide recommendations to control the spread of any relevant plant or animal pests, which may have been identified during the survey.

1.2 Project area

The Project area is located near Bungama, South Australia, which is approximately 5 km east of Port Pirie and 200 km north of Adelaide. The proposed Project area is located the east and north-east of the existing substation, and consists of approximately 500 ha across four parcels of land with multiple land owners (Table 1). The proposed Project area for BS is provided in Figure 1.

The ecological desktop assessment was extended to the near surroundings of the proposed BS (the Project area) with a 5 km buffer zone.

Table 1. Land parcel details for the proposed Bungama Solar.

Lot Number	Address	Area of Interest (ha)
D25903 A52	Lot 52 Augusta Highway, Warnertown SA 5540	109
D24997 A4	Lot 4 Augusta Highway, Warnertown SA 5540	77
F188690 A558	Lot 558 Augusta Highway, Warnertown SA 5540	174
D28632 A1	Lot 20 Gulf View Road, Napperby SA 5540	158.1
Total		**518.1**

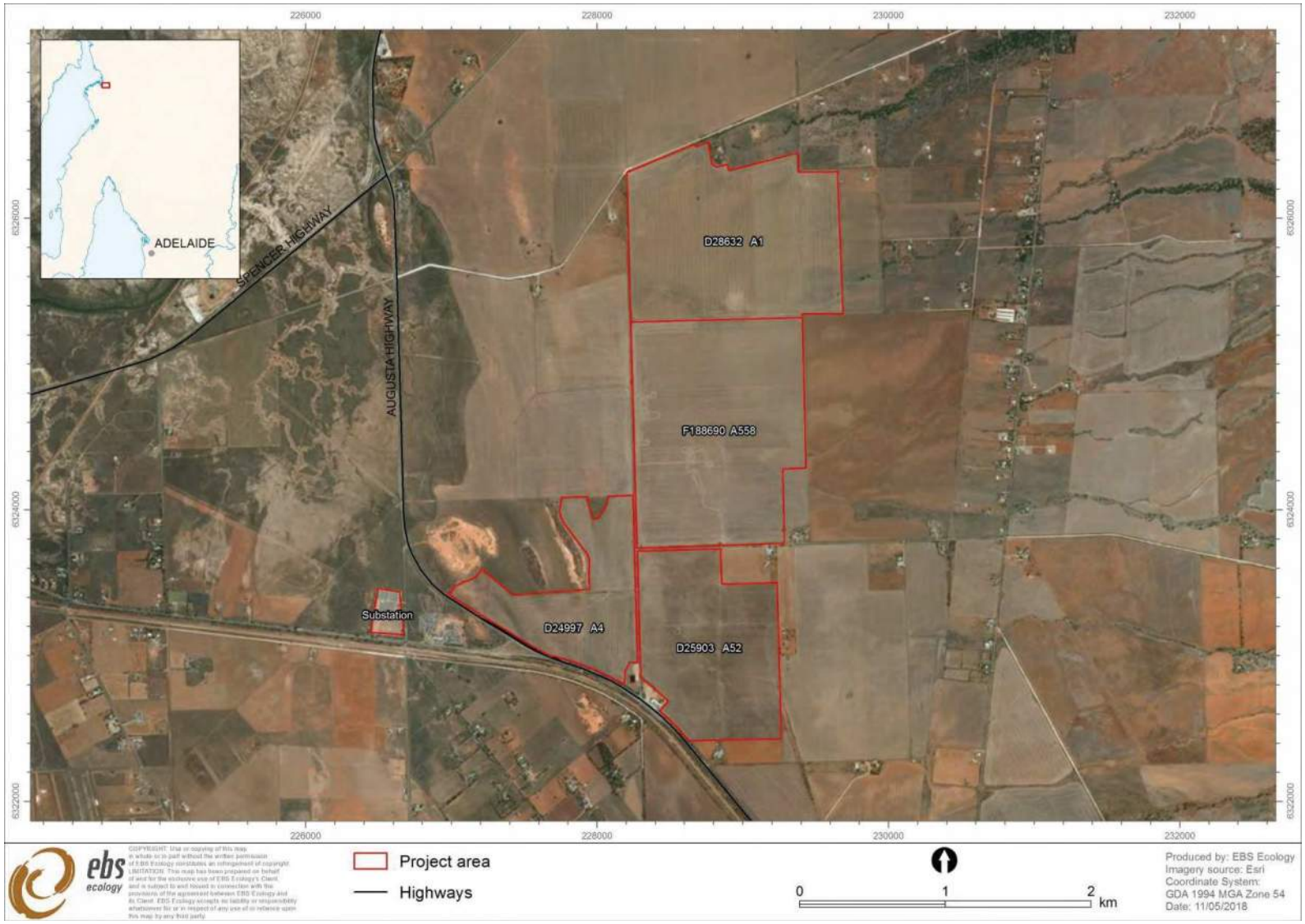

Figure 1. Location and design layout of the proposed Bungama Solar, South Australia.

2 COMPLIANCE AND LEGISLATIVE SUMMARY

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Environment Protection and Biodiversity Conservation Regulations 2000* provide a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the Act as 'matters of national environmental significance'. The nine matters of national environmental significance protected under the Act are:

1. World Heritage properties
2. National Heritage places
3. Wetlands of international importance (listed under the RAMSAR Convention)
4. Listed threatened species and ecological communities
5. Migratory species protected under international agreements
6. Commonwealth marine areas
7. The Great Barrier Reef Marine Park
8. Nuclear actions (including uranium mines
9. A water resource, in relation to coal seam gas development and large coal mining development

Matters 4 and 5 are relevant to the BS Project.

Any action that has, will have, or is likely to have a significant impact on matters of national environmental significance requires referral under the EPBC Act. Substantial penalties apply for undertaking an action that has, will have or is likely to have significant impact on a matter of national environmental significance without approval.

The EPBC Act Significant Impact Guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance. In terms of nationally threatened species, the guidelines define an action as likely to have a significant impact if there is a real chance or possibility that it will:

- Lead to a long term decrease in the population
- Reduce the area of occupancy of the species
- Fragment an existing population
- Adversely affect critical habitat
- Disrupt breeding cycles
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- Result in the establishment of invasive species that are harmful to the species
- Introduce disease that may cause the species to decline
- Interfere with the recovery of the species.

2.2 Native Vegetation Act 1991

Native vegetation within the Project area is protected under the *Native Vegetation Act 1991* (NV Act) and *Native Vegetation Regulations 2017*. Any proposed clearance of native vegetation in South Australia (unless exempt under the *Native Vegetation Regulations 2017*) is to be assessed against the NV Act Principles of Clearance, and requires approval from the Native Vegetation Council (NVC). A net environmental benefit is generally conditional on an approval being granted.

Native vegetation refers to any naturally occurring local plant species that are indigenous to South Australia, from small ground covers and native grasses to large trees and water plants.

“Clearance", in relation to native vegetation, means:

- The killing or destruction of native vegetation
- The removal of native vegetation
- The severing of branches, limbs, stems or trunks of native vegetation
- The burning of native vegetation
- Any other substantial damage to native vegetation, and includes the draining or flooding of land, or any other act or activity, that causes the killing or destruction of native vegetation, the severing of branches, limbs, stems or trunks of native vegetation or any other substantial damage to native vegetation

Approval must be obtained before performing any activity that could cause substantial damage to native plants. This also applies to dead trees that may provide habitat for animals. These activities include but are not limited to:

- The cutting down, destruction or removal of whole plants
- The removal of branches, limbs, stems or trunks (including brush cutting and woodcutting)
- Burning
- Poisoning
- Slashing of understorey
- Drainage and reclamation of wetlands
- Grazing by animals (in some circumstances).

Under the NV Act, the NVC considers applications to clear native vegetation under ten principles. Native vegetation should not be cleared if it is significantly at odds with these principles:

- It contains a high level of diversity of plant species
- It is an important wildlife habitat
- It includes rare, vulnerable or endangered plant species
- The vegetation comprises a plant community that is rare, vulnerable or endangered
- It is a remnant of vegetation in an area which has been extensively cleared
- It is growing in, or association with, a wetland environment

- It contributes to the amenity of the area
- The clearance of vegetation is likely to contribute to soil erosion, salinity, or flooding
- The clearance of vegetation is likely to cause deterioration in the quality of surface or underground water
- After clearance, the land is to be used for a purpose which is unsustainable

The principles apply in all cases, except where the vegetation has been considered exempt under the *Native Vegetation Regulations 2017* or can be classified as an 'intact stratum'. 'Intact stratum' means that applications will usually be denied when the vegetation has not been seriously degraded by human activity within the last 20 years.

All approved vegetation clearance must also be conditional on achieving a SEB to offset the clearance. The requirement for a SEB also applies to several of the exemptions. Potential SEB offsets include:

- The establishment and management of a set-aside area to encourage the natural regeneration of native vegetation
- The protection and management of an established area of native vegetation
- Entering into a Heritage Agreement on land where native vegetation is already established to further preserve or enhance the area in perpetuity
- A payment to the Native Vegetation Fund

An assessment against the Native Vegetation Clearance Principles is not required as the clearance associated with the project complies with the following regulation:

Part 3—Permitted clearance of native vegetation

Division 5—Risk assessment

16—Clearance for other activities

(1) Clearance of native vegetation for the purposes of activities of a kind specified in Schedule 1 Part 6 is permitted only if it is undertaken in accordance with—

(a) the written approval of the Council; or

(b) a standard operating procedure determined or approved by the Council for the purposes of this provision.

(2) Authorisation to clear native vegetation under subregulation (1) is subject to—

(a) a condition—

(i) that the clearance of native vegetation is to be undertaken in accordance with a management plan, approved by the Council for implementation, that results in a significant environmental benefit; or

(ii) that the person undertaking the operations is to make a payment into the Fund of an amount considered by the Council to be sufficient to achieve a significant environmental benefit in the manner contemplated by section 21(6) or (6a) of the Act,

as determined by the Council; and

(b) such other conditions as the Council thinks fit.

(3) Clearance of native vegetation for the purposes of activities of a kind specified in Schedule 1 Part 6 is permitted only if any conditions that apply to the approval are complied with.

The requirements of the proponent to undertake clearance for other activities include:

- Application to the NVC in accordance with a NCV approved Standard Operating Procedure;
- Provision of sufficient information for the NVC to assess the level of risk to biodiversity;
- Development of a SEB Management Plan to be approved by the NVC; and
- Provision of a SEB in accordance with the Management Plan or payment into the Native Vegetation Fund.

2.3 National Parks and Wildlife Act 1972

Native plants and animals in South Australia are protected under the *National Parks and Wildlife Act 1972* (NPW Act). It is an offence to take a native plant or protected animal without approval. Threatened plant and animal species are listed in Schedules 7 (endangered species), 8 (vulnerable species) and 9 (rare species) of the Act. Persons must not:

- Take a native plant on a reserve, wilderness protection area, wilderness protection zone, land reserved for public purposes, a forest reserve or any other Crown land
- Take a native plant of a prescribed species on private land
- Take a native plant on private land without the consent of the owner (such plants may also be covered by the NV Act)
- Take a protected animal or the eggs of a protected animal without approval
- Keep protected animals unless authorised to do so
- Use poison to kill a protected animal without approval

Conservation rated flora and fauna species listed on Schedules 7, 8, or 9 of the NPW Act are known to or may occur within the Project area. Persons must comply with the conditions imposed upon permits and approvals.

2.4 Natural Resources Management Act 2004

Under the *Natural Resources Management Act 2004* (NRM Act) landholders have a legal responsibility to manage declared pest plants and animals and prevent land and water degradation.

Key components under the Act include the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; requirement to control pest plants and animals and activities that might result in land degradation.

A ‘duty of care’ is a fundamental component of this Act, i.e. ensuring one’s environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations.

2.5 Planning, Development and Infrastructure Act 2016

The *Planning, Development and Infrastructure Act 2016* (PDI Act) provides for matters that are relevant to the use, development and management of land and buildings, including the provision of a planning system to regulate development within the State, rules with respect to the design, construction and use of buildings, and other initiatives to facilitate the development of infrastructure, facilities and environments that will benefit the community. The PDI Act repeals the *Development Act 1993* and will gradually come into operation over a five year period.

The State Planning Strategy establishes the broad vision for sustainable land use and the built development of South Australia. The Planning Strategy informs and guides local council development plans. No development can be undertaken without an appropriate Development Approval being obtained from the relevant authority after an application and assessment process.

The PDI Act and the *Development Regulations 2008* provide for the protection of ‘regulated’ and ‘significant’ trees; however, the Project falls outside the PDI Act boundaries.

3 BACKGROUND INFORMATION

3.1 Project details

EPS Energy provides relevant expertise for the planning and development of solar and wind projects in Australia. EPS Energy is currently investigating whether the proposed Project area at Bungama is suitable for the development of a solar farm and if an application for vegetation clearance approval is required to undertake the proposed works.

3.2 IBRA

The Interim Biogeographical Regionalisation of Australia (IBRA) identifies geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. The bioregions are further refined into subregions and environmental associations (DEWNR 2011). The Project area is located within the Eyre Yorke Block IBRA Bioregion, the St Vincent IBRA Subregion and the Nurom (to the southwest) and Glendella (to the northeast) IBRA Environmental Associations.

Native vegetation remnancy figures for IBRA subregions are useful for setting regional landscape targets. Approximately 8% (87,402 ha) of the St Vincent IBRA Subregion is mapped as remnant vegetation, of which less than 5% (4,732 ha) is formally conserved within National Parks and Wildlife reserves, and private Heritage Agreements under the NV Act. A full summary is provided below in Table 2

Table 2. IBRA bioregion, subregion, and environmental association environmental landscape summary.

Eyre Yorke Block IBRA Bioregion	
Archaean basement rocks and Proterozoic sandstones overlain by undulating to occasionally hilly calcarenite and calcrete plains and areas of Aeolian quartz sands, with Mallee Woodlands, Shrublands and Heaths on calcareous earths, duplex soils and calcareous to shallow sands, now largely cleared for agriculture.	
St Vincent IBRA Subregion	
Most of this region consists of with calcrete development and shallow reddish earths. The plain is mainly dune free but isolated areas are overlain by low indistinct sand dunes. Near the Mt Lofty Ranges the plains have a definite westerly gradient and merge eastwards with the alluvial fans from the Mt Lofty Ranges. Moderately deep Red Mallee / Yorrell (*Eucalyptus socialis, E. gracilis*) association occurs throughout the region with some woodland of *E. porosa* on the plains or *E. odorata* on the hills and footslopes. The subregion has been extensively cleared and sown to crops or exotic pastures so little of the natural vegetation remains. What does remain exists on road verges and a few isolated blocks.	
Remnant vegetation	Approximately 8% (87,402 ha) of the subregion is mapped as remnant native vegetation, of which 5% (4,732 ha) is formally conserved.
Landform	Alluvial and littoral plains with NW-SE longitudinal dunes mainly stabilized in isolated areas. Near the Mt Lofty Ranges the plains have a detritic westerly gradient and merge eastwards with the alluvial fans of the ranges.
Geology	Calcrete development; some variably oriented dunes in north west of unit beyond Port Augusta. Calcareous loams. Clay rich soils, both plastic & cracking varieties.
Soil	Cracking clays, brown calcareous earths, highly calcareous loamy earths, plastic saline clay soils, hard setting loamy soils with red clayey subsoils.
Vegetation	Mixed Chenopod, Samphire or Forblands.

Conservation significance	125 species of threatened fauna, 103 species of threatened flora. 5 wetlands of national significance.
Nurom IBRA Environmental Association	
Remnant vegetation	Approximately 5% (1,740 ha) of the association is mapped as remnant native vegetation, of which 0% (0 ha) is formally conserved.
Landform	Gently undulating calcrete plain with extensive sand sheets or longitudinal dunes.
Geology	Sand and calcrete.
Soil	Crusty red duplex soils and brown calcareous sands.
Vegetation	Open scrub of beaked Red Mallee and Yorrell and Chenopod Shrubland of Saltbush.
Conservation significance	2 species of threatened fauna, 1 species of threatened flora. 1 wetlands of national significance.
Glendella IBRA Environmental Association	
Remnant vegetation	Approximately 28% (12,641 ha) of the association is mapped as remnant native vegetation, of which 13% (1,702 ha) is formally conserved.
Landform	Coalescing alluvial fans, extending from low hills onto a narrow sandy plain with tidal flats on the coastal margin.
Geology	Gravelly alluvium, alluvium, sand and quartzite.
Soil	Hard pedal red duplex soils, red calcareous earths, red friable loams and black non-cracking plastic clays.
Vegetation	Open scrub of Beaked Red Mallee and Yorrell, Chenopod Shrubland of Saltbush and Bluebush, Chenopod Shrubland of Samphire and Low Woodland of Mangroves.
Conservation significance	28 species of threatened fauna, 25 species of threatened flora. 1 wetlands of national significance.

3.3 Administrative boundaries

The Project area is located in the in the Northern and Yorke NRM Region and Lower and Mid North NRM District. The Project area is also located within the County of Victoria and the Pirie (to the west) and Napperby (to the east) Hundreds.

3.4 Climate

The nearest long-term climate data was sourced from Georgetown weather station, which is approximately 34 km ESE of the Project area. Rainfall and temperature data are indicative that the region surrounding Bungama experiences a Mediterranean climate, with cool wet winters and hot dry summers. Changes of weather are generally associated with frontal systems from southwest in the Spencer Gulf. These frontal systems are most active in winter and spring and bring reliable and frequent light to moderate rainfall. Annual average rainfall is 474.7 mm. The majority of the rainfall occurs during winter with the highest falls in June (average 58.4 mm) and July (average 57.2 mm). The mean minimum temperature ranges from 4.2°C (July) to 15.2°C (February) and the mean maximum temperature ranges from 14.2°C (July) to 31.1°C (January) (Figure 2).

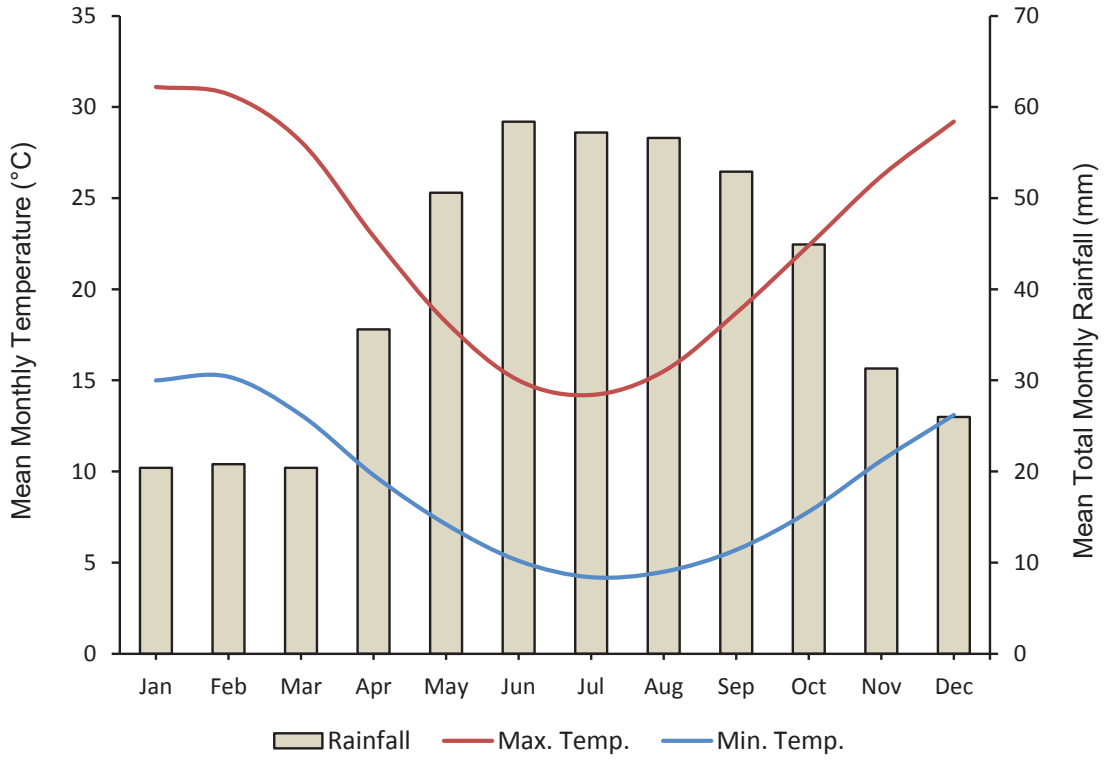

Figure 2. Mean total monthly rainfall and mean monthly maximum and minimum temperatures recorded at Georgetown (station no. 21020), located 33.9 km ESE of the Project area (BOM 2018).

4 METHODS

The ecological desktop assessment was conducted to assess the potential for any threatened species (both Commonwealth and State listed) to occur within the Project area.

4.1 Protected Matters Search Tool (PMST) – EPBC Act

A Protected Matters Search Tool (PMST) report was generated on 18 April 2018 to identify matters of national environmental significance under the EPBC Act (DotEE 2018). The PMST is maintained by the Department of the Environment and Energy (DotEE) and was used to identify flora and fauna species or ecological communities of national environmental significance that may occur or have suitable habitat within the Project area. A buffer of 5 km was applied for this search.

4.2 Biological Database of South Australia (BDBSA) – NPW Act

Threatened species listed under South Australia's NPW Act were assessed using the Biological Database of South Australia (BDBSA), which is maintained by the South Australian Department of Environment, and Water (DEW). The BDBSA is comprised of an integrated collection of corporate databases which meet DEW standards for data quality, integrity and maintenance. In addition to the DEW biological data, the BDBSA also includes data from partner organisations. This data is included under agreement with the partner organisation for ease of distribution but they remain owners of the data and should be contacted directly for further information. The dataset was obtained on 18 April 2018 (*Recordset number DEWNRBDBSA180418-1*) and used to identify threatened species that have been recorded within the 5 km buffer of the Project area (DEW 2018). Records of threatened and migratory species listed under the EPBC Act were also identified.

4.3 Assessment of the likelihood of occurrence

An assessment of the likelihood of each threatened flora and fauna species occurring within the 5 km buffer of the Project area was assessed. A likelihood of occurrence rating (Highly Likely/Known, Likely, Possible, Unlikely, Impossible) was assigned to each threatened species identified in the desktop database searches. The ratings take the following criteria into consideration:

- Date of the most recent record (taking into consideration the date of the last surveys conducted in the area) (ALA 2018; DEWNR 2018);
- Proximity of the records (i.e. distance to the Project area);
- Landscape, vegetation remnancy and vegetation type of the record location (taking into consideration the landscape, vegetation remnancy and vegetation type of the Project area, with higher likelihood assigned to species that were found in similar locations/condition/vegetation associations); and
- Knowledge of the species habitat preferences, causes of its decline, and local population trends.

A summary of the likelihood criteria is shown below in Table 3.

Table 3. Criteria for the likelihood of occurrence of threatened species within the Project area.

Likelihood	Criteria
Highly Likely/Known	• Records in the last 10 years, the species does not have highly specific needs, and the habitat is largely intact.
Likely	• Records in the last 10 years, the species does not have highly specific habitat needs and the habitat is largely intact, or • Records in the last 10 years, the species does have highly specific habitat needs and these needs occur in the area.
Possible	• No records, survey effort is considered not adequate, suitable habitat does occur (or isn't known if it does occur) and species of similar habitat needs have been recorded in the area, or • Records within the last 40 years, and the area is not largely intact, or • Records in the last 10 years, the species does not have highly specific needs, and habitat is largely intact.
Unlikely	• No records despite survey effort considered adequate, or • No records and survey effort is considered not adequate, and no suitable habitat is known to occur in the area, or • No records and survey effort is not considered adequate, and no suitable is known to occur in the area, and species of similar habitat needs have no records either.
Impossible	• Species cannot occur in Project area (e.g. it is impossible for a marine mammal to occur in a terrestrial Project area).

4.4 Additional searches

Additional searches included:

- Atlas of Living Australia (ALA) online resource, which provides records (including locations) for threatened flora and fauna; and
- NatureMaps to collect further SA Biological Survey flora site information (site descriptions), up-to-date and cross-referenced aerial photography, and spatial datasets, such as floristic mapping and protected area maps.

4.5 Survey design and site identification

All the above described information has been used to determine and document:

- Native vegetation cover within the Project area;
- Flora and fauna species (including species of national, state or local conservation significance) known or likely to occur within the Project area (5 km buffer) of the proposed Bungama Solar;
- Potential ecological constraints for the proposed Bungama Solar; and
- EBS viewed the vegetation and terrain within the Project area using NatureMaps and Google Earth to determine the appropriate method and estimate the time for field assessment.

4.6 Limitations

The content of the desktop study was derived from existing datasets and references from a range of sources. EBS has not attempted to verify the accuracy of any such information.

Flora and fauna records were sourced from the PMST and BDBSA and were limited to a 5 km buffer around the proposed BS Project area. The BDBSA only includes verified flora and fauna records submitted to DEW or partner organisations. It is recognised that knowledge is poorly captured and it is possible that significant species occur that are not reflected by database records. Although much of the BDBSA data has been through a variety of validation processes, the lists may contain errors and should therefore be used with caution. DEW give no warranty that the data is accurate or fit for any particular purpose of the user or any person to whom the user discloses the information.

The reliability of the BDBSA data ranges from 100 m to over 100 km. Fauna species, in particular birds, also have the ability to traverse distances in excess of 20 km. It is also acknowledged that the presence of species may not be adequately represented by database records. Hence the PMST and BDBSA results may not highlight all potential threatened flora and fauna species that may occur within a 5 km buffer of the Project area.

It is difficult to comment on the likelihood of occurrence of threatened species without observing the condition of vegetation in the Project area. A precautionary approach was therefore adopted during the desktop assessment, with reference to existing PMST and BDBSA records and native vegetation cover.

The findings and conclusions expressed by EBS are based solely upon information in existence at the time of the assessment. The combination of database records and background research have provided a solid foundation for determining the flora and fauna that are likely or are known to occur within the Project area.

5 RESULTS

5.1 Matters of national and state environmental significance

The EPBC Protected Matters Search identified 41 threatened species, 28 migratory species, and 2 nationally threatened ecological communities, protected under the EPBC Act that may be relevant to the BS Project area. The results of the EPBC Act PMST report are summarised in Table 4 (DotEE 2018). The relevant matters of national environmental significance, other matters protected under the EPBC Act, and threatened species listed under the NPW Act are discussed in detail below.

Note that listed marine dependent species (e.g. marine birds, turtles, sea-lions, fish, whales, and other cetaceans) are included in Table 4. However, these matters are not impacted by or relevant to the project, given that the Project area and potential impacts are confined to the terrestrial environment. Therefore these species are not further discussed.

Table 4. Summary of the results of the EPBC Act Protected Matters Search Tool report (DotEE 2018).

Project area (5 km buffer)	Matters of national environmental significance under the EPBC Act	Identified within the search area
	World heritage properties	None
	National heritage properties	None
	Wetlands of international importance	None
	Great Barrier Reef marine park	None
	Commonwealth marine area	None
	Threatened ecological communities	2
	Threatened species	41
	Migratory species	28
	Commonwealth land	2
	Commonwealth heritage places	None
	Listed marine species	35
	Whales and other cetaceans	None
	Critical habitats	None
	Commonwealth reserves terrestrial	None
	Commonwealth reserves marine	None
	State and Territory reserves	2
	Regional forest agreements	None
	Invasive species	24
	Nationally important wetlands	1
	Key ecological features (marine)	None

5.1.1 Threatened Ecological Communities

The EPBC Act PMST report identified two Nationally Threatened Ecological Communities (TECs) within 5 km of the Project area (Table 5). Both of the TECs identified are considered unlikely to occur in the Project area due to the complete clearance of remnant vegetation within the Project area.

Table 5. Threatened ecological communities potentially occurring within 5 km of the Project area identified in the PMST (DotEE 2018) and BDBSA (DEW 2018) database searches.

Threatened Ecological Community	Conservation Status[1]	Likelihood of occurrence within Project area
Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia	CE	Unlikely
Subtropical and Temperate Coastal Saltmarsh	VU	Unlikely

[1]**Conservation status**
Conservation codes under the *Environment Protection and Biodiversity Conservation Act 1999*: CE: Critically Endangered. EN: Endangered. VU: Vulnerable.

5.1.2 Nationally threatened flora

The EPBC Act PMST report identified 10 nationally threatened flora species within 5 km of the Project area. None of the nationally threatened flora species identified have potential to occur within Project area (Table 6), because the BS Project area has been entirely cleared of remnant vegetation and has been subsequently cropped.

5.1.3 State threatened flora

The BDBSA search identified six threatened flora species listed under the NPW Act (excluding those also listed under the EPBC Act) within 5 km of the Project area (Table 6 and Figure 3). None of the state threatened flora species identified by the BDBSA search have potential to occur within Project area as it has been entirely cleared of remnant vegetation and subsequently cropped.

All flora species identified in the BDBSA search within 5 km of the Project area are shown in Appendix 1.

Table 6. Threatened flora species potentially occurring within 5 km of the Project area identified in the PMST (DotEE 2018) and BDBSA (DEW 2018) database searches.

Scientific name	Common name	Conservation status[1]		Source[2]	Last BDBSA record	Likelihood of occurrence or habitat within Project area
		Aus.	SA			
Acacia iteaphylla	Flinders Ranges Wattle		R	2	2000	Unlikely
Acacia montana	Mallee Wattle		R	2	1979	Unlikely
Acanthocladium dockeri	Spiny Everlasting	CE	E	1		Unlikely
Brachyscome ciliaris var. subintegrifolia	Variable Daisy		R	2	1978	Unlikely
Caladenia macroclavia	Large-club Spider-orchid	EN	E	1		Unlikely
Caladenia tensa	Greencomb Spider-orchid	EN		1		Unlikely
Caladenia xantholeuca	White Rabbits	EN	E	1		Unlikely
Elatine gratioloides	Waterwort		R	2	1997	Unlikely
Olearia pannosa ssp. pannosa	Silver Daisy-bush	VU	V	1		Unlikely
Prasophyllum pallidum	Pale Leek-orchid	VU	R	1		Unlikely

Scientific name	Common name	Conservation status[1]		Source[2]	Last BDBSA record	Likelihood of occurrence or habitat within Project area
		Aus.	SA			
Prasophyllum validum	Sturdy Leek-orchid	VU	V	1		Unlikely
Santalum spicatum	Sandalwood		V	2	1992	Unlikely
Senecio megaglossus	Superb Groundsel	VU	E	1		Unlikely
Solanum eremophilum	Rare Nightshade		R	2	1997	Unlikely
Swainsona pyrophila	Yellow Swainson-pea	VU	R	1		Unlikely
Veronica parnkalliana	Port Lincoln Speedwell	EN	E	1		Unlikely

[1]Conservation status

Aus.: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level.

[2]Source

1: EPBC Act Protected Matters Search Tool (PMST) report (DotEE 2018) – 5 km buffer applied to Project area.

2: Biological Database of South Australia (BDBSA) data extract (DEW 2018) – 5 km buffer applied to Project area.

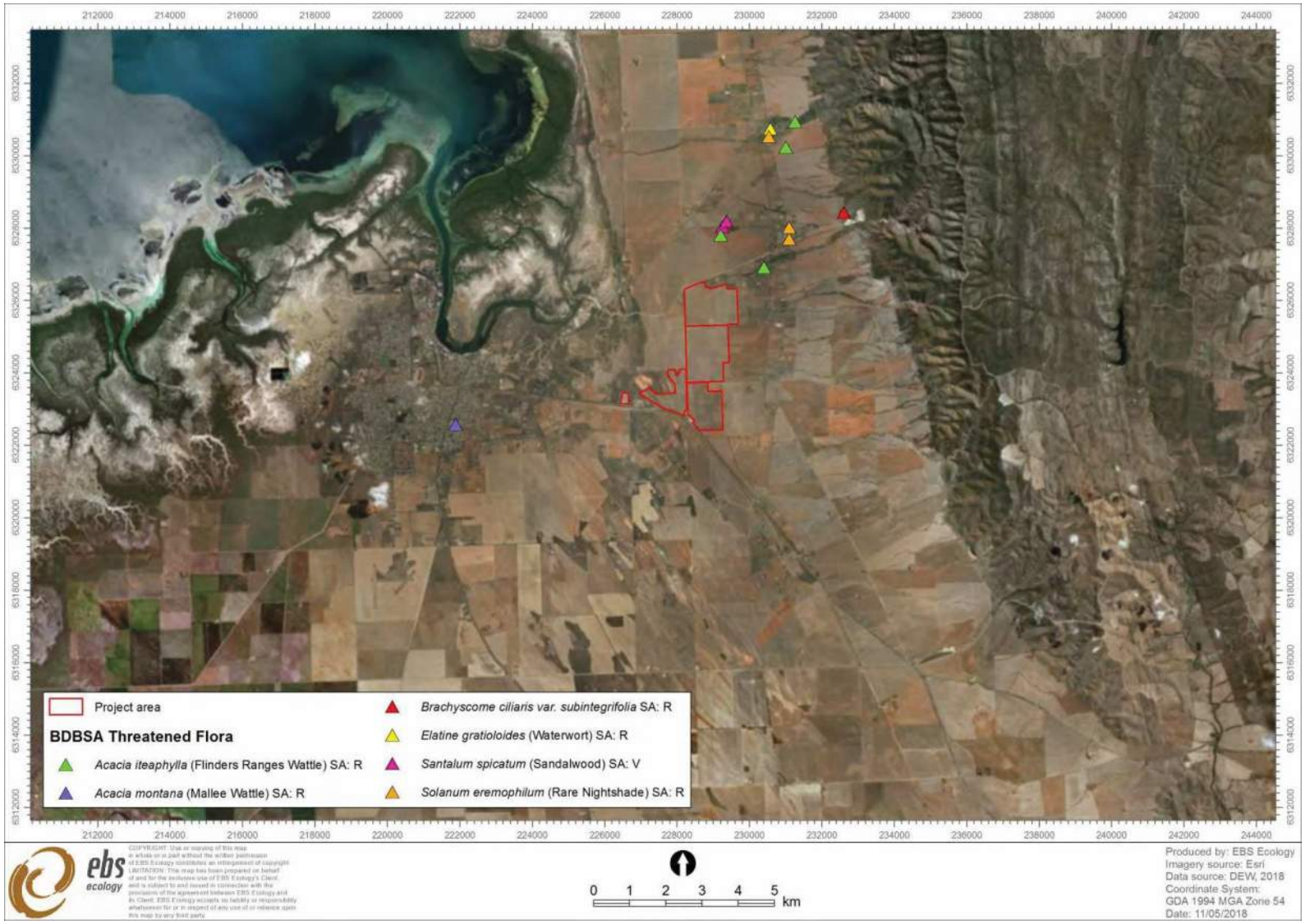

Figure 3. BDBSA records of threatened flora species recorded within 5 km of the Project area (DEW 2018).

5.1.4 Nationally threatened fauna

The EPBC Act PMST report identified 31 nationally threatened fauna species within 5 km of the Project area (Table 7). None of these species have potential to occur within Project area as it has been entirely cleared of remnant vegetation and subsequently cropped (Table 7). As such, there is no suitable habitat available for any of the threatened fauna species identified.

5.1.5 Migratory fauna

The EPBC Act PMST report and BDBSA search identified 29 migratory species within 5 km of the Project area. Two of these species were identified to potentially fly over the Project area (Table 7). No other migratory fauna species are expected to occur as they are either marine pelagic species, coastal or wetland species, or are terrestrial species that do not have suitable habitat in the Project area due to the complete clearance of native vegetation. The two species that may fly-over the Project area are the Fork-tailed Swift (*Apus pacificus*) and the Osprey (*Pandion haliaetus*).

The Fork-tailed Swift is almost exclusively aerial while in Australia, where it occurs over a weird range of habitats from open fields to rainforests to cities. The species is most common around coastal and subcoastal areas, and therefore, could possibly fly over the Project area.

The Osprey is a raptor that primarily occurs along the coast; however, will also inhabit major river systems. There are no Osprey territories in the Port Pirie region, and any individuals observed in the region are likely juveniles or lone birds. The Project area offers no habitats of importance to the species. Any individuals observed in the Project area are likely to be flying-over, while in search of a mate or new foraging grounds.

5.1.6 State threatened fauna

The BDBSA search identified seven fauna species listed under the NPW Act (excluding those also listed under the EPBC Act) within 5 km of the Project area (Table 7 and Figure 4). Two of the seven identified species; the Peregrine Falcon (*Falco peregrinus*) and Elegant Parrot (*Neophema elegans*) could use the Project area for foraging; however, nesting habitat is unlikely to occur. None of the remaining state listed species are expected to occur as they are either waterbirds or are reliant upon habitats which are absent from the Project area.

All fauna species identified in the BDBSA search within 5 km of the Project area are shown in Appendix 2.

Table 7. Threatened fauna species potentially occurring within 5 km of the Project area identified in the PMST (DotEE 2018) and BDBSA (DEW 2018) database searches.

Scientific name	Common name	Conservation status[1]		Source[2]	Last BDBSA record	Likelihood of occurrence within Project area
		Aus.	SA			
AVES	**Birds**					
Actitis hypoleucos	Common Sandpiper	Mi (W)	R	1		Unlikely
Apus pacificus	Fork-tailed swift	Mi (M)		1, 2	2003	Possible (Fly-over)
Biziura lobata	Musk Duck		R	2	2002	Unlikey
Botaurus poiciloptilus	Australasian Bittern	EN	V	1		Unlikely

Scientific name	Common name	Conservation status[1]		Source[2]	Last BDBSA record	Likelihood of occurrence within Project area
		Aus.	SA			
Calamanthus (Hylacola) pyrrhopygius	Chestnut-rumped Heathwren		E	2	1984	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	Mi (W)		1		Unlikely
Calidris canutus	Red Knot	EN, Mi (W)		1		Unlikely
Calidris ferruginea	Curlew Sandpiper	CE, Mi (W)		1		Unlikely
Calidris melanotos	Pectoral Sandpiper	Mi (W)	R	1		Unlikely
Diomedea antipodensis	Antipodean Albatross	VU, Mi (M)		1		Unlikely
Diomedea epomophora	Southern Royal Albatross	VU, Mi (M)	V	1		Unlikely
Diomedea exulans	Wandering Albatross	VU, Mi (M)	V	1		Unlikely
Diomedea sanfordi	Northern Royal Albatross	EN, Mi (M)	E	1		Unlikely
Egretta garzetta	Little Egret		R	2	2002	Unlikely
Falco peregrinus	Peregrine Falcon		R	2	2000	Possible
Gallinago hardwickii	Latham's Snipe	Mi (W)	R	1		Unlikely
Grantiella picta	Painted Honeyeater	VU	V	1		Unlikely
Hydroprogne caspia	Caspian Tern	Mi (W)		2	2001	Unlikely
Limosa lapponica baueri	Western Alaskan Bar-tailed Godwit	VU, Mi (W)	R	1		Unlikely
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	CE, Mi (W)		1		Unlikely
Macronectes giganteus	Southern Giant Petrel	EN, Mi (M)	V	1		Unlikely
Macronectes halli	Northern Giant Petrel	VU, Mi (M)		1		Unlikely
Motacilla cinerea	Grey Wagtail	Mi (T)		1		Unlikely
Motacilla flava	Yellow Wagtail	Mi (T)		1		Unlikely
Myiagra cyanoleuca	Satin Flycatcher	Mi (T)	E	1		Unlikely
Neophema chrysogaster	Orange-bellied Parrot	CE	E	1		Unlikely
Neophema elegans	Elegant Parrot		R	2	2000	Possible
Numenius madagascariensis	Eastern Curlew	CE, Mi (W)	V	1		Unlikely
Pachyptila turtur subantarctica	Fairy Prion (Southern)	VU		1		Unlikely
Pandon haliaetus	Osprey	Mi (W)	E	1		Possible (Fly-over)
Pedionomus torquatus	Plains-wanderer	CE	E	1		Unlikely
Pezoporus occidentalis	Night Parrot	EN	E	1		Unlikely
Rostratula australis	Australian Painted Snipe	EN	V	1		Unlikely
Stagonopleura guttata	Diamond Firetail		V	2	2014	Unlikely
Sternula nereis nereis	Australian Fairy Tern	VU	E	1, 2	2001	Unlikely
Thalassarche cauta cauta	Tasmanian Shy Albatross	VU, Mi (M)	V	1		Unlikely
Thalassarche cauta steadi	White-capped Albatross	VU, Mi (M)		1		Unlikely
Thalassarche impavida	Campbell Albatross	VU, Mi (M)	V	1		Unlikely

Scientific name	Common name	Conservation status[1]		Source[2]	Last BDBSA record	Likelihood of occurrence within Project area
		Aus.	SA			
Thalassarche melanophris	Black-browed Albatross	VU, Mi (M)		1		Unlikely
Tringa nebularia	Common Greenshank	Mi (W)		1		Unlikely
Zoothera lunulata halmaturina	Bassian Thrush (South Australian)	VU		1		Unlikely
MAMMALIA	**Mammals**					
Neophoca cinerea	Australian Sea-lion	VU	V	1		Impossible
Petrogale xanthopus xanthopus	Yellow-footed Rock-wallaby	VU		1		Unlikely
REPTILIA	**Reptiles**					
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1		Unlikely
Caretta caretta	Loggerhead Turtle	EN, Mi	E	1		Impossible
Chelonia mydas	Green Turtle	VU, Mi	V	1		Impossible
Dermochelys coriacea	Leatherback Turtle	EN, Mi	V	1		Impossible
Notechis scutatus ater	Krefft's Tiger Snake (Flinders Ranges)	VU		1		Unlikely
CHONDRICHTHYES	**Cartilaginous Fishes**					
Lamna nasus	Porbeagle	Mi		1		Impossible

[1]Conservation status

Aus.: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. Mi.: Migratory. (W): Wetland bird. (M): Marine bird. (T): Terrestrial bird.

[2]Source

1: EPBC Act Protected Matters Search Tool (PMST) report (DotEE 2018) – 5 km buffer applied to Project area.

2: Biological Database of South Australia (BDBSA) data extract (DEW 2018) – 5 km buffer applied to Project area.

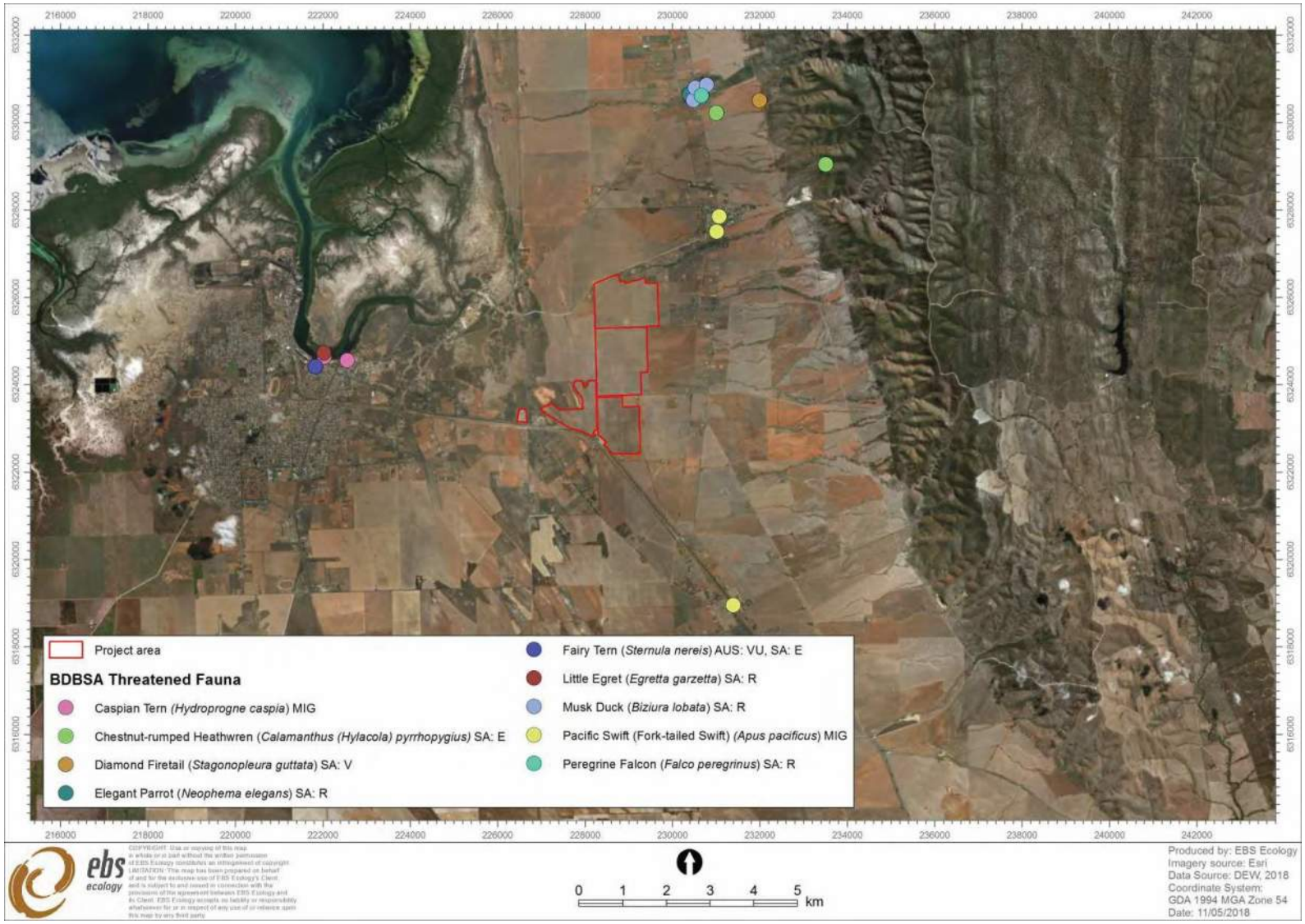

Figure 4. BDBSA records of threatened fauna species recorded within 5 km of the Project area (DEW 2018).

5.1.7 Invasive species

The EPBC Act PMST report identified 15 invasive fauna and nine invasive flora species within 5 km of the Project area. Eight invasive fauna species were determined likely to occur within the Project area. While five flora species were determined to possibly occur within the Project area (Table 8).

Table 8. Invasive flora and fauna species potentially occurring within 5 km of the Project area identified in the PMST database search (DotEE 2018).

Scientific name	Common name	Status[1]	Likelihood of occurrence within Project area
AVES	**Birds**		
Alauda arvensis	Skylark		Likely
Anas platyrhynchos	Mallard		Unlikely
Carduelis carduelis	European Goldfinch		Possible
Columba livia	Domestic Pigeon		Possible
Passer domesticus	House Sparrow		Likely
Streptopelia chinensis	Spotted Turtle-dove		Likely
Sturnus vulgaris	Common Starling		Likely
Turdus merula	Common Blackbird		Possible
MAMMALIA	**Mammals**		
Capra hircus	Goat		Unlikely
Felis catus	Cat		Likely
Lepus capensis	Brown Hare		Unlikely
Mus musculus	House Mouse		Likely
Oryctolagus cuniculus	European Rabbit		Likely
Rattus rattus	Black Rat		Possible
Vulpes vulpes	European Red Fox		Likely
PLANTAE	**Plants**		
Asparagus asparagoides	Bridal Creeper	WoNS, D	Unlikely
Austrocylindropuntia spp.	Prickly Pears	WoNS, D	Possible
Carrichtera annua	Ward's Weed	WoNS, E	Possible
Chrysanthemoides monilifera	Bitou Bush / Boneseed	WoNS, D	Unlikely
Lycium ferocissimum	African Boxthorn	WoNS, D	Possible
Opuntia spp.	Prickly Pears	WoNS, D	Possible
Rubus fruticosus aggregate	European Blackberry	WoNS, D	Unlikely
Salix spp.	Willows	WoNS, D, E	Unlikely
Solanum elaeagnifolium	Silver Nightshade	WoNS, D	Possible

[1]**Status**
WoNS: Weed of National Significance (*Environment Protection and Biodiversity Conservation Act 1999*). D: Declared (*Natural Resources Management Act 2004*). E: Environmental weed (Department of Planning, Transport and Infrastructure).

5.2 Survey design and site identification

5.2.1 Vegetation assessment

Aerial imagery and the preliminary layout of the Project area (Figure 1) showed that there are small patches of (potentially native) vegetation that are located outside of the proposed footprint, and that small patches of native vegetation within the Project area will be avoided. However some scattered

trees/shrubs may be located within the proposed BS construction footprint, which can only be determined by ground truthing the Project area. Therefore, a vegetation survey will be conducted by accredited consultants in accordance with the Scattered Tree Assessment Method (STAM), which was devised by the NVC in 2017 (NVC 2017). The STAM is suitable for assessing scattered trees in the following instances:

- Individual scattered trees (i.e. canopy does not overlap). Spatial distribution of trees may vary from approach what would be considered their pre-European distribution through to single isolated trees in the middle of a paddock; or
- Dead trees (when a dead tree is considered native vegetation); or
- Clumps of trees (contiguous overlapping canopies) if the clump is small (~<0.1 ha); and
- For both scattered trees and clumps:
    - The ground layer comprising wholly or largely of introduced species;
    - Some scattered colonising native species may be present, but represents <5% of the ground cover; and
    - The area around the trees consists of introduced pasture or crops.

Scattered trees are scored using a Point Scoring System (PSS), which facilitates the consistent and quantifiable assessment of the relative biodiversity value of a tree. This process assists in determining if clearance is at variance with the principles of clearance in Schedule 1 of the NV Act, particularly Principle 1(b) – Wildlife habitat. The PSS is also used in the calculation of the Significant Environmental Benefit (SEB) requirements.

During the assessment the following metrics of the PSS will be recorded:

- General information – date of inspection, inspectors, number of trees, name of applicant etc.;
- Photo;
- GPS point;
- Species – to subspecies level;
- Height (m);
- Diameter of trunk (cm) – recorded at 1.5 m above the ground;
- Health – % canopy dieback; and
- Hollows – number and size (Small = <5 cm, Medium = 5-15 cm, Large >15 cm).

5.2.2 Opportunistic fauna survey

Any opportunistic fauna sightings will be recorded as the Project area is traversed during the vegetation assessment. All fauna species observed, signs of fauna (i.e. scats, burrows, nests and skeletons) and potential habitat for fauna (e.g. hollows) will be recorded. In particular, scattered trees will be assessed for potential nesting (in tree hollows and spouts) and roosting habitat for the state rare Elegant Parrot (*Neophema elegans*) and Peregrine Falcon (*Falco peregrinus*).

6 DISCUSSION

6.1 Potential threatening processes

Potential impacts were assessed in relation to vegetation and fauna within the Project area and considered through elements of the project from pre-construction through to establishment of the proposed BS in South Australia.

Based on existing knowledge of potential receptors, the preliminary risks are summarised below:

- Invasion and spread of weeds and pest fauna species/pets;
- Loss of habitat and feeding opportunities via clearance/damage to nesting sites/dens for common fauna species;
- Loss of feeding and roosting habitat for nationally listed fauna species;
- Loss of feeding opportunities for threatened fauna that may visit the site on an irregular basis;
- Displacement due to habitat loss;
- Reduction in terrestrial fauna movement along existing corridors;
- Mortality via collision with vehicles associated with the BS operations; and
- Disturbance effects (e.g. impact on breeding activities, habitat suitability, flight pathways).

6.2 Protected areas

Both of the TECs identified in the EPBC Act PMST report were considered unlikely to occur in the Project area.

The Project area falls within the distribution of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland and Subtropical and Temperate Coastal Saltmarsh. However, besides scattered native trees, the majority of the Project area has been entirely cleared of remnant vegetation and subsequently cropped, and remaining vegetation patches will be avoided. Therefore, it is unlikely that these TECs occur within the Project area.

6.3 Threatened flora

All of the national and state threatened flora species identified in the EPBC Act PMST report and BDBSA search were considered unlikely to occur within Project area. This is because, besides scattered native trees, the BS Project area has been entirely cleared of remnant vegetation and has been subsequently cropped, and remaining vegetation patches will be avoided.

6.4 Threatened fauna

Besides scattered native trees, the majority of the Project area has been entirely cleared of remnant vegetation and subsequently cropped, and remaining vegetation patches will be avoided. It was therefore determined that a total of two matters of national environmental significance could occur within the

Project area: the migratory Fork-tailed Swift (*Apus pacificus*) and Osprey (*Pandon haliaetus*). Both these species are expected to only fly over the Project area.

Scattered trees can be of high value in terms of habitat and movement pathways for protected species. Within the Project area this includes the state rare Elegant Parrot (*Neophema elegans*) and Peregrine Falcon (*Falco peregrinus*), which were determined to possibly occur.

6.5 Conclusion

A field component will verify the presence of any threatened flora and fauna records as well as determine the potential for habitat for threatened flora and fauna. Ground-truthing within the Project area is required to determine the presence of scattered trees and to assess if trees are of high value. Targeted flora surveys are recommended to ground-truth the findings of the desktop study and to confirm the presence of threatened flora species within the BS Project area The field surveys should aim to determine the presence and significance of the scattered trees as habitat (roosting, feeding, nesting, movement etc.) for these two above mentioned bird species.

Field data, combined with database records and background research, is part the way to providing an adequately detailed assessment of the flora and fauna that occurs, and is likely to occur, within the BS Project area in South Australia.

All native vegetation within the Project area is covered by the *Native Vegetation Act 1991* and any proposed clearance will need to be assessed against native vegetation principles and regulations. A clearance application to the Native Vegetation Council may be required.

7 REFERENCES

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8 APPENDICES

Appendix 1. Flora species recorded in the BDBSA within 5 km of the Project area (DEW 2018).

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Acacia calamifolia (NC)	Wallowa			1998
	Acacia continua	Thorn Wattle			1979
	Acacia iteaphylla	Flinders Ranges Wattle		R	2000
	Acacia ligulata	Umbrella Bush			2000
	Acacia ligulata (NC)	Umbrella Bush			1992
	Acacia montana	Mallee Wattle		R	1979
	Acacia oswaldii	Umbrella Wattle			2000
	Acacia papyrocarpa	Western Myall			1983
	Acacia rupicola	Rock Wattle			1992
	Acacia salicina	Willow Wattle			1998
	Acacia sp.	Wattle			2003
	Acacia victoriae ssp.	Elegant Wattle			2000
	Acacia victoriae ssp. victoriae	Elegant Wattle			1992
	Actinobole uliginosum	Flannel Cudweed			1932
	Alectryon oleifolius ssp. canescens	Bullock Bush			1998
	Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush			1978
	Allocasuarina verticillata	Drooping Sheoak			1900
	Alternanthera denticulata	Lesser Joyweed			1997
	Alyogyne huegelii	Native Hibiscus			1979
	Amaranthus grandiflorus	Large-flower Amaranth			1975
	Amyema miquelii	Box Mistletoe			1982
*	*Anethum graveolens*				1992
*	*Arctotheca calendula*	Cape Weed			1992
	Aristida contorta	Curly Wire-grass			1998
	Asperula conferta	Common Woodruff			1993
*	*Asphodelus fistulosus*	Onion Weed			2003
	Atriplex eardleyae	Eardley's Saltbush			1993
	Atriplex leptocarpa	Slender-fruit Saltbush			1993
	Atriplex lindleyi ssp. lindleyi	Baldoo			1992
	Atriplex nummularia ssp. nummularia	Old-man Saltbush			1988
	Atriplex paludosa ssp. cordata	Marsh Saltbush			2003
	Atriplex vesicaria	Bladder Saltbush			1992
	Austrostipa elegantissima	Feather Spear-grass			2002
	Austrostipa eremophila	Rusty Spear-grass			1992
	Austrostipa nitida	Balcarra Spear-grass			2002
	Austrostipa nodosa	Tall Spear-grass			2005
*	*Avena barbata*	Bearded Oat			2003
	Beyeria lechenaultii	Pale Turpentine Bush			1992
	Boerhavia dominii	Tar-vine			1992
	Boerhavia dominii (NC)	Tar-vine			1992
	Bothriochloa ewartiana	Desert Blue-grass			2003

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Brachyscome ciliaris var. subintegrifolia			R	1978
*	*Brassica tournefortii*	Wild Turnip			1992
*	*Bromus diandrus*	Great Brome			1992
*	*Bromus diandrus (NC)*	Great Brome			2003
*	*Bromus madritensis*	Compact Brome			1992
*	*Bromus rubens*	Red Brome			1992
	Bulbine semibarbata	Small Leek-lily			1992
	Callistemon teretifolius	Needle Bottlebrush			1900
	Callitris glaucophylla	White Cypress-pine			1992
	Calostemma purpureum	Pink Garland-lily			1992
	Calotis hispidula	Hairy Burr-daisy			1906
	Calytrix tetragona	Common Fringe-myrtle			1992
*	*Cardamine flexuosa*	Wood Bitter-cress			1998
*	*Carduus tenuiflorus*	Slender Thistle			1992
*	*Carrichtera annua*	Ward's Weed			1992
*	*Carthamus lanatus*	Saffron Thistle			2003
	Cassinia laevis ssp. laevis	Curry Bush			1992
*	*Casuarina glauca*	Grey Buloak			1989
	Casuarina pauper	Black Oak			1992
*	*Cenchrus ciliaris*	Buffel Grass			2014
*	*Cenchrus setaceus*	Fountain Grass			2014
	Cheilanthes lasiophylla	Woolly Cloak-fern			1943
*	*Chloris gayana*	Rhodes Grass			1998
*	*Chloris virgata*	Feather-top Rhodes Grass			2014
*	*Chrozophora tinctoria*	Dyer's Litmus Plant			1997
	Chrysocephalum apiculatum (NC)	Common Everlasting			1992
	Convolvulus erubescens/remotus (NC)	Native Bindweed			1992
	Convolvulus remotus	Grassy Bindweed			1992
	Craspedia haplorrhiza	Billy-buttons			1906
	Crassula colorata var.	Dense Crassula			1992
*	*Critesion murinum ssp. (NC)*	Barley-grass			1992
	Cullen australasicum	Tall Scurf-pea			1998
*	*Cynodon dactylon (NC)*	Couch			2003
	Cyrtostylis reniformis	Small Gnat-orchid			1998
*	*Datura stramonium*	Common Thorn-apple			1988
	Daucus glochidiatus	Native Carrot			1992
	Daviesia genistifolia	Broom Bitter-pea			1992
	Dianella revoluta var. revoluta	Black-anther Flax-lily			1992
	Disphyma crassifolium ssp. clavellatum	Round-leaf Pigface			1992
*	*Dittrichia graveolens*	Stinkweed			1992
	Dodonaea viscosa ssp. angustissima	Narrow-leaf Hop-bush			1998
	Dodonaea viscosa ssp. spatulata	Sticky Hop-bush			1992
	Dysphania cristata	Crested Crumbweed			1992

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
*	*Echium plantagineum*	Salvation Jane			2003
*	*Ehrharta calycina*	Perennial Veldt Grass			1998
*	*Ehrharta longiflora*	Annual Veldt Grass			1992
	Einadia nutans ssp.	Climbing Saltbush			1992
	Elatine gratioloides	Waterwort		R	1997
	Enchylaena tomentosa var. tomentosa	Ruby Saltbush			1992
	Enneapogon nigricans	Black-head Grass			1992
	Enteropogon acicularis (NC)	Umbrella Grass			1992
*	*Eragrostis cilianensis*	Stink Grass			1997
*	*Eragrostis curvula*	African Love-grass			2014
	Eragrostis falcata	Sickle Love-grass			1992
*	*Eragrostis minor*	Small Stink-grass			1997
*	*Eragrostis trichophora*	Hairyflower Lovegrass			2014
	Eremophila alternifolia	Narrow-leaf Emubush			1978
	Eremophila glabra (NC)	Tar Bush			1992
	Eremophila glabra ssp. glabra	Tar Bush			1994
	Eremophila longifolia	Weeping Emubush			2000
	Erodium crinitum	Blue Heron's-bill			1992
	Eucalyptus camaldulensis ssp.	River Red Gum			1998
	Eucalyptus leptophylla	Narrow-leaf Red Mallee			2000
	Eucalyptus odorata	Peppermint Box			1952
	Eucalyptus porosa	Mallee Box			1992
	Eucalyptus socialis (NC)	Beaked Red Mallee			1992
	Eucalyptus socialis ssp. socialis	Beaked Red Mallee			2000
	Eucalyptus sp.				2003
	Euchiton sphaericus	Annual Cudweed			1992
	Euphorbia tannensis ssp. eremophila	Desert Spurge			1946
*	*Euphorbia terracina*	False Caper			1992
*	*Eustachys distichophylla*	Evergreen Chloris			1981
	Exocarpos sparteus	Slender Cherry			1994
*	*Galenia pubescens var. pubescens*	Coastal Galenia			2003
*	*Galenia secunda*	Galenia			1998
*	*Galium aparine*	Cleavers			1998
*	*Galium spurium*	Bedstraw			1978
	Gonocarpus elatus	Hill Raspwort			1992
	Goodenia albiflora	White Goodenia			1932
	Grammosolen dixonii				1981
	Grevillea huegelii	Comb Grevillea			1992
	Hakea leucoptera ssp. leucoptera	Silver Needlewood			1932
	Hakea rugosa	Dwarf Hakea			1978
	Halosarcia sp. (NC)	Samphire			2003
*	*Helianthus annuus*	Sunflower			1998
*	*Hordeum glaucum*	Blue Barley-grass			2003
*	*Hordeum sp.*	Barley-grass			1992

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Hormophysa cuneiformis				2010
	Hyalosperma semisterile	Orange Sunray			1978
	Hybanthus monopetalus	Slender Violet			1978
*	*Hypochaeris glabra*	Smooth Cat's Ear			1992
*	*Hypochaeris radicata*	Rough Cat's Ear			1992
	Juncus aridicola	Inland Rush			1987
	Juncus bufonius	Toad Rush			1987
*	*Lactuca serriola (NC)*	Prickly Lettuce			2003
*	*Lamarckia aurea*	Toothbrush Grass			1992
	Leiocarpa tomentosa	Woolly Plover-daisy			1994
*	*Limonium sinuatum*	Notch-leaf Sea-lavender			2000
*	*Lolium perenne*	Perennial Ryegrass			1992
	Lomandra effusa	Scented Mat-rush			1992
	Lomandra multiflora ssp. dura	Hard Mat-rush			1978
	Lotus cruentus	Red-flower Lotus			1993
*	*Lycium ferocissimum*	African Boxthorn			1998
	Maireana brevifolia	Short-leaf Bluebush			2003
*	*Malva parviflora*	Small-flower Marshmallow			1992
	Malva preissiana	Australian Hollyhock			1979
*	*Marrubium vulgare*	Horehound			1998
*	*Matthiola longipetala ssp. bicornis*	Two-horned Stock			1989
*	*Medicago littoralis*	Strand Medic			1939
*	*Medicago minima var. minima*	Little Medic			1992
*	*Medicago polymorpha var. polymorpha*	Burr-medic			2000
	Melaleuca lanceolata	Dryland Tea-tree			2000
*	*Melilotus indicus*	King Island Melilot			1992
*	*Mesembryanthemum crystallinum*	Common Iceplant			1992
*	*Mesembryanthemum nodiflorum*	Slender Iceplant			1992
	Millotia myosotidifolia	Broad-leaf Millotia			1978
*	*Misopates orontium*	Lesser Snapdragon			1992
	Myoporum insulare	Common Boobialla			2000
	Myoporum montanum	Native Myrtle			2000
	Myoporum platycarpum ssp.	False Sandalwood			1992
	Myoporum viscosum	Sticky Boobialla			1994
	Myriophyllum verrucosum	Red Milfoil			1997
	Nicotiana sp.	Tobacco			1992
	Nitraria billardierei	Nitre-bush			2003
*	*Oenothera stricta ssp. stricta*	Common Evening Primrose			2000
*	*Olea europaea ssp. europaea*	Olive			2005
	Olearia pimeleoides	Pimelea Daisy-bush			1978
*	*Opuntia ficus-indica*	Indian Fig			2006
*	*Opuntia puberula*				2006
	Oxalis perennans (NC)	Native Sorrel			1992
*	*Oxalis pes-caprae*	Soursob			1992
*	*Parapholis incurva*	Curly Ryegrass			1992

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Parietaria cardiostegia	Mallee Smooth-nettle			1978
*	*Pentameris airoides ssp. airoides*	False Hair-grass			1992
	Persicaria prostrata	Creeping Knotweed			1997
	Phyllanthus saxosus	Rock Spurge			1994
	Pimelea microcephala ssp. microcephala	Shrubby Riceflower			1992
	Pimelea stricta	Erect Riceflower			1982
*	*Piptatherum miliaceum*	Rice Millet			2014
	Pittosporum angustifolium	Native Apricot			2000
*	*Polycarpon tetraphyllum*	Four-leaf Allseed			1992
	Polygonum plebeium	Small Knotweed			1997
	Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris			1982
	Portulaca oleracea	Common Purslane			1997
	Prostanthera sp.	Mintbush			2009
	Pultenaea largiflorens	Twiggy Bush-pea			1978
*	*Rapistrum rugosum ssp. rugosum*	Turnip Weed			1998
*	*Reichardia tingitana*	False Sowthistle			1992
	Rhagodia parabolica	Mealy Saltbush			1904
	Rhagodia spinescens	Spiny Saltbush			1992
	Rhodanthe haigii	Haig's Everlasting			1900
*	*Rostraria cristata*	Annual Cat's-tail			1992
*	*Rumex crispus*	Curled Dock			2003
*	*Rumex hypogaeus*	Three-corner Jack			1992
	Rytidosperma caespitosum	Common Wallaby-grass			1992
	Salsola australis	Buckbush			1992
*	*Salvia aethiopis*	Woolly Sage			1946
*	*Salvia verbenaca var. verbenaca*	Wild Sage			1992
	Santalum acuminatum	Quandong			1992
	Santalum lanceolatum	Plumbush			1994
	Santalum spicatum	Sandalwood		V	1992
	Sarcocornia quinqueflora	Beaded Samphire			2003
	Scaevola spinescens	Spiny Fanflower			1992
*	*Schinus molle*	Pepper-tree			1998
*	*Schismus barbatus*	Arabian Grass			1992
	Sclerolaena diacantha	Grey Bindyi			1988
	Sclerolaena patenticuspis	Spear-fruit Bindyi			1992
	Senecio glossanthus	Annual Groundsel			1930
	Senna artemisioides ssp. petiolaris				2000
	Sida fibulifera	Pin Sida			1997
	Sida intricata	Twiggy Sida			1997
	Sida petrophila	Rock Sida			1932
*	*Silene gallica var.*	French Catchfly			1992
*	*Silene gallica var. gallica*	French Catchfly			1932
*	*Silene nocturna*	Mediterranean Catchfly			1992
*	*Sisymbrium erysimoides*	Smooth Mustard			1992

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
*	*Sisymbrium orientale*	Indian Hedge Mustard			2000
*	*Sisymbrium sp.*	Wild Mustard			1998
	Solanum coactiliferum	Tomato-bush			1974
*	*Solanum elaeagnifolium*	Silver-leaf Nightshade			1983
	Solanum eremophilum	Rare Nightshade		R	1997
	Solanum esuriale	Quena			1964
*	*Solanum nigrum*	Black Nightshade			1992
	Solanum oligacanthum	Desert Nightshade			2012
	Solanum petrophilum	Rock Nightshade			1976
	Solanum simile	Kangaroo Apple			1979
*	*Sonchus oleraceus*	Common Sow-thistle			1992
*	*Spergularia diandra*	Lesser Sand-spurrey			1960
	Spyridium stenophyllum ssp. renovatum	Forked Spyridium			1978
	Stenanthemum leucophractum	White Cryptandra			1901
*	*Suaeda aegyptiaca*				2000
	Suaeda australis	Austral Seablite			1992
	Tecticornia halocnemoides ssp. longispicata	Grey Samphire			1967
	Tecticornia indica ssp. leiostachya	Brown-head Samphire			1992
	Tecticornia pergranulata ssp.	Black-seed Samphire			2003
	Tecticornia pergranulata ssp. pergranulata	Black-seed Samphire			1998
	Tetragonia eremaea	Desert Spinach			1992
	Tetragonia implexicoma	Bower Spinach			2000
	Tetragonia tetragonoides	New Zealand Spinach			1978
	Teucrium corymbosum	Rock Germander			1976
	Tribulus minutus				1997
*	*Trifolium arvense var. arvense*	Hare's-foot Clover			1992
*	*Trifolium campestre*	Hop Clover			1992
	Unidentified sp.				1998
*	*Vicia monantha*	Spurred Vetch			1992
	Vittadinia cervicularis var. cervicularis	Waisted New Holland Daisy			1992
	Vulpia bromoides/myuros				1992
*	*Vulpia myuros f. myuros*	Rat's-tail Fescue			1992
	Wahlenbergia gracilenta	Annual Bluebell			1978
	Wahlenbergia luteola	Yellow-wash Bluebell			1992
	Wahlenbergia stricta ssp. stricta	Tall Bluebell			1992
	Xanthorrhoea quadrangulata	Rock Grass-tree			1963
	Zygophyllum billardierei (NC)	Coast Twinleaf			1992

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. *: Introduced.

Appendix 2. Fauna species recorded in the BDBSA within 5 km of the Project area (DEW 2018).

*	Scientific name	Common name	Conservation status	Last sighting

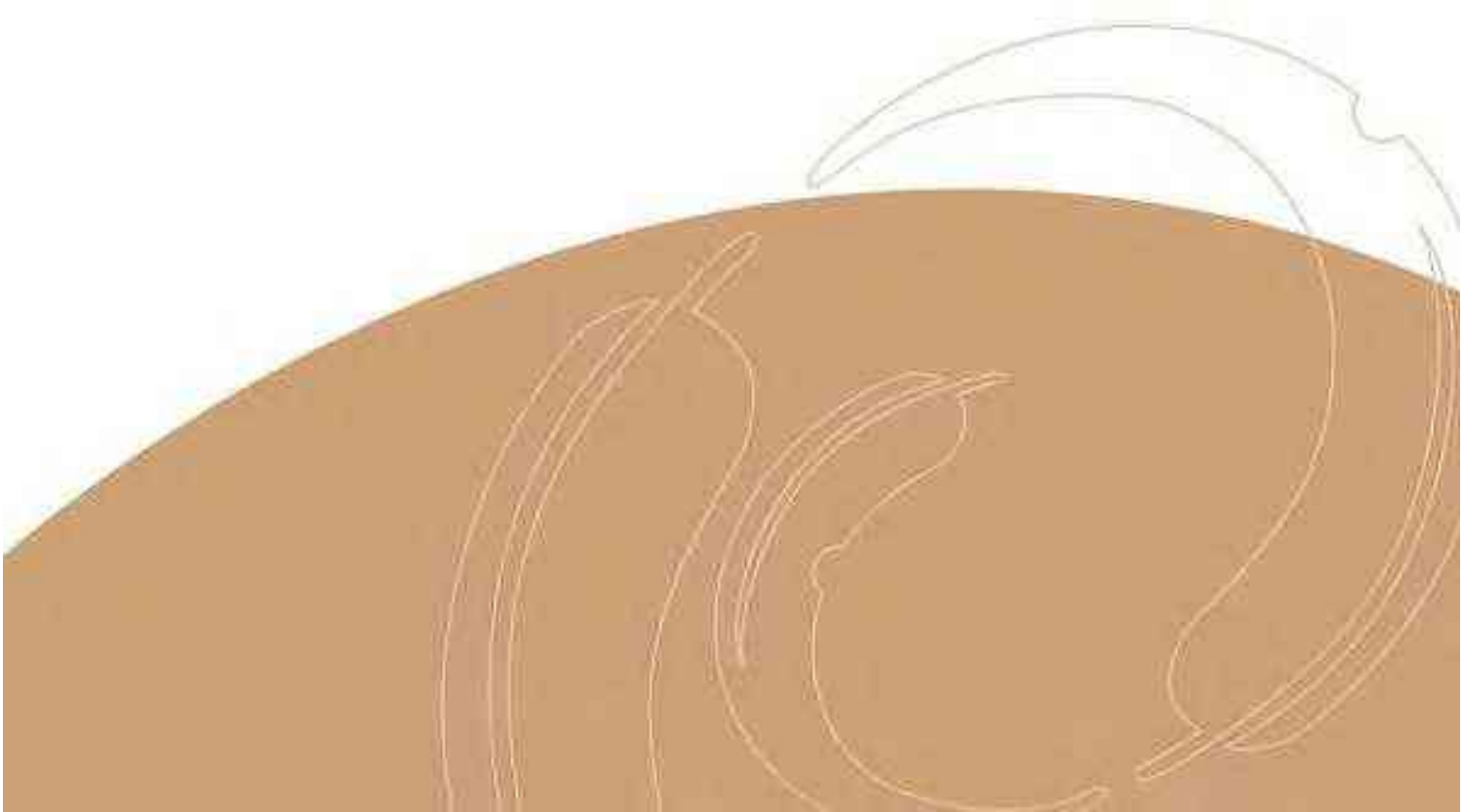
			Aus	SA	(year)
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater			2003
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill			2001
	Acanthiza nana	Yellow Thornbill			1999
	Acanthiza uropygialis	Chestnut-rumped Thornbill			2000
	Accipiter cirrocephalus cirrocephalus	Collared Sparrowhawk			1999
	Accipiter fasciatus	Brown Goshawk			2000
	Acrocephalus australis	Australian Reed Warbler			2001
	Anas gracilis	Grey Teal			2003
	Anas superciliosa	Pacific Black Duck			2003
	Anthochaera carunculata	Red Wattlebird			2003
	Aprasia inaurita	Red-tailed Worm-lizard			1990
	Apus pacificus	Pacific Swift (Fork-tailed Swift)			2003
	Ardea alba modesta	Great Egret			2006
	Ardea pacifica	White-necked Heron			2001
	Artamus cinereus	Black-faced Woodswallow			2000
	Artamus cyanopterus	Dusky Woodswallow			1999
	Aythya australis	Hardhead			2002
	Barnardius zonarius	Australian Ringneck			2006
	Biziura lobata	Musk Duck		R	2002
	Cacomantis pallidus	Pallid Cuckoo			2000
	Calamanthus (Hylacola) pyrrhopygius	Chestnut-rumped Heathwren		E	1984
	Caligavis chrysops samueli	Yellow-faced Honeyeater (MLR, southern FR)			2002
*	*Capra hircus*	Goat (Feral Goat)			2010
	Chalcites lucidus	Shining Bronze Cuckoo			2000
	Chroicocephalus novaehollandiae	Silver Gull			2006
	Cincloramphus mathewsi	Rufous Songlark			2001
	Circus assimilis	Spotted Harrier			1999
	Colluricincla harmonica	Grey Shrikethrush			2003
*	*Columba livia*	Feral Pigeon			2006
	Coracina novaehollandiae	Black-faced Cuckooshrike			2003
	Corvus coronoides	Australian Raven			2002
	Corvus mellori	Little Raven			2003
	Corvus sp.	crows			2000
	Coturnix pectoralis	Stubble Quail			2000
	Cracticus torquatus	Grey Butcherbird			2001
	Crinia signifera	Common Froglet			2002
	Cryptoblepharus pannosus	Speckled Wall Skink			1985
	Ctenophorus decresii	Tawny Dragon			1979
	Cygnus atratus	Black Swan			2001
	Dacelo novaeguineae	Laughing Kookaburra			2000
	Diplodactylus furcosus	Ranges Stone Gecko			1989
	Egretta garzetta	Little Egret		R	2002
	Egretta novaehollandiae	White-faced Heron			2001
	Elanus axillaris	Black-shouldered Kite			2001
	Elseyornis melanops	Black-fronted Dotterel			2001

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Eolophus roseicapilla	Galah			2006
	Erythrogonys cinctus	Red-kneed Dotterel			2002
	Falco berigora	Brown Falcon			2000
	Falco cenchroides	Nankeen Kestrel			2002
	Falco peregrinus	Peregrine Falcon		R	2000
	Fulica atra	Eurasian Coot			2002
	Gavicalis virescens	Singing Honeyeater			2006
	Gehyra lazelli	Southern Rock Dtella			1950
	Geopelia placida	Peaceful Dove			2006
	Gliciphila melanops	Tawny-crowned Honeyeater			2002
	Grallina cyanoleuca	Magpielark			2003
	Gymnorhina tibicen	Australian Magpie			2006
	Haliastur sphenurus	Whistling Kite			2002
	Hemiergis decresiensis	Three-toed Earless Skink			1985
	Hieraaetus morphnoides	Little Eagle			2004
	Hirundo neoxena	Welcome Swallow			2003
	Hydroprogne caspia	Caspian Tern			2001
	Lalage tricolor	White-winged Triller			2000
	Larus pacificus	Pacific Gull			2001
	Lerista dorsalis	Southern Four-toed Slider			1990
	Lerista edwardsae	Myall Slider			1969
	Limnodynastes dumerilii	Banjo Frog			2001
	Limnodynastes tasmaniensis	Spotted Marsh Frog			2001
	Macropus robustus	Euro			2001
	Malacorhynchus membranaceus	Pink-eared Duck			2002
	Malurus lamberti	Variegated Fairywren			2004
	Malurus leucopterus	White-winged Fairywren			2003
	Manorina flavigula	Yellow-throated Miner			2006
	Megalurus gramineus	Little Grassbird			2001
	Menetia greyii	Dwarf Skink			2000
	Merops ornatus	Rainbow Bee-eater			1999
	Microcarbo melanoleucos melanoleucos	Little Pied Cormorant			2002
	Milvus migrans	Black Kite			2002
	Neobatrachus pictus	Burrowing Frog			2001
	Neophema elegans	Elegant Parrot		R	2000
	Ocyphaps lophotes	Crested Pigeon			2006
	Pachycephala pectoralis	Golden Whistler			1981
	Pachycephala rufiventris rufiventris	Rufous Whistler			2004
	Parasuta spectabilis	Mallee Black-headed Snake			2000
	Pardalotus striatus	Striated Pardalote			2006
*	*Passer domesticus*	House Sparrow			2006
	Pelecanus conspicillatus	Australian Pelican			2006
	Petrochelidon nigricans	Tree Martin			2001
	Petroica goodenovii	Red-capped Robin			2001
	Phalacrocorax sulcirostris	Little Black Cormorant			2002

*	Scientific name	Common name	Conservation status		Last sighting (year)
			Aus	SA	
	Phalacrocorax varius	Great Pied Cormorant			2006
	Phaps chalcoptera	Common Bronzewing			2001
	Phylidonyris novaehollandiae	New Holland Honeyeater			2002
	Platycercus elegans	Crimson Rosella			2004
	Podargus strigoides	Tawny Frogmouth			2001
	Poliocephalus poliocephalus	Hoary-headed Grebe			2002
	Pomatostomus superciliosus	White-browed Babbler			2001
	Porzana fluminea	Australian Crake (Australian Spotted Crake)			2002
	Porzana pusilla	Baillon's Crake			2001
	Psephotus haematonotus	Red-rumped Parrot			2006
	Psephotus haematonotus haematonotus	Red-rumped Parrot (eastern SA except NE)			2000
	Pseudonaja aspidorhyncha	Patch-nosed Brown Snake			1978
	Pseudonaja textilis	Eastern Brown Snake			1985
	Ptilotula penicillata	White-plumed Honeyeater			2002
	Ptilotula plumula	Grey-fronted Honeyeater			1981
	Purnella albifrons	White-fronted Honeyeater			2003
	Rhipidura albiscapa	Grey Fantail			2004
	Rhipidura leucophrys	Willie Wagtail			2004
	Smicrornis brevirostris	Weebill			2003
*	*Spilopelia chinensis*	Spotted Dove			2006
	Stagonopleura guttata	Diamond Firetail		V	2014
	Sternula nereis	Fairy Tern	VU	E	2001
	Strophurus intermedius	Southern Spiny-tailed Gecko			1989
*	*Sturnus vulgaris*	Common Starling			2006
	Sugomel niger	Black Honeyeater			1991
	Tachybaptus novaehollandiae	Australasian Grebe			2002
	Todiramphus sanctus	Sacred Kingfisher			2003
	Tribonyx ventralis	Black-tailed Nativehen			2003
*	*Turdus merula*	Common Blackbird			2004
	Tyto delicatula delicatula	Eastern Barn Owl			2007
	Vanellus miles	Masked Lapwing			2006
	Zosterops lateralis	Silvereye			2002

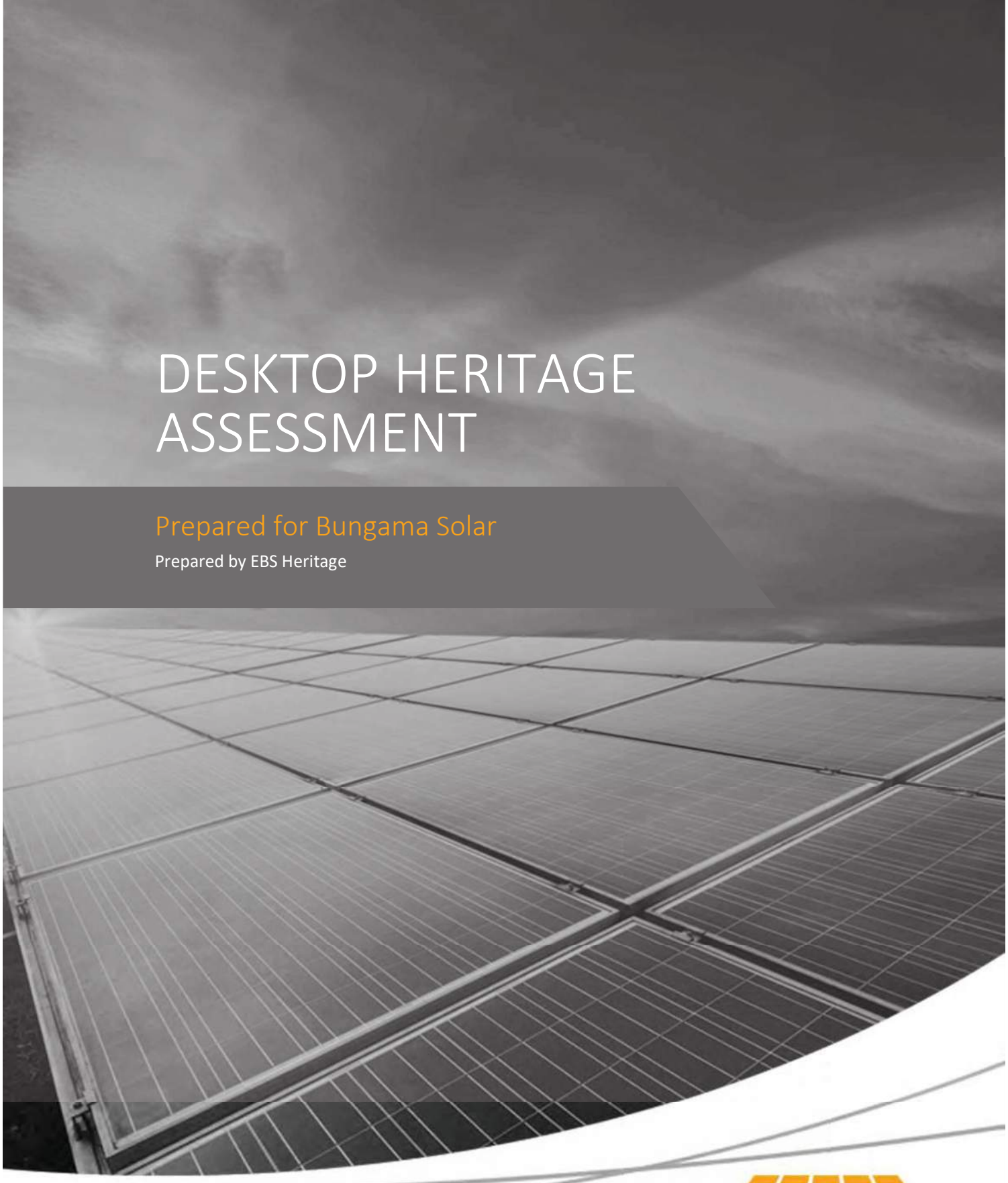
Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. *: Introduced.

EBS Ecology
3/119 Hayward Avenue
Torrensville, SA 5031
www.ebsecology.com.au
t. 08 7127 5607
f. 08 8352 1222



APPENDIX 9

Desktop Heritage Assessment



DESKTOP HERITAGE ASSESSMENT

Prepared for Bungama Solar

Prepared by EBS Heritage

EPS ENERGY

Reference No. 11297

November 18

BUNGAMA SOLAR

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Bungama Solar

Desktop Heritage Assessment

Bungama Solar: Desktop Heritage Assessment

23 July 2018

Version 3

Prepared by EBS Heritage for Bungama Solar 1 Pty Ltd

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125 Hayward Avenue
Torrensville, South Australia 5031
t: 08 7127 5607
email: shannon.smith@ebsheritage.com.au

GLOSSARY AND ABBREVIATION OF TERMS

AHA	*Aboriginal Heritage Act* 1988
CHMP	Cultural Heritage Management Plan
DAC	Development Assessment Commission
DEW	Department of Environment and Water (formerly Department of Environment, Water and Natural Resources (DEWNR))
DPC-AAR	Department of the Premier and Cabinet – Aboriginal Affairs and Reconciliation
DSD-AAR	Department of State Development – Aboriginal Affairs and Reconciliation
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographical Regionalisation of Australia
KM	Kilometres
NTA	*Native Title Act 1993*
Project	The proposed development of the solar farm at Bungama
Project area	The land where the solar farm at Bungama is proposed to be constructed
BS	Bungama Solar
SA	South Australia / South Australian
SAM	The South Australian Museum

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1 INTRODUCTION

EBS Heritage has been engaged by EPS Energy to undertake a heritage desktop and risk assessment of the proposed Bungama Solar Project (BS). EBS understands that these initial investigations are necessary to determine if the proposed site is suitable for development.

The following report contains a summary of the available previous heritage work carried out for the Project area, and heritage management recommendations in light of the desktop risk assessment and the relevant heritage protection legislation.

1.1 Project area

The Project area is located near Bungama, South Australia (SA), which is approximately 5 km east of Port Pirie and 200 km north of Adelaide (Figure 1). The proposed Project area is located to the the east and north-east of of the existing substation, and consists of approximately 500 ha across four parcels of land with multiple land owners (Table 1 and Figure 1). The proposed Project area of the BS is provided in Figure 1.

Table 1: Land parcel details for the proposed Bungama Solar.

Lot Number	Address	Approx. Area of Interest (Ha)
CT 5954/187	Lot 52 Augusta Highway, Warnertown SA 5540	109
CT 5949/272	Lot 4 Augusta Highway, Warnertown SA 5540	77
CT 6217/5	Lot 558 Augusta Highway, Warnertown SA 5540	174
CT 6037/29	Lot 20 Gulf View Road, Napperby SA 5540	158.1
Total		**518.1**

1.2 Cultural Heritage Desktop Assessment Objectives

- Conduct background research including a review of heritage register searches and the SA Heritage Database as well as background research of primary and secondary sources and previous heritage reports for the Project area;
- Review archival aerial photographs where available to determine levels of historical disturbance in Project area;
- Identify State and Commonwealth legislative requirements pertinent to heritage in the current Project area;
- Determine the likelihood or risk of cultural heritage sites being present as well as the potential impacts for any known heritage within the Project area in accordance with the South Australian Aboriginal Heritage Act 1988; and
- Prepare risk management recommendations for future works and provide recommendations in relation to any potential impacts the proposed activities could have on locations of heritage significance, in light of clients' responsibilities under the South Australian *Aboriginal Heritage Act 1988.*

Figure 1: Location of the Project area.

2 COMPLIANCE AND LEGISLATIVE SUMMARY

2.1 Commonwealth Legislation

2.1.1 Environmental Protection & Biodiversity Conservation Act 1999 (amended 2003).

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Environment Protection and Biodiversity Conservation Regulations 2000* protect places of national cultural and environmental significance from damage and interference by establishing a National Heritage list (for places outside of Commonwealth land) and a Commonwealth Heritage List (for places within Commonwealth land). Under the EPBC Act any action that has, will have, or is likely to have a significant impact on a place of national culture and/or environmental significance must be referred to the Minister for the Environment for approval. The EPBC Act sets out a procedure for obtaining approval, which may include the need to prepare and environmental impact statement for the proposed action (an action is defined in section 523 to include a project, development or undertaking or an activity or series of activities).

The EPBC Act is only relevant in relation to Aboriginal heritage sites if the site is entered onto the National Heritage List or the Register of the National Estate. None of these sites are located within the Project area.

2.1.2 Aboriginal & Torres Strait Islander Heritage Protection Act 1984

The Commonwealth *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* provides a mechanism for the Commonwealth Minister for Environment to make declarations regarding the protection of an Aboriginal area when the Minister is not satisfied that under State or Territory Law there is effective protection of the area from a threat of injury or desecration. Declarations made under this Act involve restricting activities and/or access to an Aboriginal site.

Under Section 21H of the *Aboriginal and Torres Strait Islander Protection Act 1984* it is an offence to conduct behaviour or partake in an action that contravenes a declaration made by the Minister. Penalties under this section are $10,000 or imprisonment for 5 years, or both for an individual, or $50,000 for a corporate body where an Aboriginal place is concerned and $5,000 and imprisonment for 2 years or both for an individual, or $25,000 for a corporate body where an Aboriginal object is concerned.

If the requirements of the South Australian Aboriginal Heritage Act are adhered to and sufficiently protect any Aboriginal heritage in the eyes of the Federal Minister, the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* will not be relevant for any cultural heritage site that may be in the Project area.

2.1.3 Native Title Act 1993

The Commonwealth *Native Title Act 1993* (NTA) is part of the Commonwealth's response to the High Court's decision in Mabo v Queensland (No.2) and adopts the common law definition of Native Title which is defined as the rights and interests that are possessed under the traditional laws and customs of Aboriginal people in lands and waters.

The NTA recognises the existence of Indigenous land ownership tradition where connections to country have been maintained and where acts of government have not extinguished this connection.

The following list is indicative of the type of land that might be subject to native title:

- Vacant Crown Land
- State forests
- National Parks
- Public Reserves
- Beaches and foreshores
- Land held by the government agencies
- Land held in trust for Aboriginal communities
- Any other public or Crown lands including oceans and inland waterways
- Pastoral leases

Under the amended NT Act, native title is extinguished by the following:

- Private freehold land,
- Valid grants of private freehold land or waters,
- Residential or commercial leases,
- Exclusive possession of leases,
- Mining dissection leases,
- Community purpose leases,
- Public works

2.2 SA State Legislation – Aboriginal Heritage

2.2.1 Native Title (SA) Act 1994

The act establishes a Register that must keep a register of native title and claims to native title in land in the State. The register is to determine whether the claim is to be registered. It is a requirement of this Act that when a developer is carrying out certain activities or development in areas where native title exists or may exist, the developer will need to consider the possible impacts of their actions on native title rights and interests. A search of National Native Title register Native Title Vision is presented in Table 2.

Table 2: Native Title Claims

Name	Tribunal No.	Status
Nukunu Native Title	SC1996/005	Accepted for registration

Contact information for the group was identified by DPC-AAR:

Nukunu Peoples Council Inc.

Chairperson: Doug Turner
Email: dmturner@internode.on.net
Mobile: 0421 612 236

2.2.2 Aboriginal Heritage Act 1988 (SA)

The South Australian *Aboriginal Heritage Act 1988* (AHA) is administered by the South Australian Department of Premier and Cabinet, Aboriginal Affairs and Reconciliation (DPC-AAR). This legislation

outlines that any Aboriginal site, object or remains whether previously recorded or not, are covered by the AHA. The Act provides the following definition of an Aboriginal site in Section 3.

“Aboriginal Site” means an area of land;

a) That is of significance according to Aboriginal tradition; and / or

b) That is of significance according to Aboriginal archaeology, anthropology or history.

The AHA states that it is an offence under Section 23 (s.23) of the AHA to ‘damage, disturb or interfere’ with an Aboriginal site, object or remains unless written authorisation is obtained from the Minister for Aboriginal Affairs and Reconciliation. Penalties for an offence under s.23 are up to $10,000 or six months’ imprisonment for an individual or $50,000 in the case of a corporate body. An owner or occupier of private land, or an employee or agent of such an owner or occupier, who discovers on the land an Aboriginal site or Aboriginal object must as soon as practicable report the discovery to the Minister. Penalties for an offence under s.20 are up to $50,000 for a body corporate and $10,000 or 6 months imprisonment for an individual.

It is also an offence under s.35 of the Act to divulge information relating to an Aboriginal site, object, remains or Aboriginal tradition without authorisation from the relevant Aboriginal group or groups. Penalties for an offence under this section are up to $10,000 or six months imprisonment.

The *Aboriginal Heritage Act 1988* is the most relevant piece of legislation for this particular project.

2.3 A State Legislation – European Heritage

2.3.1 Heritage Places Act 1993

The Heritage Places Act 1993 makes provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance in SA. A State Heritage Place is entered in the SA Heritage Register or contained within an area established as a State Heritage Area. Once registered, State Heritage Places are protected under the Heritage Places Act 1993 and the Development Act 1993.

The Heritage Places Act 1993 is governed by the Department of Environment and Water (DEW) and the South Australian Heritage Council. No Heritage Places related to the current Project area.

Under sections 26, 27 and 28 of this act it is an offence to carry out the following actions without a permit from the Council:

- Excavate or disturb a State Heritage Place designated as a place of archaeological significance; or remove archaeological artefacts from such a place.
- Excavate or disturb any land (not designated as a place of archaeological significance) for the purpose of searching for or recovering archaeological artefacts of heritage significance; or excavate or disturb any land (not designated as a place of archaeological significance) knowing or having reasonable cause to suspect that the excavation or disturbance will or is likely to result in an archaeological artefact of heritage significance being discovered, exposed, moved, damaged or destroyed.

- Damage, destroy or dispose of an archaeological artefact removed from a State Heritage Place designated as a place of archaeological significance (whether removed before or after the entry of that place in the Register) and to damage, destroy or dispose of an object entered in the Register (either as a provisional or confirmed entry).

Penalties for any offences under section 26, 27 and 28 of the Heritage Places Act 1933 are up to $75,000.

Under section 36 of the Heritage Places Act, a person who intentionally or recklessly damages a heritage place or engages in conduct knowing that it will or might destroy or reduce the significance to a State Heritage Place can be fined a maximum penalty of $120,000.

There is no penalty if damage results from an action authorised by an approval or authorisation under the Development Act 1993.

2.3.2 Planning, Development and Infrastructure Act 2016

The Planning, Development and Infrastructure Act 2016 (PDI Act) provides for matters that are relevant to the use, development and management of land and buildings, including the provision of a planning system to regulate development within the State, rules with respect to the design, construction and use of buildings, and other initiatives to facilitate the development of infrastructure, facilities and environments that will benefit the community. The PDI Act repeals the Development Act 1993 and will gradually come into operation over a five year period.

The PDI Act deals with planning and development measures in the State and specifically deals with any proposed activity which may materially affect a heritage place of either State or local significance. The PDI Act enables local councils to include places of local heritage value into a Planning and Design Code (To replace development plans). The Planning and Design Code will be a central feature of SA's new planning system, becoming the state's single planning rulebook for assessing all development applications. It will transform complex, inconsistent planning rules found within the 72 Development Plans into a single, easy-to-access set of rules that can be applied consistently across the State.

Approval must be obtained if a site or place on the State Heritage Register is to be affected. Places of local heritage value are listed in an inventory attached to the State Heritage Register.

Where construction is likely to take place in the vicinity of heritage listed places, and direct disturbance is possible, the client should seek advice from construction, vibration and sound engineers on mitigation measures that may be required, such as buffer zones to protect the integrity of the building or structure. Where disturbance is likely the client may also need a more detailed assessment of sub-surface deposits associated with historical buildings, such as an archaeological assessment.

Figure 2: Native Title within in the Project area.

3 BACKGROUND INFORMATION

In order to understand the archaeological context of an area it is important to have a good understanding of local environmental landscape features. Past and present environmental factors have an impact on the type, presence and location of cultural material.

3.1 IBRA

The Interim Biogeographical Regionalisation of Australia (IBRA) identifies geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. The bioregions are further refined into subregions and environmental associations (DEWNR 2011). The Project area is located within the Eyre Yorke Block IBRA Bioregion, the St Vincent IBRA Subregion and the Nurom (to the southwest) and Glendella (to the northeast) IBRA Environmental Associations Table 3

Table 3: IBRA bioregion, subregion, and environmental association environmental landscape summary.

Eyre Yorke Block IBRA Bioregion	
Archaean basement rocks and Proterozoic sandstones overlain by undulating to occasionally hilly calcarenite and calcrete plains and areas of Aeolian quartz sands, with Mallee Woodlands, Shrublands and Heaths on calcareous earths, duplex soils and calcareous to shallow sands, now largely cleared for agriculture.	
St Vincent IBRA Subregion	
Most of this region consists of with calcrete development and shallow reddish earths. The plain is mainly dune free but isolated areas are overlain by low indistinct sand dunes. Near the Mt Lofty Ranges the plains have a definite westerly gradient and merge eastwards with the alluvial fans from the Mt Lofty Ranges. Moderately deep Red Mallee / Yorrell (*Eucalyptus socialis, E. gracilis*) association occurs throughout the region with some woodland of *E. porosa* on the plains or *E. odorata* on the hills and footslopes. The subregion has been extensively cleared and sown to crops or exotic pastures so little of the natural vegetation remains. What does remain exists on road verges and a few isolated blocks.	
Remnant vegetation	Approximately 8% (87,402 ha) of the subregion is mapped as remnant native vegetation, of which 5% (4,732 ha) is formally conserved.
Landform	Alluvial and littoral plains with NW-SE longitudinal dunes mainly stabilized in isolated areas. Near the Mt Lofty Ranges the plains have a detritic westerly gradient and merge eastwards with the alluvial fans of the ranges.
Geology	Calcrete development; some variably oriented dunes in north west of unit beyond Port Augusta. Calcareous loams. Clay rich soils, both plastic & cracking varieties.
Soil	Cracking clays, brown calcareous earths, highly calcareous loamy earths, plastic saline clay soils, hard setting loamy soils with red clayey subsoils.
Vegetation	Mixed Chenopod, Samphire or Forblands.
Conservation significance	125 species of threatened fauna, 103 species of threatened flora. 5 wetlands of national significance.
Nurom IBRA Environmental Association	
Remnant vegetation	Approximately 5% (1,740 ha) of the association is mapped as remnant native vegetation, of which 0% (0 ha) is formally conserved.
Landform	Gently undulating calcrete plain with extensive sand sheets or longitudinal dunes.
Geology	Sand and calcrete.
Soil	Crusty red duplex soils and brown calcareous sands.

Vegetation	Open scrub of beaked Red Mallee and Yorrell and Chenopod Shrubland of Saltbush.
Conservation significance	2 species of threatened fauna, 1 species of threatened flora. 1 wetlands of national significance.
Glendella IBRA Environmental Association	
Remnant vegetation	Approximately 28% (12,641 ha) of the association is mapped as remnant native vegetation, of which 13% (1,702 ha) is formally conserved.
Landform	Coalescing alluvial fans, extending from low hills onto a narrow sandy plain with tidal flats on the coastal margin.
Geology	Gravelly alluvium, alluvium, sand and quartzite.
Soil	Hard pedal red duplex soils, red calcareous earths, red friable loams and black non-cracking plastic clays.
Vegetation	Open scrub of Beaked Red Mallee and Yorrell, Chenopod Shrubland of Saltbush and Bluebush, Chenopod Shrubland of Samphire and Low Woodland of Mangroves.
Conservation significance	28 species of threatened fauna, 25 species of threatened flora. 1 wetlands of national significance.

3.2 Climate

The nearest long-term climate data was sourced from Georgetown weather station, which is approximately 34 km east / south east of the Project area. Rainfall and temperature data are indicative that the region surrounding Bungama experiences a Mediterranean climate, with cool wet winters and hot dry summers. Changes of weather are generally associated with frontal systems from southwest in the Spencer Gulf. These frontal systems are most active in winter and spring and bring reliable and frequent light to moderate rainfall. Annual average rainfall is 474.7 mm. The majority of the rainfall occurs during winter with the highest falls in June (average 58.4 mm) and July (average 57.2 mm). The mean minimum temperature ranges from 4.2°C (July) to 15.2°C (February) and the mean maximum temperature ranges from 14.2°C (July) to 31.1°C (January) (Figure 3).

Rain shapes almost all human activity in Australia. The deviation from the average and the cycles of prolific rain, which the early settlers of this region convinced themselves were normal, followed inevitably by years of drought, have shaped the economy and the way of life of the region for over 160 years (Austral Archaeology 2000).

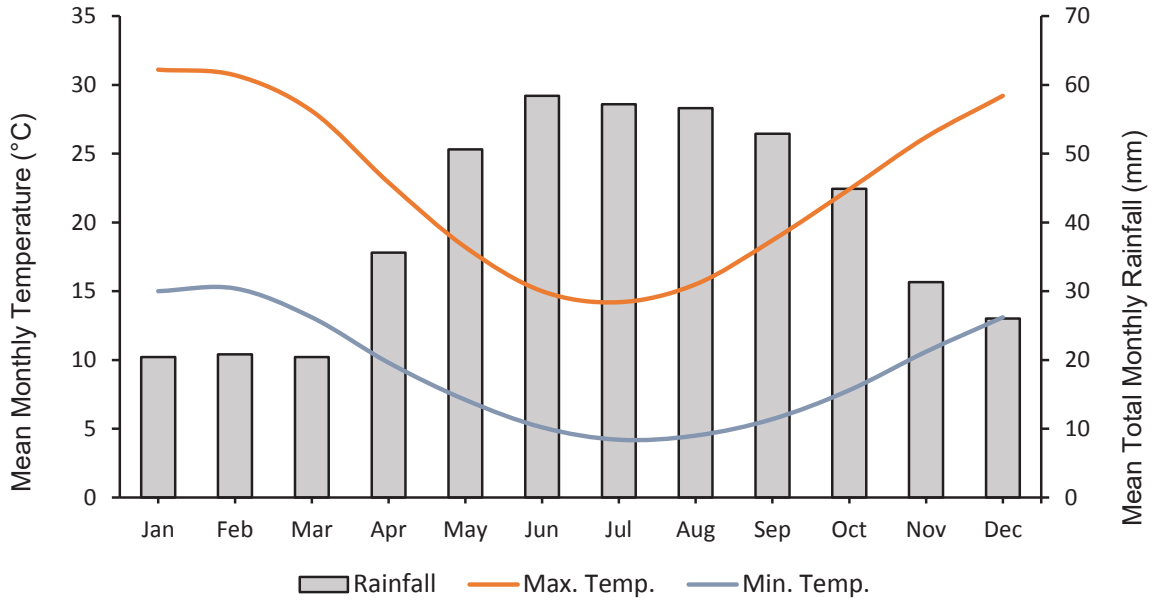

Figure 3. Mean total monthly rainfall and mean monthly maximum and minimum temperatures recorded Georgetown (station no. 21020), located 33.9 km ESE of the Project area (BOM 2018).

3.3 Soil Landscape Information

The Project area is predominantly located within plains and gentle slopes with mainly deep calcareous soils and dune / swale systems with unbleached neutral to alkaline PH sand with calcareous subsoils on dunes (Figure 4). Most descriptions of the soil within this Project area note a deep subsoil and connections to the coastal dune environment. Neutral soils are more conductive to decomposition than acidic or alkaline soils. This is important because certain soil landscapes, such as this one, have a higher risk of containing and preserving cultural material.

3.4 Hydrology

When looking at an area it is important to take into consideration the natural water sources in the region and how these would have affected the occupation of the area by past peoples. The most major waterway in the area is the Port Pirie River and its associated estuary, which is just west of the current Project area. The Port Pirie River is a tide dominated tidal flat / creek. Although this is not a freshwater source, it would have provided a food source for people living in the area. The second most important waterway is the Broughton River and the Broughton catchment area. The Broughton catchment is the major drainage system in the district and covers around 5761 Km^2 (NYNRSMB 2018). There are also a number of drainage lines that run down from the southern Flinders Ranges into the Project area (Figure 5 and Figure 6).

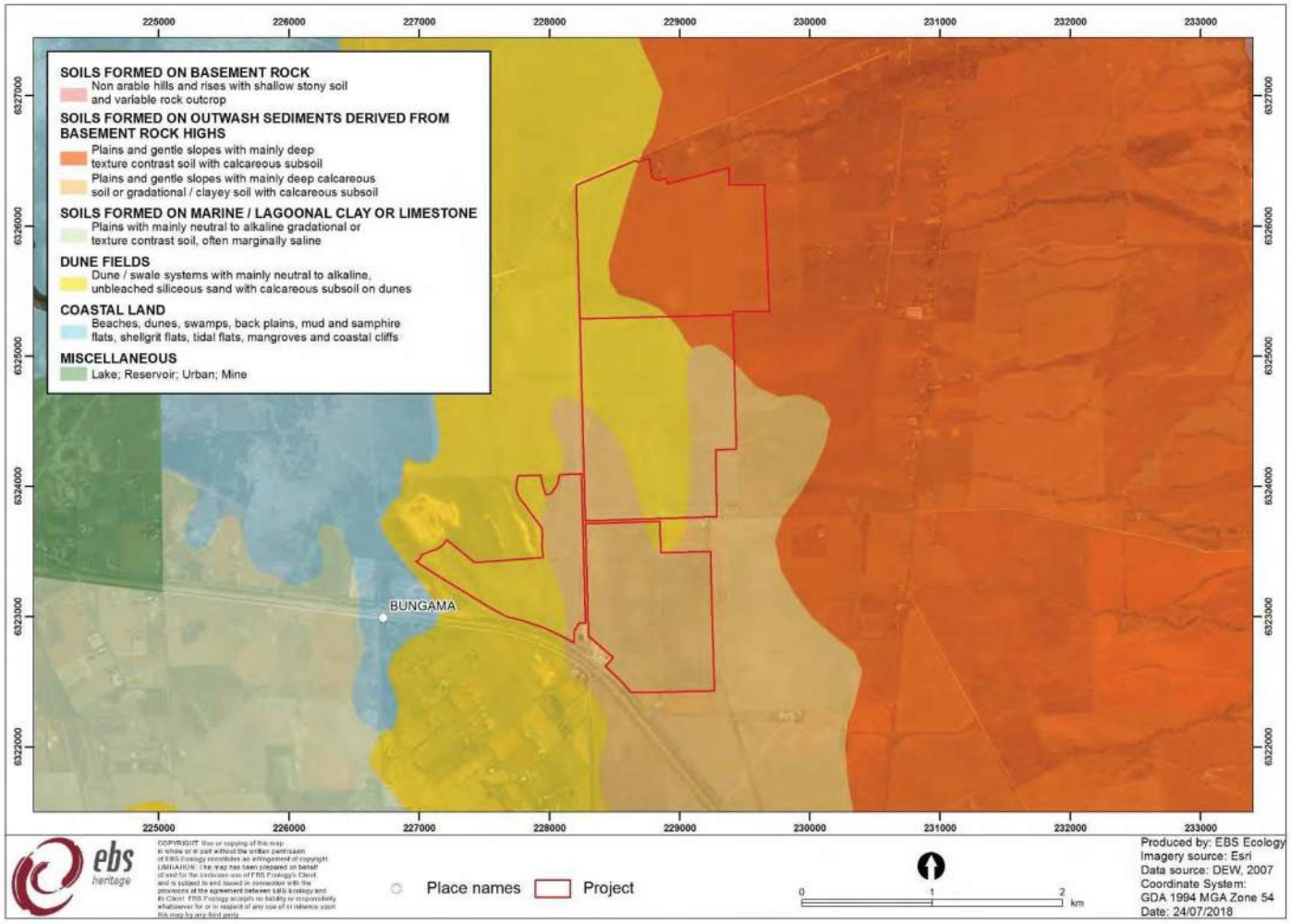

Figure 4: Soil landscape in the Project area.

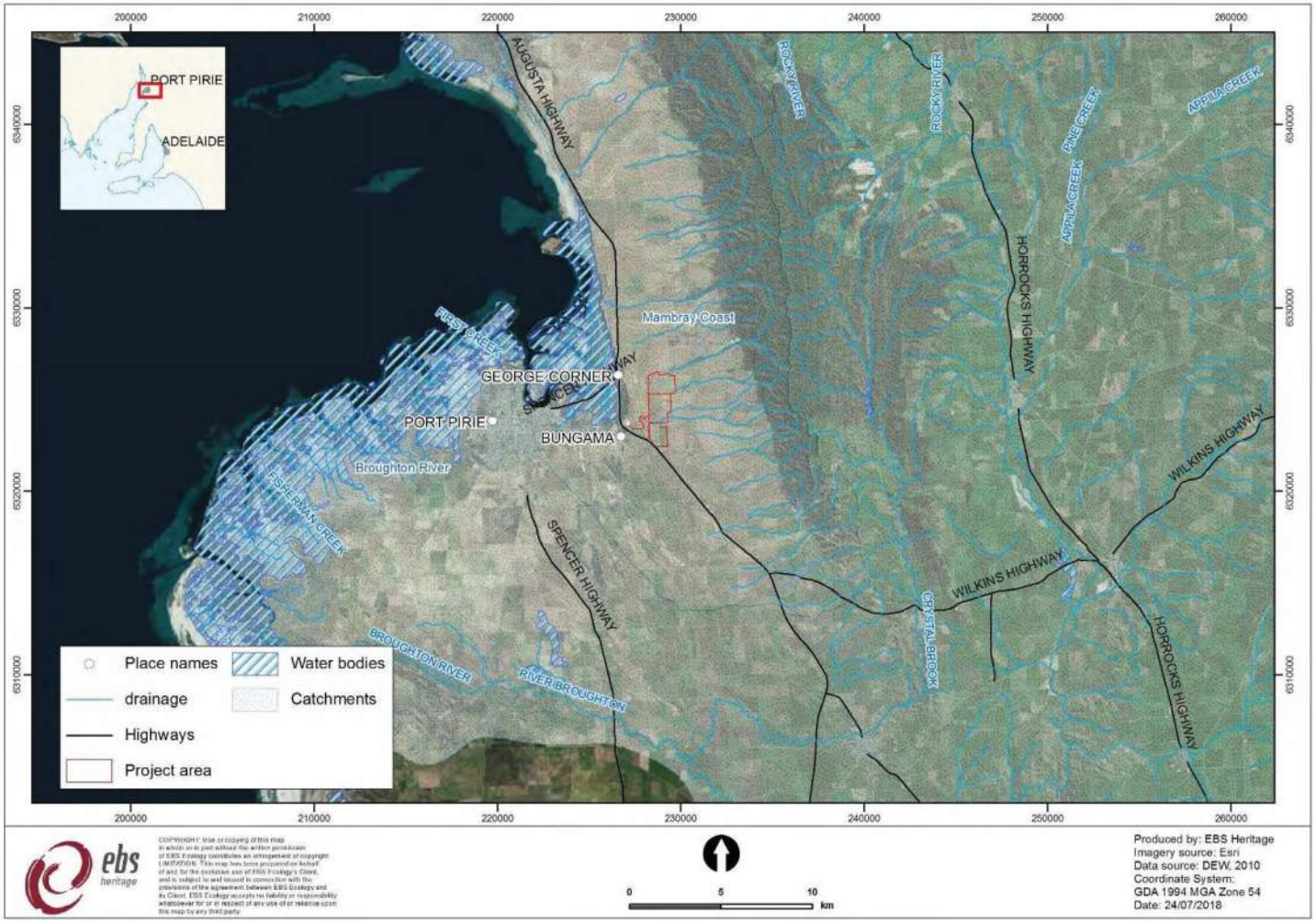

Figure 5: Hydrology in the local area.

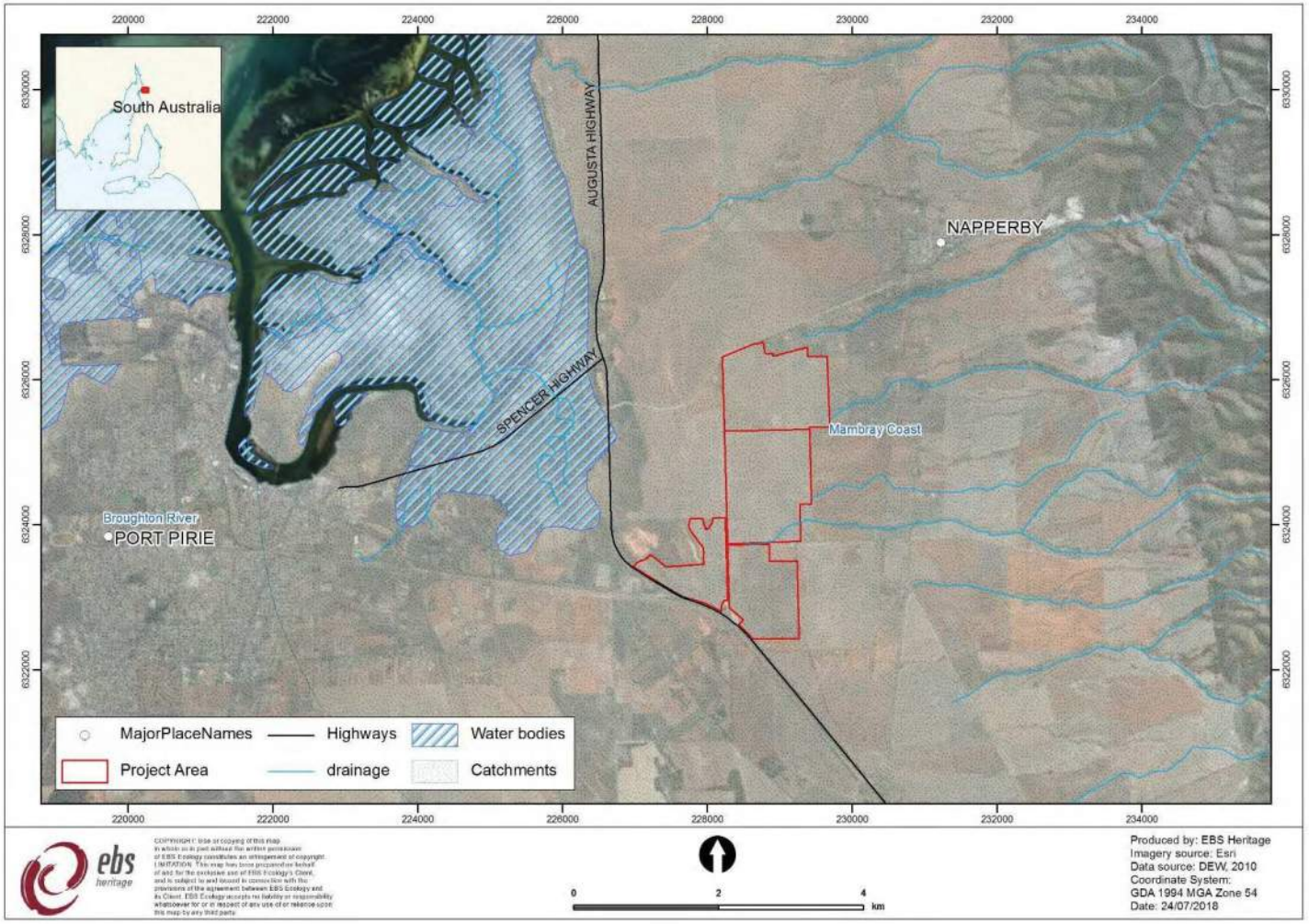

Figure 6: Hydrology in the Project area.

4 DESKTOP ASSESSMENT METHODS

The heritage desktop assessment was conducted to assess the risk of encountering any Aboriginal sites within the Project area. This was achieved by undertaking the following:

4.1 DPC-AAR Register Search

EBS completed a search of the Central Archive and Register of Aboriginal Sites and Objects maintained by DPC-AAR. This search identified any previously recorded sites (as defined under Part 1, Section 3 of the *Aboriginal Heritage Act 1988* (AHA)). Not only does the DSD-AAR search provide a list of sites within the Project area, it also provides an indicator of the types of sites found in the region. The results can be found in Section 7.1.

4.2 Archival Research

EBS undertook searches to find any available information regarding early land use and European heritage items within the Project area. Searches were conducted of the:

- the Australian Heritage Database (World Heritage list, National Heritage list, Commonwealth heritage list, the register of the National Estate and places under consideration);
- the SA Heritage Places Database (State, Territory and Commonwealth heritage places);
- the South Australian Museum Database (SAM);
- the Australian Heritage Photographic Library; and
- Local council development plans.

EBS conducted research at the SA archives for archival information such as images, newspaper clippings, journal entries and other primary sources that may contain information on the early uses of the area and early interactions between Aboriginal people and European colonialists. The results from this research can be seen in Section 5 and 7.

4.3 Previous Work / Consultancy Reports

EBS undertook a review of any available heritage reports / works previously carried out in the area and general region, where available and applicable. Section 6 of this report summarise those relevant projects.

4.4 Cultural Heritage Risk Assessment

EBS undertook a risk assessment of the Project areas to assess the likelihood of the project impacting environmental landforms most commonly associated with cultural heritage sites. Coupled with the desktop research, EBS prepared a detailed maps showing areas of high, moderate and low risk for encountering cultural heritage sites. Section 8 presents this information.

4.5 Limitations

The search results of the Department of Premier and Cabinet – Aboriginal Affairs and Reconciliation (DPC-AAR) (Formally the Department of State Development – Aboriginal Affairs and Reconciliation (DSD-AAR)) central archive search results are provided only as a guide and is not an extensive list of all heritage items within an area.

5 BACKGROUND RESEARCH

5.1 Aboriginal Occupation

5.1.1 Nukunu

In 1974 Norman Tindale published a detailed map of Aboriginal tribal boundaries at the time of European contact based on tribal boundary research in the 1930's (Figure 7). The *Nukunu* territory was identified by Tindale to stretch from the eastern side of Spencers Gulf from a little north of the mouth of the Broughton River and vicinity of Crystal Brook, northward to Port August (Hercus 1992; Tindale 1974; Field & Morley 2014).

Tindale wrote of the Nukunu:

> ***Location:*** *Eastern side of Spencer Gulf from a little north of the mouth of the Broughton River and vicinity of Crystal Brook northward to Port Augusta; east to Melrose, Mount Remarkable, Gladstone, and Quorn; at Baroota. The Ngaiawang of the Murray River used the term Nulonno as name of a fabulous Being who went about at night killing people. The Kaurna tribe term ['nokun: a] has a meaning of an imaginary being, like a man, who prowls at night and kills, an assassin (Teichelmann and Schurmann 1840). The Nukunu were the southeasternmost tribe to practice subincision, in addition to circumcision, as a male initiation rite. Pangkala men used the pronunciation ['Nukuna] for the name. The few survivors are settled at Baroota inland from Port Germein where they are known as the Barutadura.*
>
> ***Coordinates:*** 138º10'E x 32º55'S.
>
> ***Area:*** *2,200 sq. .m. (5,700 s. km.).*
>
> ***Alternatives:*** *Wongaidja (valid alternative), Nukuna, Nukunnu, Nugunu, Nookoona, Nukunna, oocoona, Nokunna, Nuguna, Pukunna (misprint), Wongaidja, Wongaiydya, Tura ['tura] = man), Tyura, Doora, Eura (general term for several tribes), Warra (name of language), Barutadura (men of Baroota)..*
>
> Tindale 1974

Elkin's (1934-1938) work showed that the *Nukunu* people were the south eastern most of those people who had a matrilineal kinship system and used the terms *Mathari* and *Kararru* for their moieties (Elkin 1934-1938). *Nukuna* had social, cultural and ceremonial interest in the Port Augusta region and shared strong bonds with other neighbouring groups like the *Kokatha*, *Barngarla* and the *Adyamathanha*. These bonds included similar social systems, possibly shared ceremonies and a similar language.

The *Nukunu* language is closely related to the neighbouring *Nharangka, Kaurna* and *Ngadjuri* groups and is one of the languages sometimes collectively called the *Thura-Miru* The languages from around Port Augusta also have similarities with those the Gawler Ranges. Margot Barefoot noted that many *Nukunu* words had close associations with a number of *Wirangu* words (Hercus 1992, Field & Morley 2014). Hercus and Simpson wrote:

"O'Grady (1966) claimed that the languages of central and southern Australia surrounding Spencer's Gulf and the Gulf of St Vincent form a subgroup, dubbed 'Yura'. These languages include at least Barngala, Nukunu, Narrangu, Kuyani, Ngadjuri, Adnyamathanha and Kaurna, with Nauo and Wirangu as possible outliers. We support this supposed subgroup by reconstruction of an ancestral case system for those languages for which inflectional data is recorded (Barngala, Nukunu, Kuyani, Adnyamathanha, Kaurna and Wirnagu)."

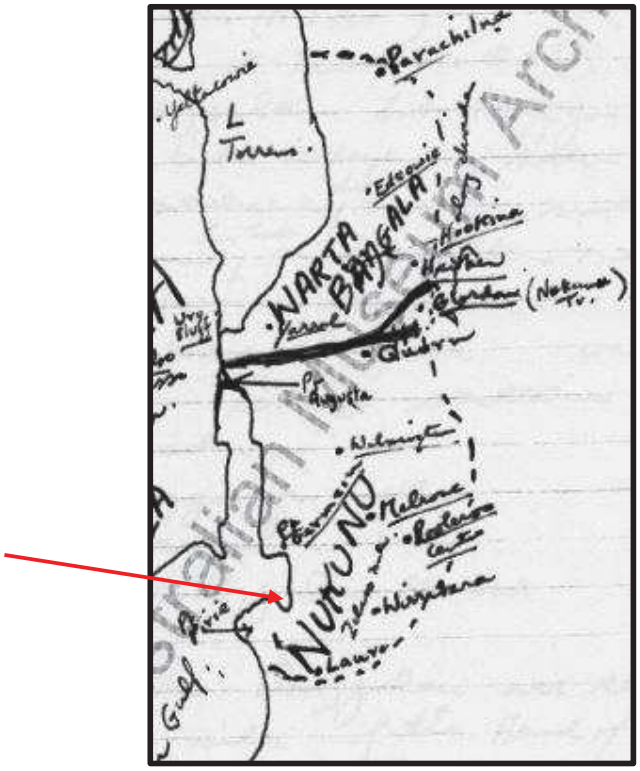

Figure 7: Nukunu territory (red arrow indicating the current Project area) (Tindale 1938-1939).

5.1.2 Ethnographic Background

Note: Information provided in this section is brief so as to not offend Aboriginal cultural tradition.

Occupation of this area has been expressed throughout the landscape in complex tangible (physical) and intangible (not physical) locations of significance. Myths associated with the constellations known as the Pleiades and Orion, are the most widely recorded in the world. In Australia, these myths can extend across the entire country, crossing the boundary of a number of tribal groups. These myths are generally associated with Dreamtime Beings and can be dived into several categories, which can be restricted depending on a person's gender and tribal association. For this reason information about these stories is not often published and is still considered highly sensitive for Aboriginal people (Field *et al.* 2014). Archaeological sites represent tangible connections to country where as dreaming stories and song lines represent an intangible connection between people and certain places. Stanner (1991) stated in his work that this creates a '*…interrelated responsibility between people and country…*'

Several important Ancestor Creation (or Dreaming) stories travel through the region, linking the local tribal groups through ceremony and ritual (Field *et al.* 2014; Walshe 2005). A number have been recorded previously including the "Seven Sisters", "Willuroo Man", "Moon", "Native Cat" and "Urumbula" song lines.

Tindale wrote a definitive description of the Kungkarungkara or "Seven Sisters" myth:

> *In Western Desert lore the Pleiades and the Morning Star are ancestral Women Beings…They climbed into the sky and became stars to escape the attentions both of a man named Njiru, and of his son Jula. These women attacked Njiru with packs of dogs that they kept as their protectors. In the sky of autumn, the early morning appearance of the Pleiades, low down in the east, marks to beginning of the aboriginal New Year and the commencement of the season when dingo dogs (papa) give birth to their young. Since these pups serve as food for men, Increase Ceremonies for the dingo are a feature of the autumn season. The stories of the would-be virgin women are made complex because the names of some of the principal beings are changed and even become transposed in some tribal versions of the story (Tindale 1959: 305).*

The Kungkarungkara women are then believed to have fled south and Tindale stated that Jangkundjara senior men told him that they understood that the Kungkarungkara women went south into:

> *…the Pangkala territory near Port Augusta with Njiru still in pursuit. They have the idea that the Beings made a circuitous eastward journey returning again to the north. During the journey Njiru and the Kelilbi (Star Women) are supposed to have visited a big jabu (hill) beside the sea, south and east of Port Augusta… (Tindale 1959: 321).*

Work done by Hagen has also stated that accounts given to him by various informants does confirmed that the Kunkaralinya or "Seven Sisters" story refers to starting in Port Augusta. Hagen stated:

> *Arcoona the sisters travelled to the west, creating the sand-hills in the Phillip Ridge area, and at the site of the proposed new town (see Mountford, 1976 for an analogous version from parts of Central Australia). They travel on through Lake Blanche (Matlumpa), heading towards Kingoonya, then turn to the north-east, towards Stuart Ck…They travel to a place west of Fregon…This track also passes through the Cane Grass Dam area according to my informants* (Hagen 1983, Field *et al.* 2014).

The "Urumbula" story line is of interest to this Project area, as it travels from Port Augusta north to the Gulf of Carpentaria in the Northern Territory. This story line is concerned with the travels of the Malbunga, or the Native Cat and his followers. (Field *et al.* 2014; Gara 1989; Hercus & Potezny 1996; Walshe 2005).

Louise Hercus has also made mention of another creation story in their work, related to the salty lakes above Spencers Gulf. Hercus was told by Nukunu man Gilbert Bramfield that:

> *An Ancestor from Pt Germain [Germein] made that kangaroo bone and made that sea right through (he carved out Spencer Gulf). The bloke that went this way with his kangaroo bone he broke it at Pt Augusta, and then he was digging with a really short stumpy one and made all these lakes all the way through (the salty lakes up from Pt Augusta) (Hercus 1992: 16).*

5.1.3 Language

Connections between the languages of the people of the Gawler Ranges and the Port Augusta area have been identified (Austral Archaeology 2000, Field *et al.* 2014; O'Grady *et al* 1966). Hercus and Simpson wrote:

> *O'Grady (1966) claimed that the languages of central and southern Australia surrounding Spencer's Gulf and the Gulf of St Vincent form a subgroup, dubbed 'Yura'. These languages include at least Barngala, Nukunu, Narrangu, Kuyani, Ngadjuri, Adnyamathanha and Kaurna, with Nauo and Wirangu as possible outliers. We support this supposed subgroup by reconstruction of an ancestral case system for those languages for which inflectional data is recorded (Barngala, Nukunu, Kuyani, Adnyamathanha, Kaurna and Wirnagu).*

5.1.4 European contact and historical research

Specific ethno-historical data on the region is limited. Two early accounts of European expeditions into the area are from Eyre in 1839 and Sturt in 1844. The Eyre (1845) expedition passed the region to the west and Sturt (1849) (Sturt and Waterhouse 1984). Both expeditions failed in their purpose seeking the centre of the continent. Journal accounts of both explorers display little contact with Aboriginal people, even though the area supported large numbers of Aboriginal people. Eyre writes:

> *"In going up the watercourse I again found a native fire, where the natives had been encamped within a mile of us during the night, without our being aware of it..."* (Eyre 1845:93).

There are little other written records of contact between European settlers and Indigenous land owners in the Upper North. There were Aboriginal employees in many of the pastoral runs and stations. In 1853 a magistrate did report that:

> *"The natives in the northern settlements are very bold and troublesome…" (J.W Macdonald to Colonial Secretary 31 January 1853).*

5.2 European Settlement History

The history of European settlement within SA, or Adelaide, had its beginning in 1836 when Colonel William Light (the inaugural surveyor-general for the colony of South Australia) undertook a survey of the Adelaide plains to identify a suitable location for the future capital city. Before Adelaide was first surveyed, Captain Mathew Flinders, sailed his ship the *Investigator* into the head of Spencers Gulf on the 21 February 1802. This was one of his many stops made during his discovery and circumnavigation of Australia. The gulf was named by Flinders in honour of the First Lord of Admiralty, George John the Second Earl Spencer (Flannery 2000). By March the 10th 1802 Flinders' party had already ascended a nearby peak, now named Mount Brown, which is located 75 km north of the current Project area (Walshe 2005).

When the Province of South Australia was established in 1834 by an Act of British Parliament, provisions were made for local government when the colony's population passed 50,000. That figure was reached in 1849, but the first attempt of establishing local government outside of Adelaide was made in the form of District Boards of Roads, based on the surveyed Hundreds. By the 1850s the South Australian government had established a standard hierarchy of Counties, Hundreds, rural sections and town allotments. By 1860 no land could be sold unless located within a proclaimed County and Hundred (Susan 2012).

SA was settled during a time when humanitarian principles were being spread in England. Due to this it was thought that Aboriginal people, particularly in SA, would be treated more humanely. In the first annual report in 1836 made by SA Colonisation Commissioners it was remarked that the subject of Aboriginal rights can "…*be regarded as of first importance in the formation of the new settlement of South Australia"*. They stated that:

> "…*colonisation of South Australia will be an advert of mercy to the native tribes… [In Australia] they are now exposed to every species of outrage and treated like cattle of the fields; they will in future be placed under the protection of British laws, and invested with the rights of British subjects".*

The Commissioners also made plans to occupy land only by agreement with the Aboriginal inhabitants; with it also being proposed that one-fifth of every 80 acres section of the land be *"… resumed as a reserve for the use of the Aborigines, and the remaining four parts, or 64 acres, to remains with the proprietor as his freehold."* Small pockets of land were also suggested to be designated within settled areas as refuges for Aboriginal people. However, these proposals conflicted with the SA Colonisation Act of 1834, which was to regulate land sales in SA. Governor Hindmarsh and Commissioner Fisher ignored the 1836 suggestions by the Colonisation Commissioners. Not until the passing in 1842 of the Waste Lands Act that the Governor could start to put aside land for the benefit of the Aboriginal people. By 1860 over forty reserves has been declared. After 1860 it was argued that the Aborigines were not properly using the land put aside for them and it was subsequently resumed and then leased or sold to European settlers.

By 1915, only two kinds of land remained for Aboriginal use in settled areas. First, very small pockets of land unwanted by Europeans and second, relatively substantial areas, often land considered to be poor or unsuitable for European use, were owned or leased by missionary societies. This land was leased to mission societies for the 'benefit of Aborigines' rather than being granted directly to them (Atlas 1986).

Below is a table highlighting the general chorology of the current Project area (Table 4).

Table 4: General Chorology of the local area (Austral Archaeology 2001, Walshe and Bonnell 2003, Wood 2009a).

Date Range	Event
1802 – March	First Europeans in the region on the ship HMS *Investigator.*
1802 – April	French explorer Nicolas Baudin charted the gulf on the ship *Le Geographe.*
1839	Edward John Eyre set out from Adelaide north to Mount Arden.
	Anlaby on the Light River had been taken up by pastoralists.
1840	Edward Eyre again went north from Adelaide in search of grazing lands and instead located the chain of salt lakes known as Torrens, Eyre, Blanche, Callabinna and Frome.
	John Ainsworth Horrock followed northward through the region.
1842	Deputy Surveyor-General Thomas Burr and Inspector Alexander Tolmer led an expedition north.
	John Hallett is believed to have been the first to bring sheep into the Hallett district. He made a selection of land in the Hallett district, named Willogoleeche.
	The *Act to Protect the Waste Lands of the Crown from Encroachment, Intrusion and Trespass* was passed. This was as a result of impatient graziers driving their flocks out beyond the surveys and occupying land without legal entitlement. This created Occupation Licences to give pastoralists renewable tenure of land which was identified by a system of landmarks rather than a formal survey.
1840s.	John Bristow established Bundaleer Station. This run extended from the Broughton River in the south to Mount Lock in the north and comprised an area of 799 square kilometres.
1843	Surveyor-General Edward Frome continued the search for pastoral lands in the north.
	John Bristow Hughes taken up Bundaleer Run straddling the Broughton River.
1844	William Younghusband and Peter Ferguson took up Crystal Brook.
	John Jacob and William Jacob took up Beetaloo Run, Samuel White and Fredrick White took up the Charlton Run near Wirrabara and Herbert Hughes took up the run adjacent to his brother John Hughes at Booyoolee.
1845	John Pirie during his voyage discovered Port Germein. His voyage was at the request of William Younghusband in search of a port for his Crystal Brook Run. For a while it was called Hammocks Harbour but soon became Port Pirie.
1847	Bundaleer, Booyoolee and Crystal Brook runs were shipping their wool from Port Pirie.
1849	A private town was surveyed at the anchorage known as Port Pirie and in November allotments were offered at auction.
1850s	Most of the suitable grazing land was taken up.
1865	Joseph Gilbert took over Willogoleche and Mount Bryan stations.
1869	*Strangways Act* was passed through parliament. Here were vast changes to what became known as the North Agricultural Areas. During the following years the whole of the area was resumed by the Government and surveyed into farms with an average size of 130 hectares. The large sheep

Date Range	Event
	runs in the region were subsequently broken up and made available to small farmers. Many of the smaller farmers used their newly acquired land for wheat growing. By 1875, 400,000 hectares of land were under wheat.
	Within months of the *Strangways Act* towns were established.
	The towns of Georgetown and Redhill were drawn up.
1870	The towns of Hallet and Yacka were surveyed.
	The railway reached the mining town of Burra.
1871	The towns of Caltowie, Jamestown, Laura and Narridy were drawn up and surveyed.
	The Port Pirie that we know of today was surveyed along the Port Pirie river. It became one of the very few SA towns to have curved streets.
1872	Appila, Boroota and Gladstone are established.
1874	Gulnare, Nelshaby, Pekina, Stone Hut, Yarcowie, Wirrabarra and Yatina were established. Nelshaby is 6 km north of the current Project area.
1875	Crystal Brook, Lake View, Koolunga and Tarcowie were established.
	The first railway line from Port Pirie through Crystal Brook Gap to Peterborough. The line was extended to Gladstone in 1876, Caltowie in 1878 and Jamestown in July 1877. A line was built from Burra to Hallett in 1878.
1876	The towns of Orroroo, Spalding, Wilmington and Yongala were drawn up.
	After passing the Act to Encourage the Planting of Forest Trees, the first seedlings were grown at Bundaleer, south of Jamestown.
1877	Huddleston, Lancelot, Mannanarie, Morchard and Warnertown were established. Warnertown is 4 km south east of the current Project area.
1878	Booleroo, Hornsdale, Port Germein, Terowie and Willowie were established.
25 July 1878	Corporation of Jamestown was proclaimed. The town was named after the then Governor of South Australia, Sir James Fergusson.
1879	Amyton and Hammond were established.
1881	Jamestown had a population of 995.
1880s	Franklyn, Merriton and Petersburg were established.
	The wheat farmers of Jamestown and district formed the Farmers' Co-operative Union. It heralded the start of a number of well-known brands including Farmers Union, Southern Farmers, Safcol and Fine Foods.
29 June 1885	Land grant of CT 5949/272, (section of the current Project area) was given to labourer John Keane of Spencer Street Adelaide.
1902	Land grant of a portion of CT 6037/29 (section of current Project area), was granted to William George Hendrt.
1903	Transfer of CT5954/187 (section of current Project area) to Thomas Henry League a farmer.

Through examining the contextual history of the Project area a number of historical themes relating to the occupational history have been identified. Historical sites located within the Project area, if discovered, would relate to the national, SA and local historical themes presented within Table 5.

Table 5: Australian, SA and Local Historical themes relevant to the Project area.

Australian Theme	State Theme	Local Theme	Examples
Peopling Australia	Aboriginal Cultures and interactions with other cultures	Activities associated with maintaining, developing, experiencing and remembering Aboriginal cultural identities and practises, past and present; with demonstrating distinctive ways of life; and with interactions demonstrating race relations.	Place name, camp site, midden, fish trap, trade route, massacre site, missions and institutions, pastoral workers camp, timber mill settlement, removed children's home, town reserve, protest site, places relating to self-determination, keeping place, resistance & protest sites, places of segregation, places of indentured labour and places of reconciliation.
Developing local, regional and national economies	Agriculture	Activities relating to the cultivation and rearing of plant and animal species, usually for commercial purposes, can include aquaculture.	Hay barn, wheat harvester, silo, dairy, rural landscape, plantation, farmstead, shelterbelt, silage pit, fencing, plough markings, shed, irrigation ditch and Aboriginal seasonal picking camp.
	Commerce	Activities relating to buying, selling and exchanging goods and services.	Trade routes, Aboriginal trading places, Aboriginal ration/blanket distribution points and Aboriginal tourism ventures
	Communication	Activities relating to the creation and conveyance of information.	Telegraph equipment, network of telegraph poles, track and airstrip.
	Events	Activities and processes that mark the consequences of natural and cultural occurrences.	Monument, flood marks, memorial, blazed tree, obelisk, camp site, place of pilgrimage, places of protest, demonstration, congregation and celebration.
	Exploration	Activities associated with making places previously unknown to a cultural group known to them.	Explorers route, marked tree, camp site, mountain pass, water source, Aboriginal trade route and landing site.
	Pastoralism	Activities associated with the breeding, raising, processing and distribution of livestock for human use.	Pastoral station, shearing shed, slaughter yard, homestead, pastoral landscape, common, fencing, grassland, well, water trough, freezer boat shipwreck and wool store.
	Transport	Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements.	Highway, lane, stock route, footpath, radar station, toll gate, horse yard and coach stop.

Australian Theme	State Theme	Local Theme	Examples
Building settlements, towns and cities	Land tenure	Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal.	Fence, survey mark, subdivision pattern, boundary hedge, stone wall, shelterbelt, cliff, river, seawall, rock engravings, shelters & habitation sites, cairn, survey mark, trig station and colonial/state border markers.
	Utilities	Activities associated with the provision of services, especially on a communal basis.	Water pipeline, sewage tunnel, gas retort, powerhouse, garbage dump, windmill, radio tower, bridge, culvert, weir, well, cess pit, reservoir, dam, places demonstrating absence of utilities at Aboriginal fringe camps.
Working	Labour	Activities associated with work practises and organised and unorganised labour.	Shearing shed.
Developing Australia's cultural life	Persons	Activities of, and associations with, identifiable individuals, families and communal groups.	A monument to an individual, a family home, a dynastic estate, private chapel, a birthplace, a place of residence, a gendered site, statue, commemorative place name and place dedicated to memory of a person.

6 PREVIOUS HERITAGE WORK

6.1 Accessible

A number of cultural heritage studies have been undertaken for various development projects in the area. However, information relating to some of these reports is limited due to the fact that a letter from the relevant Indigenous organisations is required to get more detailed access to the database of reports held by DPC-AAR. Some details of these studies are provided in Table 6 and Table 7.

6.1.1 Port Augusta region

Table 6: Archaeological studies undertake north of the Project area (Port Augusta).

Year	Author	Description
2005	Draper, D. Mott, D & J. Mollan	In 2005, ACHM was engaged by ElectraNet to undertake an Aboriginal Cultural Heritage Survey for the proposed Davenport Substation Expansion with representatives of the Barngarla people. A previously recorded archaeological site was re-assessed and the boundary was revised. Monitoring was undertaking and two areas were classified as sensitive landforms. Recommendations for further monitoring were also made by the Barngarla.
2005	Wood, V. & Fitzpatrick, P.	Vivienne Wood Heritage Consultant Pty Ltd was engaged by ElectraNet to undertake heritage assessment. Vivienne Wood and Phil Fitzpatrick undertook two field studies of the proposed Davenport Substation near Port Augusta. The field studies were undertaken with representatives of the Nukunu people. The recommendations from the survey were that the works could proceed with a number of restrictions. Monitoring was recommended for a number of locations, along with salvaging of cultural material, with the exception of skeletal remains. This assessment also predicted that there would be a high potential for pre-contact artefact scatters and / or campsites and for mythological sites and a lower potential for stone arrangements, painting or engraving sites.
2008	Mott, D.	ACHM carried out an Aboriginal cultural heritage survey of two truck parking bays and one turning lane, at Warnertown (4 km south east of current Project area) and Winninowie (66 km north of current Project area). A field survey was conducted along with representatives of the Nukunu. No Aboriginal archaeological or anthropological sites were identified within the Project areas. Recommendations were made that Aboriginal monitors be present for any excavation works and that any new borrow pits would require further assessment.
2014	Field M. & A. Morley	ACHM was engaged by DP Energy Australia Pty Ltd, to undertake an anthropological and archaeological heritage survey of the proposed Port Augusta Renewable Energy Park. A total of five registered archaeological sites were located within 1 km of the survey area. During the anthropological survey, it was determined that the survey area was clear of anthropological significance. However, several areas within the survey area were deemed to be of higher risk of containing Aboriginal heritage sites. These areas included ephemeral and permanent water sources and watercourses, sand dunes and areas of undisturbed native vegetation. The recommendations from this assessment were that an archaeological pedestrian cultural heritage survey be

Year	Author	Description
		undertaken prior to the commencement of ground disturbance work for the entire projects footprint and a Cultural Heritage Management Plan should be developed to provide for long term management of heritage sites for those sites not subject to a Section 23 application to destroy.
2017	EBS Heritage	EBS Heritage was engaged to undertake an Archaeological and Anthropological assessment for a proposed Solar Project located near Port Augusta, in SA. The field surveys were carried out by EBS staff, members of the Barngarla Determination Aboriginal Corporation (BDAC) and a representative of the UQ Cultural Heritage Unit. During the assessment a total of five archaeological sites were recorded, all of which were artefact scatters with four containing potential archaeological deposits. The survey team also located eight isolated artefacts of silcrete and quartz. A total of 15 other areas were identified as important to the BDAC representatives.
2017	EBS Heritage	EBS Heritage was engaged to undertake a desktop assessment and heritage survey of a proposed pipeline route located near Port Augusta. The desktop assessment assessed that there was a moderate to high level of impacting Aboriginal sites. There were also two registered sites in close proximity to the Project area. The field survey was carried out by EBS staff, members of the Barngarla BDAC and a representative of the UQ Cultural Heritage Unit. The heritage survey located two new archaeological sites (artefact scatters & potential archaeological deposits) and six new anthropological / cultural sites.

6.1.2 Burra / Clare region

Table 7: Archaeological studies undertake south / south east of the Project area (Burra / Clare).

Year	Author	Description
1925	Biddle, J.P.	Research on engraving sites that is located five miles due east of Burra, at Deep Creek. The engraving site consisted of a huge platform with a series of pecking's. Campbell (1925) also recorded this site and noted a number of various animal tracks, circular and ovate motifs.
1983	Gara, T.	Gara conducted an archaeological survey of a 275kV transmission line from Port Augusta to Eudunda. During this assessment a total of five Aboriginal archaeological sites were located. The sites consisted of stone artefact scatters and a scar tree.
1995	Crow, H. & P. Clark	Crow and Clark undertook s heritage assessment of Burra Creek Gorge (Worlds end), which is situated 20 km north of Robertstown. During the assessment a total of 15 Aboriginal sites were located. Seven were artefact scatters, one was an isolated artefact and the other seven were scarred trees. All scar trees were found on red river gums and all were located in creek banks.
1995	Stockton, J.	Stockton undertook a survey of the road between Morgon and Burra. During the assessment a total of five stone artefact scatters were located. Three of these sites are located just south of the current Project area. Four were in line with the road alignment

Year	Author	Description
		and would be destroyed. The fifth was next to an eroding gully. The main stone material noted was quartz, which is available from fossil river gravels. These occur throughout the plains. The sites were located on hill slopes or ridgetops, all well drained locations.
2001	Wood, V.	Wood undertook a heritage survey of the proposed location of communication infrastructure for the emergency serves network at Bumbunga Hill, near Clare. The survey was the result of a previous study undertaken by Rhondda Harris, on behalf of the Native Title Unit. No Aboriginal archaeological sites were found during the survey by Harris, but it was suggested that Bumbunga Hill was a possible anthropological sites. Wood suggested further work be undertaken into the significance of the area.
2003	Walsh, K & J. Bowell	Walsh and Bowell were engaged by Wind Prospect Pty Ltd to undertake an archaeological and anthropological desktop assessment of known Aboriginal and non-Aboriginal archaeological sites and heritage places for the proposed Willogoleche Wind Farm located near Hallet. The recommendations from the assessment included that a ground survey be undertaken across the development area due to the high likelihood of finding stone cairns, culturally modified trees, quarries and a lower possibility of finding stone tool scatters, campsites, engravings, painting sites and burials.
2007	Wood, V.	Wood was engaged to undertaken an Indigenous cultural heritage survey of the proposed Willogoleche Hill Wind Farm, near Hallet. No archaeological or anthropological sites were identified during the survey. It was recommended that monitoring occurring of any ground disturbance.
2009	Lower, K.	Lower Master's thesis focused on landscape archaeology and Indigenous nation building in *Ngadjuri* Country. Lowers work included comparing site types recorded in the area by previous studies to those recorded by Smith's work at Plumbago (1980). When comparing this data is was evident that there were a greater occurrence of rock art, particularly engravings outside of Smith's survey area. Lower suggested this was probably indicative of selective recording practices, rather than a reflecting of genuine site distribution. This research showed that landscape archaeology can play a vital role in the re-acquisition of cultural knowledge, assertion and authentication of identity (Figure 8).
2009a	Wood, V.	Wood undertook a heritage desktop assessment of the proposed transmission line connection the Bluff Wind Farm to the southern end of the North Brown Hill Wind Farm in Jamestown. The development was considered to have a low impact and was unlikely to impinge into location that have elevated archaeological sensitivity.
2009b	Wood, V.	Wood undertook a heritage survey of the North Brown Hill Range Wind Farm. During the assessment a total of three Aboriginal archaeological sites were noted including stone artefact scatters and a stone cairn.
2009c	Wood, V.	Wood undertook a field cultural heritage assessment of the Willogoleche Wind Farm Project area. No Indigenous sites of significance to archaeology, anthropology, history or tradition were identified during the study.

Year	Author	Description
2010	Wood, V.	Wood was engaged by International Power Pty Ltd to undertake a desktop study for the proposed amendments to the Willogoleche Hill Wind Farm previously investigated. The report summarised previous work done in the area and concluded that were was still a risk of encountering Aboriginal sites and objects in the area.
2016	Hobbs, J.	ACHM was commissioned by Aurecon Australia Pty Ltd to undertake a desktop assessment of the proposed Hornsdale Wind Farm, near Jamestown in SA. The desktop analysis found that there was a moderate likelihood of the proposed Project area containing undiscovered Aboriginal sites. A recommendation to undertake a cultural heritage survey be undertaken to ensure that no European or Indigenous heritage places were damaged. They also made recommendations to engage with both the Ngadjuri and Nukunu traditional owners.
2017	EBS Heritage	EBS Heritage undertook a heritage desktop and risk assessment of the Barrier Highway intersection of Copperhouse Road. The assessment concluded that there were no registered Aboriginal sites in the area and that there was a moderate risk in one section due to the presence of an ephemeral creek line.
2017	EBS Heritage	EBS Heritage undertook a gap analysis desktop and field inspection for the Barn Hill Wind Farm, near Redhill. The survey identified eight previously recorded Aboriginal sites in the Project area. New locations were surveyed but no new sites were identified. All the sites were stone artefact scatters.

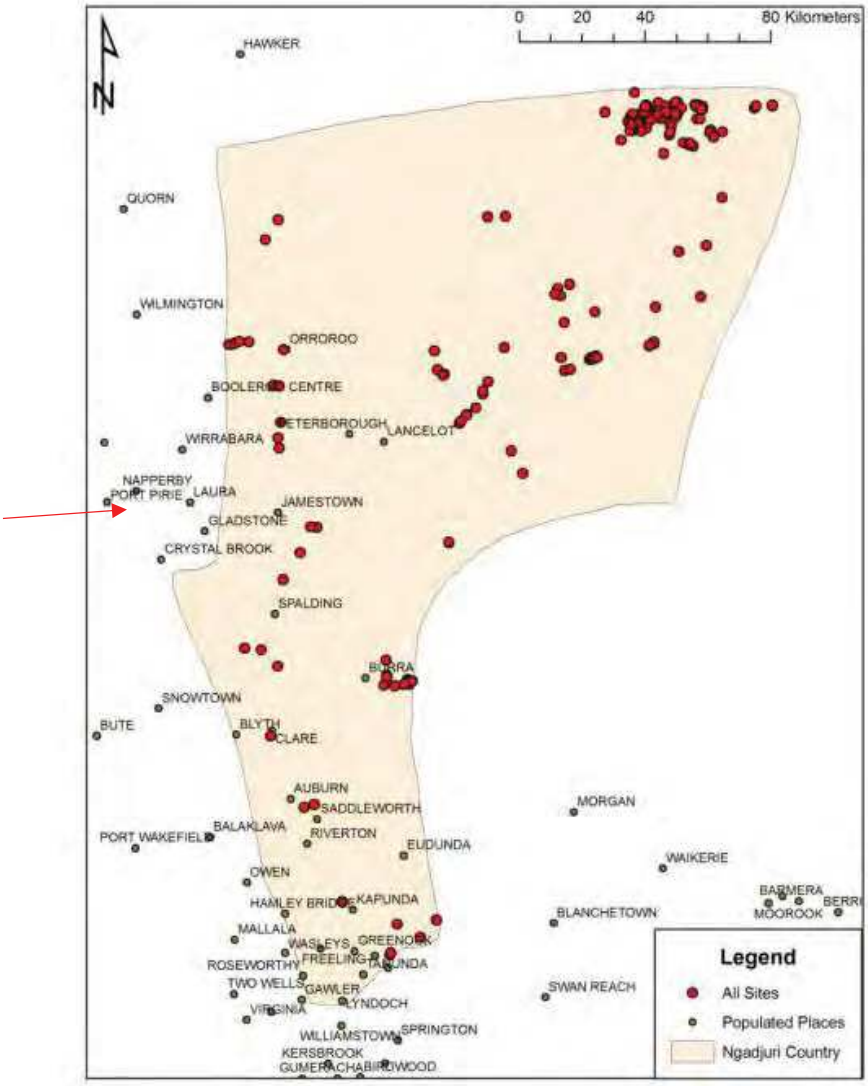

Figure 8: Figure showing the location of all known sites in 2009 in Ngadjuri land (red arrow indicating the location of the current Project area (Lower 2009).

7 HERITAGE REGISTER SEARCHES

7.1 DPC-AAR Register Search

The Central Archive is maintained by DPC-AAR and includes the Register of Aboriginal Sites and Objects. The Central Archive is a record of previously recorded heritage sites in SA and facilitates the identification of known sites within a project development area. The Central Archive is not an exhaustive list of heritage sites in a specific area, it contains only sites that have been reported and/or registered.

A request for a search of the DPC-AAR records for information on previously recorded Aboriginal sites located within the development area was submitted on the 18th of April 2018. A registered Aboriginal site is located on the boundary line of the current Project area. The accuracy of these sites boundaries will need to be further investigated to insure that the proposed works will not impact them (Figure 9).

EBS Heritage also undertook a DPC-AAR search of the wider area to gather information about previously recorded Aboriginal sites types within the broader area. This information would then be used to generate the predictive statements and risk assessment for the current Project area. The search results were received on the 26 April 2018 and indicated that there are 13 registered and reported Aboriginal sites in the wider area (Table 8 and Figure 10). The most dominate site types are archaeological sites, scarred trees and cultural sites.

Due to the restriction of data imposed by DPC-AAR the precise spatial data for these sites was not obtained. DPC-AAR advises that all Aboriginal sites recorded are protected under the AHA and pursuant to the Act, it is an offence to damage, disturb or interfere with any Aboriginal site or damage any Aboriginal object (registered or not) without Authority from the Minister for Aboriginal Affairs and Reconciliation. If construction is to occur within the boundaries of these Aboriginal sites a Section 23 permit would be required.

Table 8: DPC-AAR Registered Sites in close proximity to the Project area.

Site Number	Site Status	Site Type
6531 2971	Registered	Archaeological
6531 2972	Registered	Archaeological
6531 3361	Registered	Scarred Tree
6531 4070	Reported	Archaeological
6531 5871	Reported	Archaeological
6531 5872	Reported	Archaeological
6531 6227	Reported	Cultural
6531 6396	Reported	Scarred Tree
6531 6397	Reported	Scarred Tree
6531 6533	Registered	Archaeological
6531 6534	Registered	Archaeological
6531 7775	Reported	Archaeological
6531 7776	Reported	Archaeological

7.2 SA Museums Database

The SAM contains information regarding culturally sensitive finds such as human remains and items recorded prior to the establishment of the DPC-AAR Register. Where available, the database contains information on how the item(s) came into the collection, the location in which it was found and the date it was acquired.

EBS Heritage conducted a search of the SAM Database for references to Port Pirie, Port Germein, Solomontown, Napperby, Bungama, Warnertown, Nelshaby and Crystal Brooke. A total of 98 entries were found that made reference to these areas. Out of this seven are related to human remains. Of particular note are the ones recorded at Solomontown, which is approximately 4.7 km to the west of the current Project area.

As the SAM database does not always specify exactly where cultural material items and human remains were found and its contents are often the result of specifically targeted expeditions and accidental finds, the database is best viewed as an indicative tool. The results indicate that a significant level of cultural activity has occurred in the vicinity. Of note are the entries regarding human remains. This information, combined with the other research indicates that it is likely that unrecorded Aboriginal sites are located within undisturbed sections of the Project area.

7.3 European Heritage

The South Australian (SA) Heritage Places Database is maintained by the South Australian Government Department of Planning and Local Government. This database holds information relating to places on the SA Heritage Register, Local Heritage Places from SA Development Plans and Contributory Items from SA Development Plans.

7.3.1 Commonwealth Heritage Places

The National Heritage List records places with outstanding natural, Indigenous or historic heritage value to the nation of Australia. Places on the National Heritage List and their heritage value are recorded on the list and are protected by the *EPBC Act 1999*. In order to be listed on the National Heritage, the item must meet one or more of nine criteria. These criteria are as follows;

(a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;

(b) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;

(c) the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;

(d) the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:

    (i) a class of Australia's natural or cultural places; or

    (ii) a class of Australia's natural or cultural environments;

(e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

(f) the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period;

(g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

(h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history; and / or

(i) the place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.

No listings were found for places of Commonwealth level historical significance within the Project area (DotEE 2018).

7.3.2 State Heritage Places

The South Australian Heritage Register is a list of places of heritage value in the state of SA. The list is on the Department of Environment and Water SA Heritage Register. In order to be listed as a State Heritage Place it must satisfy one or more of the criteria listed in Section 16 of the *Heritage Places Act* 1993. These places are also identified and protected by the *Development Act* 1993 and the *Planning, Development and Infrastructure Act* 2016. The State Heritage Place criterion are as follows;

- Demonstrates important aspects of the evolution or pattern of the state's history;
- Has rare, uncommon or endangered qualities that are of cultural significance;
- May yield information that will contribute to an understanding of the state's history, including its natural history;
- Is an outstanding representative of a particular class of places of cultural significance;
- Demonstrates a high degree of creative, aesthetic or technical accomplishment or is an outstanding representative of particular construction techniques or design characteristics;
- Has a strong cultural or spiritual association for the community or group within it; and
- Has a special association with the life or work of a person or organisation or an event of historical importance.

No listings were found for places of State level historical significance within the Project area. There are a number of locations of State significance in close proximity to the Project area (Figure 11) (Austral Archaeology 2000, DEW 2018, DPTI 2017).

7.3.3 Local Heritage Places

A Local Heritage Place is a place of heritage value due to its history, architectural and design qualities, built form character and integrity. These places are listed in the Development Plan and may be considered to have local heritage value if they meet one or more of the listed criteria in the Development Act 1993 section 23(4). The criteria are as follows:

- Displays historical, economic or social themes that are of importance to the local area;
- Represents customs or ways of life that are characteristic of the local area;
- Has played an important part in the lives of local residents;
- Displays aesthetic merit, design characteristics or construction techniques of significance to the local area;
- Is associated with a notable local personality or event;
- Is a notable landmark in the area; and
- Is a tree of special historical or social significance or importance within the local area.

No listings were found for places of local level historical significance within the Project area (Austral Archaeology 2000, DEWNR 2018, DPTI 2017, PPRC 2017).

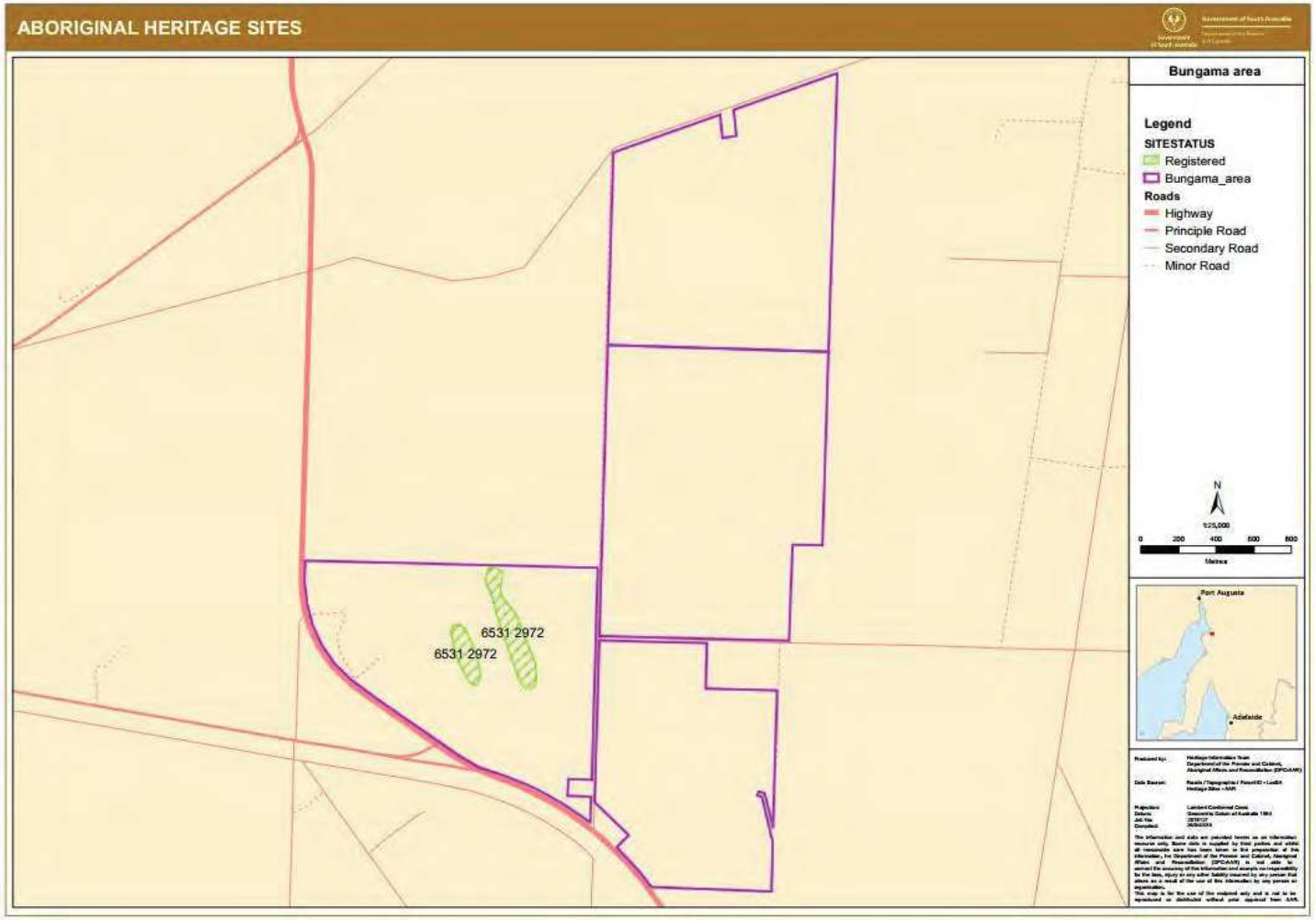

Figure 9: DPC-AAR Registered Aboriginal Heritage sites within the local area (DPC-AAR 2018).

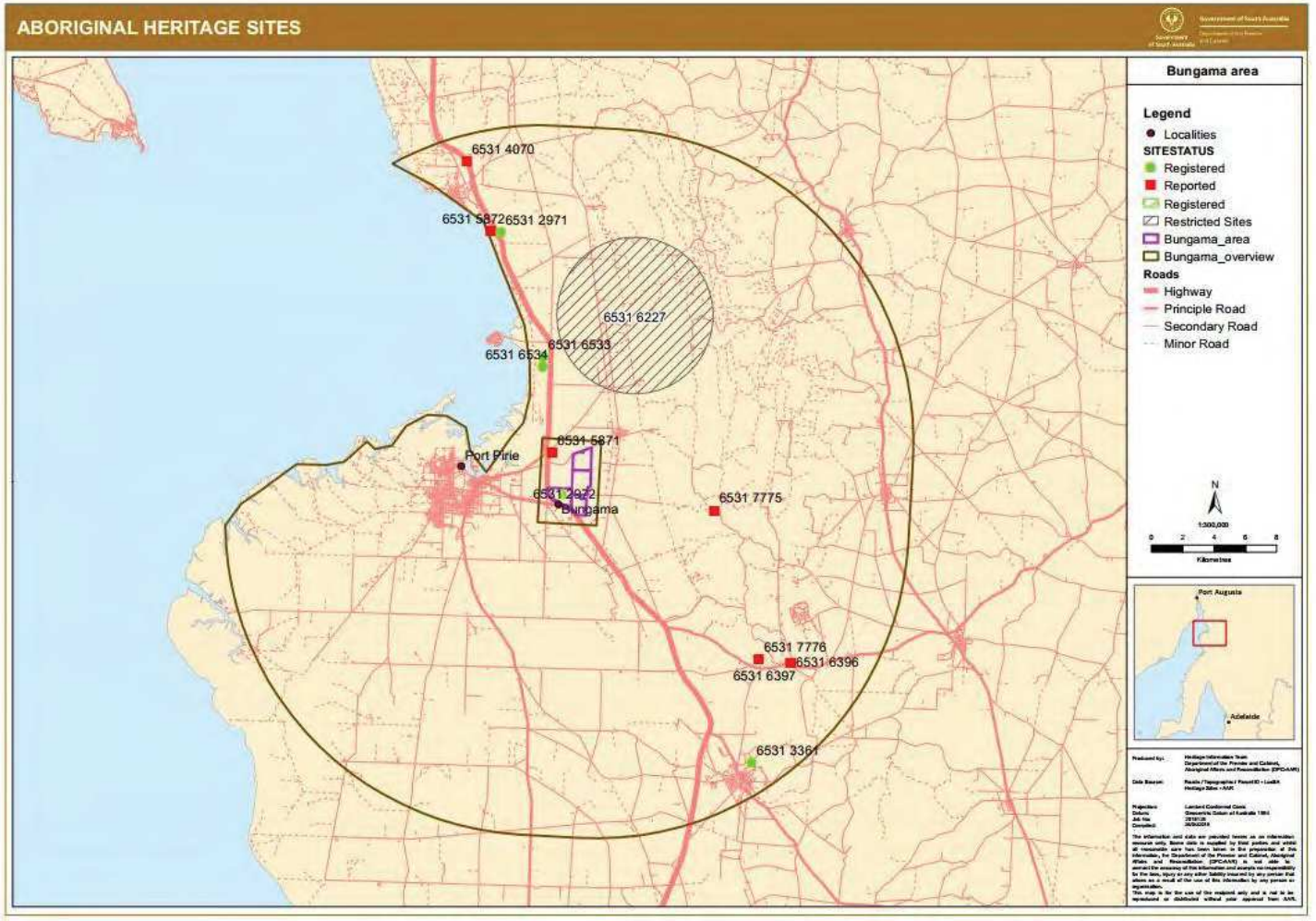

Figure 10: DPC-AAR Registered Aboriginal Heritage sites within the broader area (DPC-AAR 2018).

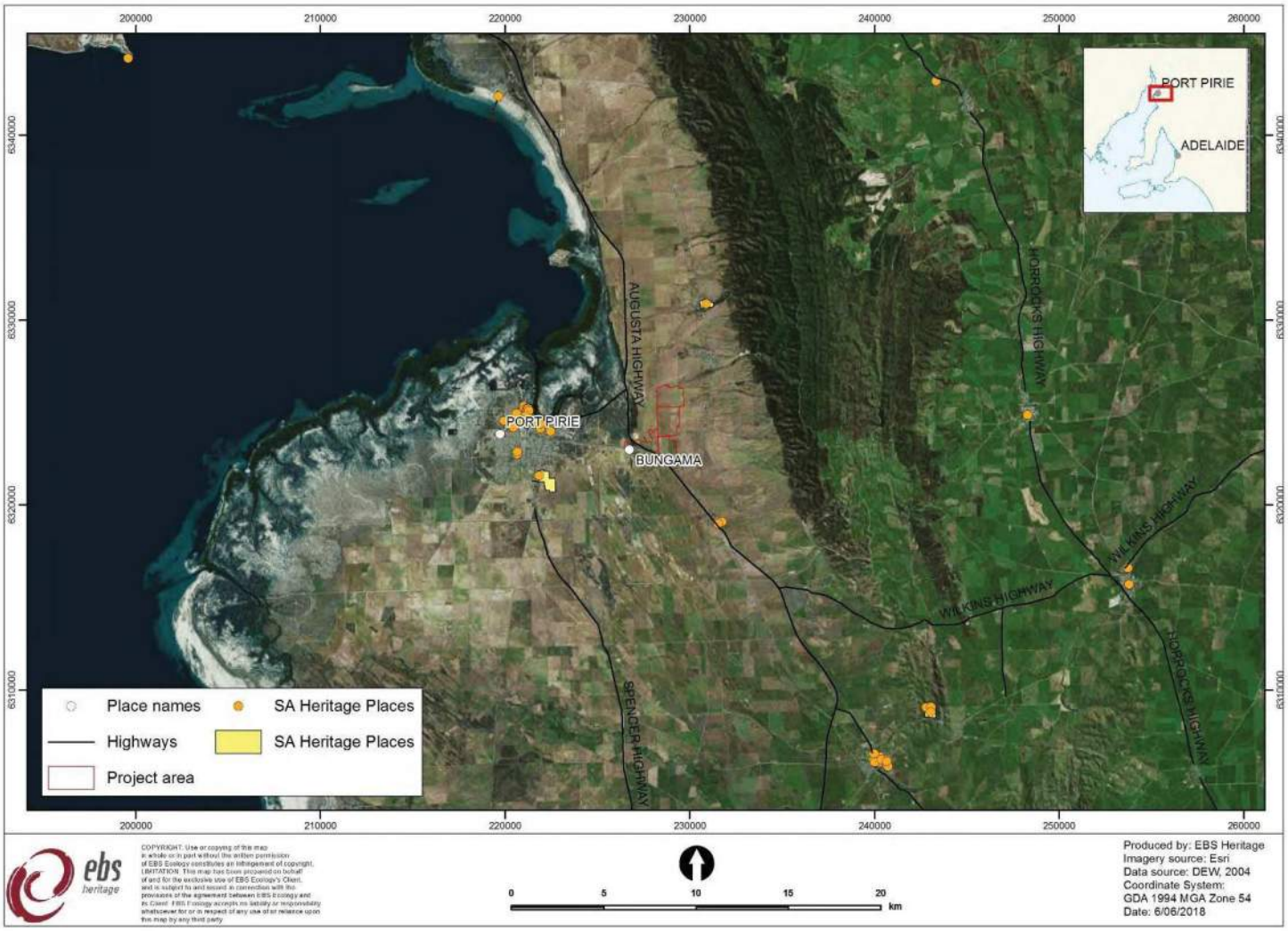

Figure 11: European Heritage within the local area.

8 PREDICTIVE STATEMENTS AND RISK ASSESSMENT

8.1 Predictive Statements

The archaeological predictive statements and risk assessment has been formulated based on the results of the locations and type of Aboriginal sites that have been recorded with the regional area and information about previous archaeological work. From the predictive statements evident that there is a higher chance of encountering stone artefact scatters / isolated artefacts, potential archaeological deposits and burials sites within the Project area. The results are presented in Table 9 below.

Table 9: Table with predictive statements and risk assessments for the Project area.

Site Type	Site Description	Associated Landform / Environment	Statement
Artefact Scatters / Isolated Artefacts	Debris which results from flaking stone and will include unmodified flakes, cores and flaked pieces. Actual stone tools such as deliberately formed artefacts (such as scrapers, backed blades or adzes) or pieces which possess evidence of use are generally present in low frequencies.	Stone artefacts are located either on the ground surface and/or in subsurface contexts. Within alluvial plains this site type is normally located to high terraces and sand bodies on the floodplain adjacent to drainage features.	Due to the widespread and common nature of this site type there is a high change of finding it within the Project area, especially considering the areas close location to the coastline. There were also nine 'archaeological' sites recorded in the area. The previous work in the area also noted this site type.
Scarred Trees	This site type consists of tress that have been modified through the removal of bark sections to construct canoes, shields and dishes. Typically river red gums or river box are targeted. Sculpted trees are when the tree has been carved for ceremonial purposes.	These site types can occur anywhere that trees of sufficient age are present, however, in an Aboriginal land use context would most likely have been situated on flat or low gradient landform units in areas suitable for either habitation and/or ceremonial purposes.	This site type is the second highest recorded according to the DPC-AAR database search. However, there does not appear to be any remnant vegetation in the current Project area. There is subsequently a moderate chance only if mature vegetation is present.
Potential Archaeological Deposit (PAD)	These are areas that have a potential to contain an archaeological deposit. They can be found in association with other cultural material or without.	They can be located in many different environmental locations including within rock shelters, along creek lines, sand dunes and anywhere a deposit can assimilate.	The soil profile in this area would assimilate subsurface deposits. There is a high chance of locating this site type.

Site Type	Site Description	Associated Landform / Environment	Statement
Engravings	Creation of geometric shapes, patterns or symbols into rock surface. There are many different styles including pecked, grooved etc.	This site type is located on bedrock outcrops are varying sizes and formations.	At this stage of the assessment there appears to be few rock outcrops, suggesting a low risk of locating this site type within the Project area. However, if there were rock outcrops then this site type could be located.
Quarries	They consist of sources of stone that is used to manufacture stone artefacts. There are also quarries of ochre. Quarries are procurement sites and normally have an associated artefact scatter and areas of reduction or knapping areas.	Located in areas where there are large bedrock outcrops that are available for quarrying.	At this stage of the assessment there appears to be few rock outcrops, suggesting a low risk of locating this site type within the Project area.
Burials	This site type can include an isolated bone fragment to a complete individuals or group of burials. Burials include flexed, extended and cremated inhumations with common comprising extended inhumations with an east-west attitude. Bundle burials are restricted to the late Holocene.	Burials in this area tend to be associated with ridges and lunettes and other sand bodies, such as source boarding dunes, perched dunes, and point bar deposits, spits and sandy river or creek banks.	The current Project area is located in dune / swale systems that have deep soils. There were also a number of human remains noted in the SAM database. The nine 'archaeological' sites or the one 'cultural' site recorded with DPC-AAR could be burials. There is subsequently a moderate chance of burials in some sections of the Project area.
Middens	This site type typically comprise of shell remains and other faunal materials. In the region middens will be dominated by freshwater mussels, but are also likely to contain animal bones, stone artefacts, ash, charcoal and other remnants of hearths such as heat retainer stones.	These site types are located in associated with waterways. They are present on floodplain and riverbanks. Older middens are found along prior streams and within lunette sediments.	The current Project area is located in close association with the coastal estuary, system associated with the Port Pirie River a salt water creek. Because of the close proximity to this environmental feature there is a moderate chance of locating this site type.
Rock Art / Paintings	Rock art is found across the continent as paintings, drawings, and pecked or abraded imagery and mechanically produced motifs such as stencils.	Art in the Australian semi-arid zone is associated with rock shelters and other stone feature, in open contexts as pecked or abraded art.	At this stage of the assessment there appears to be few rock outcrops, suggesting a low risk of locating this site type within the Project area. However, if there were rock outcrops then this site type could be located.

Site Type	Site Description	Associated Landform / Environment	Statement
Stone Arrangements	Stone arrangements are formed by placing rocks in a variety of different patterns and shapes. These can include standing stones, cairns, bora rings and fish traps. Bora Rings are Aboriginal ceremonial places.	Anywhere that suitable rock is located. Fish traps are normally located in association with waterways.	There is a low chance of finding this site type in the Project area. However, if there are suitable rocks within the Project area there is some chance of locating this site type.
Engravings	Creation of geometric shapes, patterns or symbols into rock surface. There are many different styles including pecked, grooved etc.	This site type is located on bedrock outcrops are varying sizes and formations.	There is a low chance of finding this site type in the Project area. However, if there are suitable rocks within the Project area there is some chance of locating this site type.
Mythological Sites / Aboriginal Ceremony and Dreaming	Places of significance to Aboriginal people connected to ceremonial activates or dreaming stories.	They can be present in wide variety of environmental landforms.	There is a registered 'cultural' site with DPC-AAR north of the current Project area. There is a moderate chance of finding this site type.
Soaks / Water Holes / Water sources	Locations that are a source of water. Some examples include rock holes that collect rain water (known as "gnamma" holes and natural springs).	These can be located anywhere there is natural water and rock formations.	There are no recorded soaks in the area and there is not the right bedrock present in the Project area. There is a low chance of locating this site type.
Historic Sites	These are sites relating to the shared history of Aboriginal and non-Aboriginal people after first contact. Examples include missions, massacre sites, post-contact camping sites.	Not dictated by any landform or environmental factors. More common in areas that had a higher influence by Europeans after contact.	Although there are none recorded in the area this part of SA has a long European history with intensive occupation after settlement. There is also accounts of Aboriginal people working in farms and stations. There would be a low to moderate chance of finding this site type.
Rock Shelters	Habituation locations that are formed naturally and may contain rick art, stone artefacts or midden deposits.	These sites will occur within rock overhands, shelters and caves where suitable bedrock is present.	There does not appear to be the required large rock formations to create this site type. There is a low chance of finding it within this Project area.

8.2 Risk Assessment

There are generally three levels of heritage risk assigned; low, moderate and high risk.

High Risk: identifies landforms where traditionally, cultural heritage sites have been found and where there is a high risk of proposed works encountering heritage sites. This risk has been assessed on the understanding that these areas have not experienced high levels of disturbance or geotechnical data indicates that the disturbance has not significantly impacted sub-surface soils. Areas traditionally considered to be of 'high' risk include the margins of undisturbed waterways, sand dunes and remnant trees.

Moderate Risk: identifies landforms where traditionally opportunistic use cultural heritage sites have been found and where there is a moderate risk of proposed works encountering unidentified heritage sites. Areas traditionally considered to be of 'moderate' risk are areas which may have once been classified as 'high' risk but appear to have been impacted by modern disturbance.

Low Risk: are areas where there is a very low to no chance of encountering cultural heritage sites and where there is low likelihood of proposed work impacting heritage sites. Areas assessed as having a 'low' risk are areas where there has been considerable modern impact and/or where geotechnical data indicates soils have been heavily impacted by modern activities and there is therefore a lower risk of cultural heritage sites to remain undisturbed.

Based on a review of the previous heritage work and the landforms present in the current Project area, EBS has assessed that there is a ***high*** to ***moderate*** risk of works impacting archaeological sites. Areas with visible sand dune features, or the areas in close proximity to these environmental features, have been assessed as high risk. These areas have also been registered as Aboriginal sites previously. The remainder of the Project area has been assessed as having a moderate risk because of the close proximity to the coastline, the Port Pirie River and the drainage lines that run down from the ranges in the east. Although there has been surface disturbance, recordable to the 1880's in some sections of the Project area, there could still be a risk of intact deep subsurface deposits in certain sections. Of note are the presence of human remains being uncovered in Solomontown in close proximity. This would of course depend on the soil profiles, which currently appear to be deep sandy dunes or swales, but this is something that can be reassessed during field inspections (Figure 12).

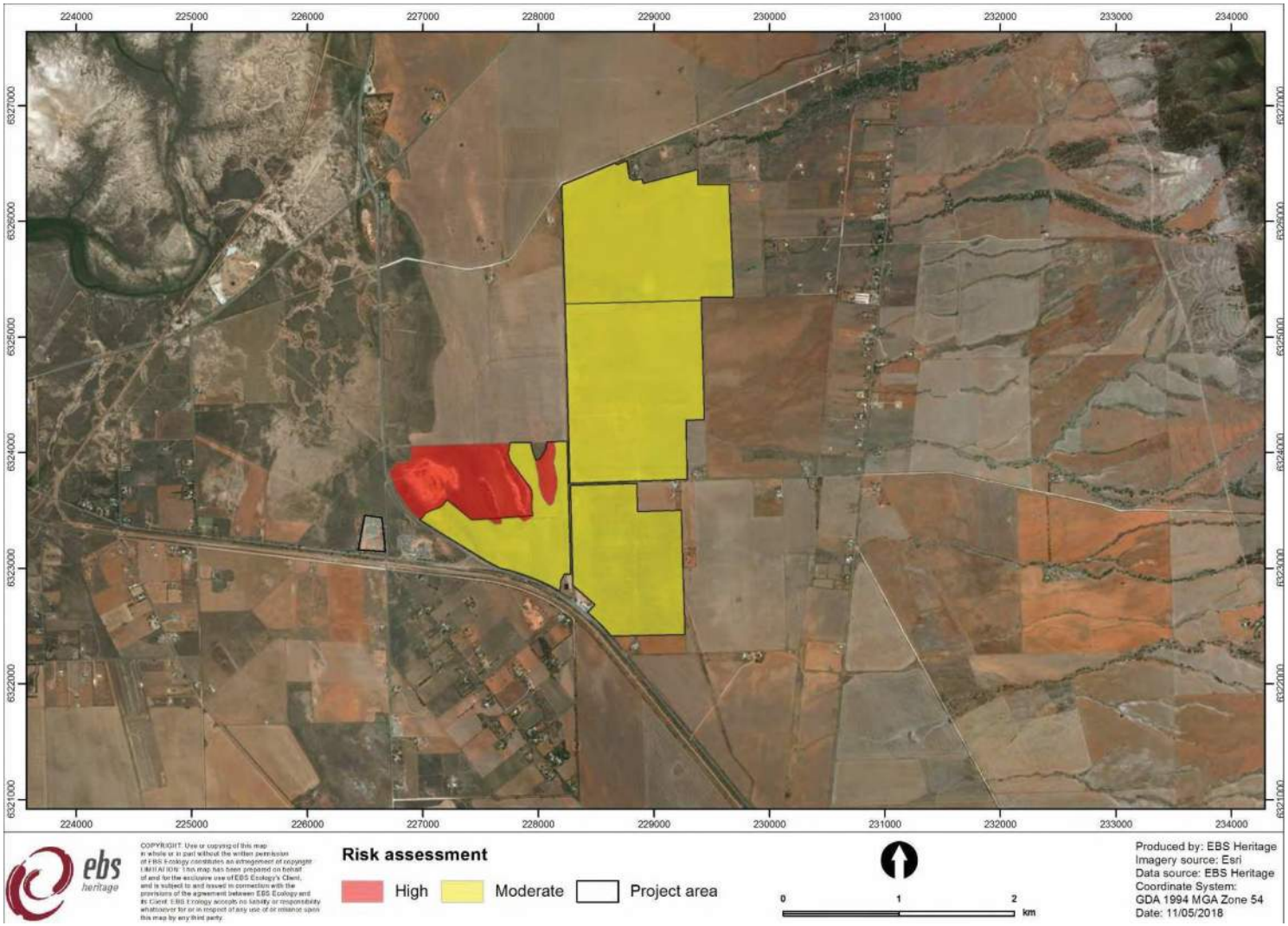

Figure 12: Heritage Risk Assessment.

9 SUMMARY AND RECOMMENDATIONS

EBS Heritage has carried out a desktop risk assessment based on the information available. As a result of this assessment, EBS Heritage recommend the following:

- The client should undertake community consultation with the recognised Aboriginal Traditional Owners for the region before the construction phase of the project;
- A site avoidance survey is undertaken for the proposed infrastructure footprint. If any heritage sites are located, the client has the capacity to modify their proposed construction footprint to avoid any sites. If the client is able to avoid all sites, there is no requirement to apply for a Section 23 permit (Ministerial consent to damage, disturb or interfere with Aboriginal Heritage Sites under the South Australian *Aboriginal Heritage Act 1988*);
- Should the future heritage survey identify any previously unreported Aboriginal sites within the Project area that cannot be avoided, then Section 23 approval will be required to damage, disturb or interfere with those sites;
- After the site avoidance survey, a Cultural Heritage Management Plan (CHMP) should be developed to provide long term management of Aboriginal sites within the Project area that can be avoided and will not be subject to Section 23 approval. This CHMP should include a site discovery procedure (refer Appendix 1);
- EBS recommends that construction personnel receive a heritage induction prior to works as a minimum requirement to manage heritage risk;
- EBS recommends that the client have a stop work/site discovery procedure in place in the event of an unexpected find. EBS has included a site discovery procedure in the appendix of this report for the client's convenience; and
- The client may wish to engage the services of an archaeologist "on-call" to assist in the identification of any unexpected finds.

10 REFERENCES

Note: Referencing style based on the Australian Archaeological Association style guide

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11 APPENDIX

11.1 DPC-AAR Register Search

Physical ID: AHRCA18D0112
File No. 2018/000011

Government of South Australia
Department of the Premier and Cabinet

Aboriginal Affairs & Reconciliation
GPO Box 320
Adelaide SA 5001
DX 452
Tel 08 8226 8900
Fax 08 8226 8999

26 April 2018

Shannon Smith
EBS Heritage
3/119 Hayward Avenue
TORRENSVILLE SA 5031

Dear Shannon

Thank you for your correspondence (email) dated 18 April 2018, regarding G80401 Project area 2, search 1, zoomed into the Bungama area, and to be used as part of a desktop risk assessment and cultural heritage survey. The search was based on the shapefile provided.

I advise that the central archive, which includes the Register of Aboriginal Sites and Objects (the Register), administered by the Department of the Premier and Cabinet, Aboriginal Affairs and Reconciliation (DPC-AAR), has an entry for Aboriginal sites within the project area.

This entry for an Aboriginal site is described as one archaeological site. The enclosed map identifies the approximate site location. It should be noted however that the site indicator does not reflect the actual area of the site; as this will vary from site to site, depending on the site information contained in the Central Archive.

The applicant is advised that sites or objects may exist in the proposed development area, even though the Register does not identify them. All Aboriginal sites and objects are protected under the *Aboriginal Heritage Act 1988* (the Act), whether they are listed in the central archive or not. Land within 200 metres of a watercourse (for example the River Murray and its overflow areas) in particular, may contain Aboriginal sites and objects.

Pursuant to the Act, it is an offence to damage, disturb or interfere with any Aboriginal site, object or remains (registered or not) without the authority of the Minister for Aboriginal Affairs and Reconciliation (the Minister). If the planned activity is likely to damage, disturb or interfere with a site, object or remains, authorisation of the activity must be first obtained from the Minister under Section 23 of the Act. Section 20 of the Act requires that any Aboriginal sites, objects or remains, discovered on the land, need to be reported to the Minister. Penalties apply for failure to comply with the Act.

It should be noted that this Aboriginal heritage advice has not addressed any relevant obligations pursuant to the Native Title Act 1993.

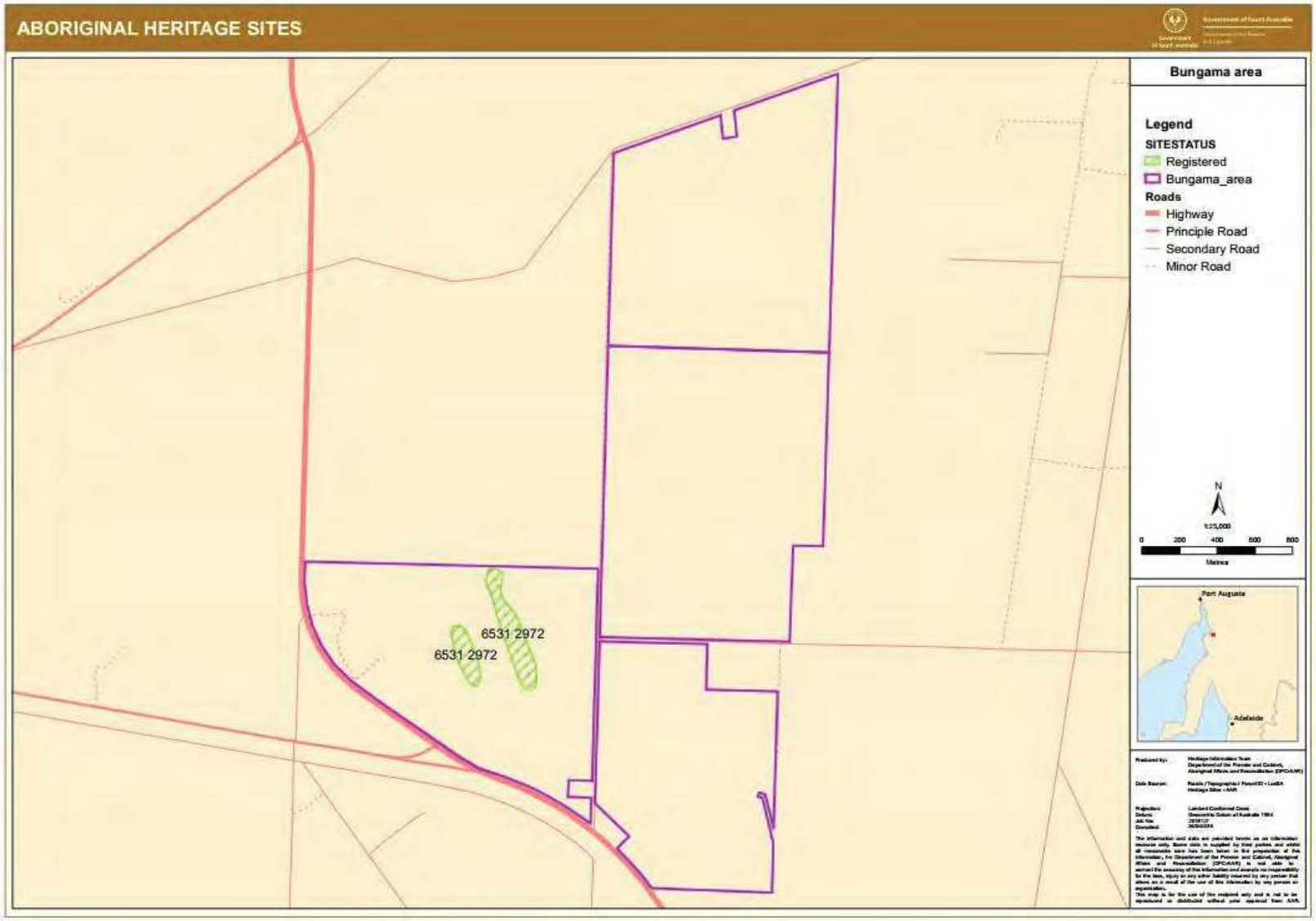
Please be aware in this area there are various Aboriginal groups/organisations/traditional owners that may have an interest, these may include:

NUKUNU PEOPLES COUNCIL INC
Chairperson: Doug Turner
Email: dmturner@internode.on.net
Mobile: 0421 612 236

If you require further information, please contact the Aboriginal Heritage Team on telephone (08) 8226 8900 or send to our generic email address dsdaarheritagesites1@sa.gov.au

Yours sincerely

Perry Langeberg
SENIOR INFORMATION OFFICER (HERITAGE)
ABORIGINAL AFFAIRS & RECONCILIATION


ABORIGINAL HERITAGE SITES
Government of South Australia
Bungama area
Legend
SITESTATUS
Registered
Bungama_area
Roads
Highway
Principle Road
Secondary Road
Minor Road
N
1:25,000
0
200
400
600
800
Metres
Port Augusta
Adelaide
6531 2972
6531 2972

Physical ID: AHRCA18D0113
File No. 2018/000011

Government of South Australia
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NUKUNU PEOPLES COUNCIL INC

Chairperson:	Doug Turner
Email:	dmturner@internode.on.net
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If you require further information, please contact the Aboriginal Heritage Team on telephone (08) 8226 8900 or send to our generic email address dsdaarheritagesites1@sa.gov.au

Yours sincerely

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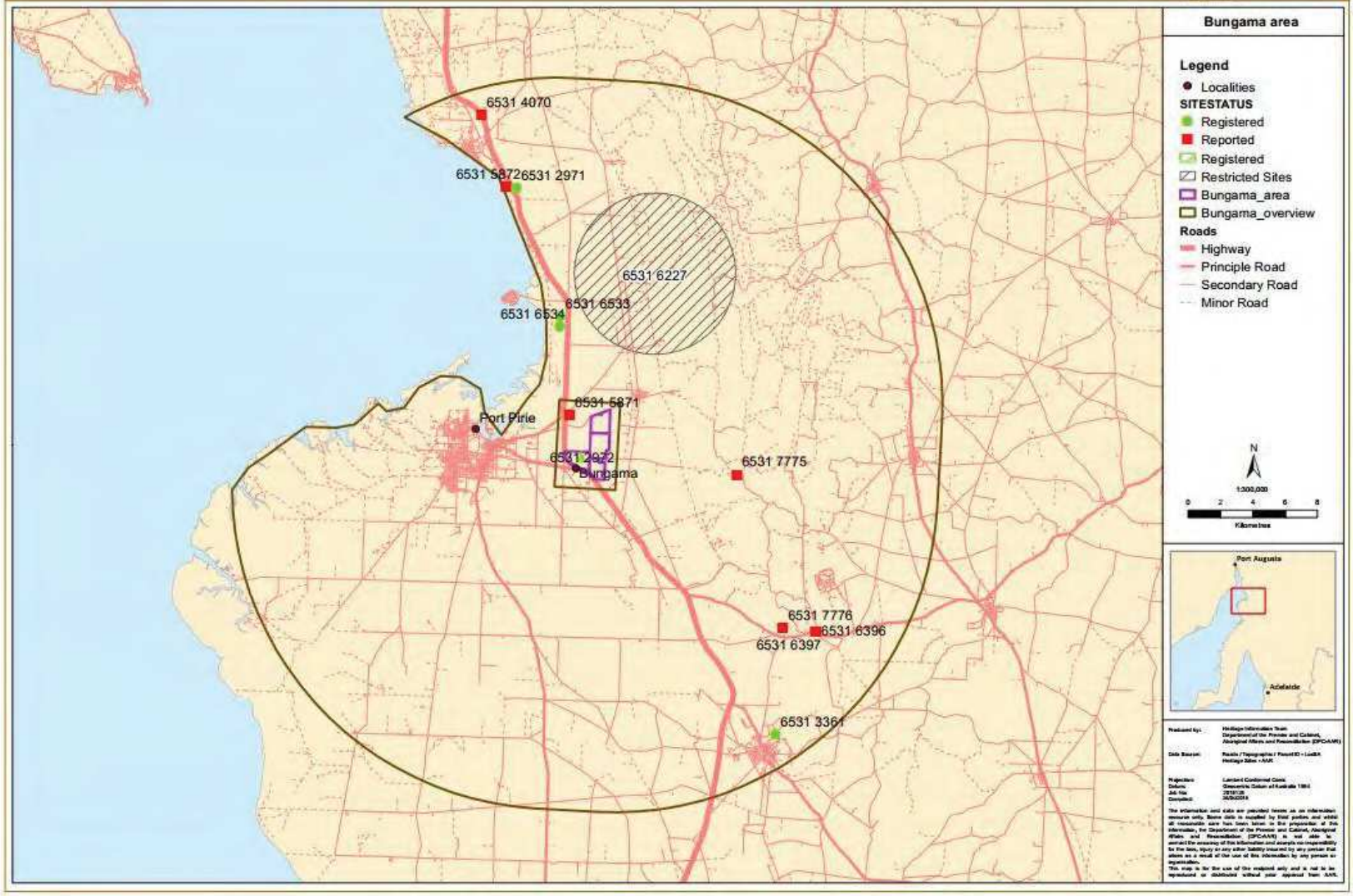
ABORIGINAL AFFAIRS & RECONCILIATION

ABORIGINAL HERITAGE SITES



11.2 Site Discovery Procedure

Discovery of Aboriginal Heritage Procedure

Have you found a site, object or skeletal remains that may be Aboriginal Heritage?

- See example pictures on next page.

STOP

All works in Vicinity of Site

- **Do not disturb/remove/touch or displace the site**, object or skeletal remains.
- It is an offence to disturb or interfere with Aboriginal heritage or skeletal remains.
- (*SA Aboriginal Heritage Act 1988*)
- ***Leave objects in place*** –Supervisor to take photos and send to archaeologists for verification.

PROTECT

Restrict access. Site supervisor to take note of:

- Location in relation to site works (pref GPS).
- Identify any immediate threats to heritage e.g. construction activities, vandalism, water level.
- Name and contact details of the person who made the discovery.
- Do not proceed with any works (or move ot touch objects) until advice has been sought from site archaeologists

NOTIFY

Site Supervisor to immediately notify:

- Client Representative
- Archaeologists
- Local Police or 131 444. If suspected human remains have been discovered.

MANAGE

Manage the incident with appropriate guidance from:

- Local Police (where skeletal remains have been discovered).
- Aboriginal Affairs and Reconciliation .
- The local Aboriginal community.
- An Archaeologist /Cultural Heritage Advisor

RESUME

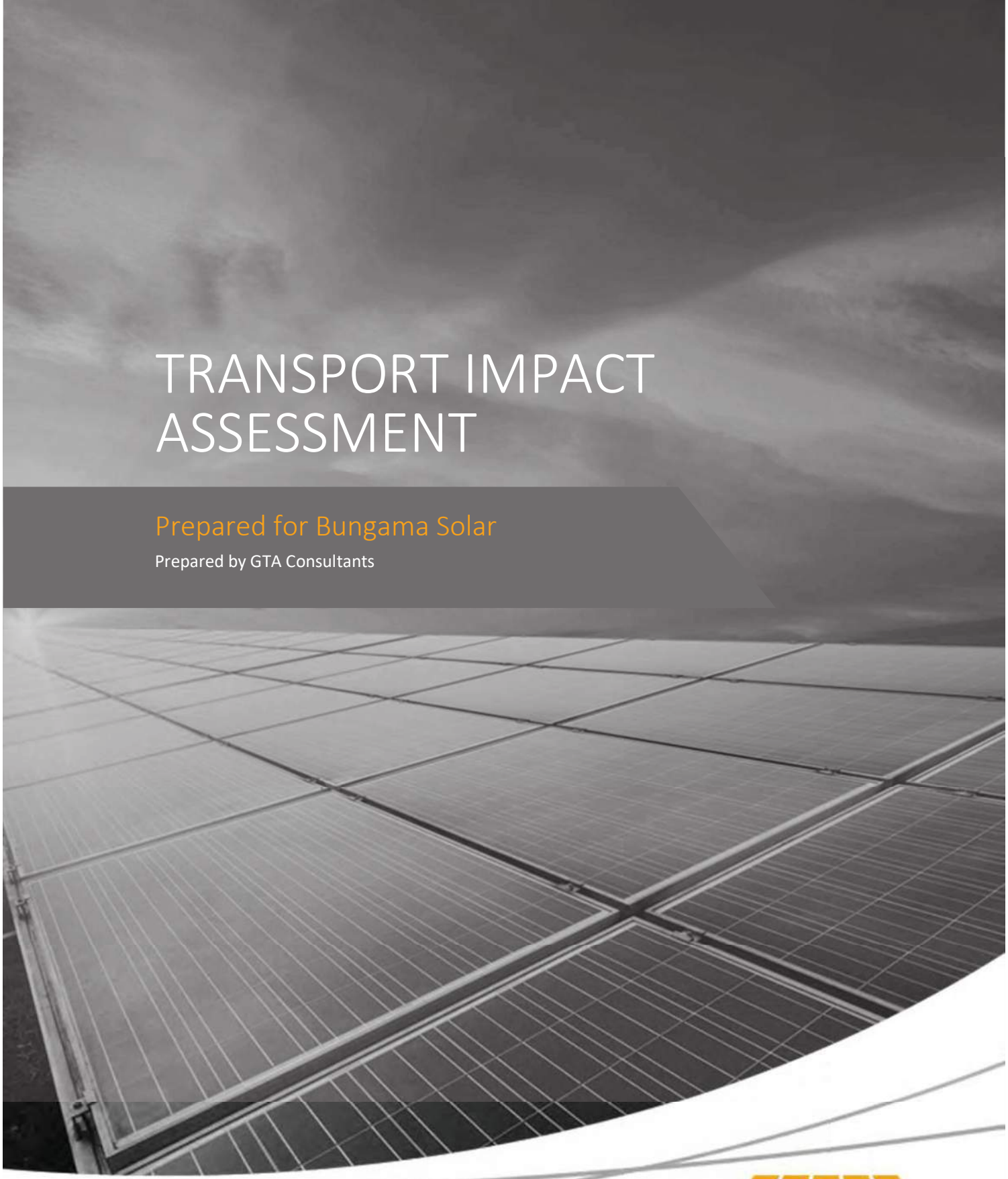
- The Site Manager will advise contractors when work can resume.
- This decision will be made in consultation with the archaeologists
- There may be conditions that need to be followed to allow work to resume.

3/119 Hayward Avenue
Torrensville, SA 5031
www.ebsheritage.com.au
t. 08 7127 5607
f. 08 8352 1222

APPENDIX 10

Transport Impact Assessment

BUNGAMA SOLAR



TRANSPORT IMPACT ASSESSMENT

Prepared for Bungama Solar

Prepared by GTA Consultants

EPS ENERGY

Reference No. 11297

November 18

BUNGAMA SOLAR

www.bungamasolar.com.au

Bungama Solar Project

Bungama, SA
Transport Impact Assessment

Prepared by: GTA Consultants (SA) Pty Ltd for Energy Projects Solar (EPS) Pty Ltd on behalf of Bungama Solar 1 Pty Ltd

on 27/11/18

Reference: S159810

Issue #: A

GTAconsultants

Bungama Solar Project

Bungama, SA
Transport Impact Assessment

Client: Energy Projects Solar (EPS) Pty Ltd on behalf of Bungama Solar 1 Pty Ltd

on 27/11/18

Reference: S159810

Issue #: A

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	27/11/2018	Final	Ian Bishop	Paul Froggatt	Paul Froggatt	

GTAconsultants

Melbourne | Sydney | Brisbane
Canberra | Adelaide | Perth

CONTENTS

1. INTRODUCTION

01

1.1. Background

A Development Application is currently being sought for a proposed solar project on land located at Bungama, approximately 6km east of Port Pirie, SA. The proposed development incorporates the construction of a Photovoltaic Energy Generation System (PVS) of approximately 280 MW (AC) generation capacity and Battery Energy Storage System (BESS).

GTA Consultants was commissioned by the EPS Energy in 2018 to undertake a transport impact assessment of the proposed development.

1.2. Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the proposed development, including consideration of the following:

1. existing traffic conditions surrounding the site
2. traffic generation characteristics of the proposed development
3. heavy vehicle route to the proposed development
4. proposed access arrangements and sight distance for the site
5. transport impact of the development proposal on the surrounding road network.

1.3. References

In preparing this report, reference has been made to the following:

- Port Pirie Regional Council Development Plan (consolidated – 31 October 2017)
- AustRoads Guide to Road Design – Part 4A – Signalised and Unsignalised Intersections (2017)
- Locality plan and project boundary for the proposed development
- various technical data as referenced in this report
- other documents as nominated.

2. EXISTING CONDITIONS

02

2.1. Project Area

The project area of approximately 530 hectares (ha) is located at Bungama, approximately 6km east of Port Pirie on the northeast of the Augusta (Princes) Highway.

The location of the project land, that includes the project area and the surrounding environs is shown in Figure 2.1.

Figure 2.1: Project Land and its Environs

2.2. Road Network

2.2.1. Adjoining Roads

Augusta Highway

The Augusta Highway forms part of the National Land Transport Network (NLTN) and is under the care and control of the Department for Planning, Transport and Infrastructure (DPTI). In the vicinity of the project area, the highway comprises a two-way carriageway approximately 8 metres wide with a single traffic lane in each direction and is set within a road corridor approximately 60 metres wide. A truck rest area is provided on the western side of the highway, opposite the intersection with Locks Road. A nature strip with a nominal width of approximately 3.8 metres separates the rest area from the highway. A left turn deceleration lane is provided at the intersection with Locks Road.

Augusta Highway carries approximately 4,800 vehicles per day[1] along the section adjacent to the project area and has a sign posted speed limit of 100km/h.

A service station is located on the south-eastern side of the intersection of Augusta Highway and Locks Road. At the service station, a short auxiliary left turn (AUL(S)) lane and a channelised right turn (CHR) lane are provided on Augusta Highway to facilitate access into the site.

Some other minor roads in the locality of the project area, including Scenic Drive to the south have basic right turn (BAR) treatments provided at their intersections with the Augusta Highway.

Locks Road

Locks Road is a sealed two-way local road under the care of Port Pirie Regional Council. Locks Road has a carriageway approximately 8 metres wide with a single lane of traffic in each direction and is aligned in a north/south direction. The carriageway is set within a road corridor approximately 22 metres wide. Locks Road is subject to the rural default speed limit of 100 km/h. GTA was unable to source traffic data for Locks Road to determine current traffic volumes, however an auxiliary left turn (AUL) treatment is currently provided into Locks Road from the Augusta Highway.

2.2.2. Surrounding Intersections

The following intersections currently exist in the vicinity of the site:

- Locks Road/ Augusta Highway (unsignalised)

2.2.3. Sight Distance

A desktop assessment of sight distance at the intersection of Locks Road and Augusta Highway has been undertaken in accordance with the requirements of the Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections (Austroads, 2017). The assessment considers the Safe Intersection Sight Distance (SISD) and Minimum Gap Sight Distance (MGSD).

- Safe Intersection Sight Distance (SISD) – the sight distance for a vehicle travelling on a major road and approaching an intersection to observe a vehicle on the minor road approach moving into a collision situation and to decelerate to a stop before reaching the collision point; and
- Minimum Gap Sight Distance (MGSD) – sight distance for vehicles exiting the minor road to observe approaching vehicles on the major road and decide whether there is a sufficient gap to turn from the minor road.

[1] LocationSA – Traffic Volume Estimates, base year 2014.

Given the rural location of the project area, at a design speed of 110km/h and a reaction time of 2.5 seconds, an SISD of 300 metres is required.

MGSD is based on the critical gap acceptance time that drivers are prepared to accept when undertaking a crossing or turning manoeuvre at intersections. Depending on the types of turning movements, critical gap acceptance time has the following values:

- Right turn from major road – across one lane: 4 secs
- Right turn from minor road – two lane/two way: 5 secs
- Crossing – two lane/two way: 5 secs
- Left turn: 5 secs

A design speed of 110m and critical gap acceptance time of 5 secs requires a MGSD of 153m.

GTA has determined that both the SISD and MGSD at the intersection of Locks Road and Augusta Highway are satisfactory.

.

3. DEVELOPMENT PROPOSAL

03

3.1. Proposed Development

The proposal includes the construction of a Photovoltaic Energy Generation System (PVS) of approximately 280 MW (AC) generation capacity and Battery Energy Storage System (BESS). Construction of the development is proposed in stages. A construction scenario of 24 months is adopted for the assessment.

3.2. Vehicle Access

Access locations to the project are to be confirmed but will primarily be located on Locks Road. Where possible, options to utilise the existing crossovers will be adopted. Some access locations may be temporary to facilitate construction and may be closed once the solar facility is in operation.

4. TRAFFIC IMPACT ASSESSMENT

04

4.1. Heavy Vehicle Route Access to Project Area

During the construction phase of the project, heavy vehicles up to a 26 metre B-double (PBS Level 2) combination will access the project area and surrounding areas for solar PV module deliveries, BESS infrastructure deliveries, road upgrades associated with project area access, internal access tracks, sub-station, office and maintenance facility construction. During the operational phase, it is envisaged there will be very few heavy vehicle movements.

The indicative heavy vehicle route for the proposed project area at Bungama is as follows:

- From Port Adelaide via National Highway A9 (Port River Expressway, Salisbury Highway) and National Highway A1 (Port Wakefield Road, Port Wakefield Highway, Augusta Highway) and Locks Road

The existing DPTI approved restricted access vehicle routes are detailed on the DPTI RAVnet website and are reproduced in Figures 4.1 and 4.2, with the proposed route highlighted. Figure 4.3 shows the existing 26m B-Double (PBS Level 2) network in the locality of the project area.

With the exception of a small number of oversize vehicles used for delivery of transformers and substations, the maximum design vehicle proposed for project area access is a 26 metre B-Double (PBS Level 2) which is currently approved for travel on the proposed route, including Locks Road.

Over dimensional vehicles will require an application to be lodged with DPTI and require either private or police escort depending on the limits of the over dimensional load.

Figure 4.1: Existing 26m B-Double Approved Routes – Port Adelaide to Port Wakefield

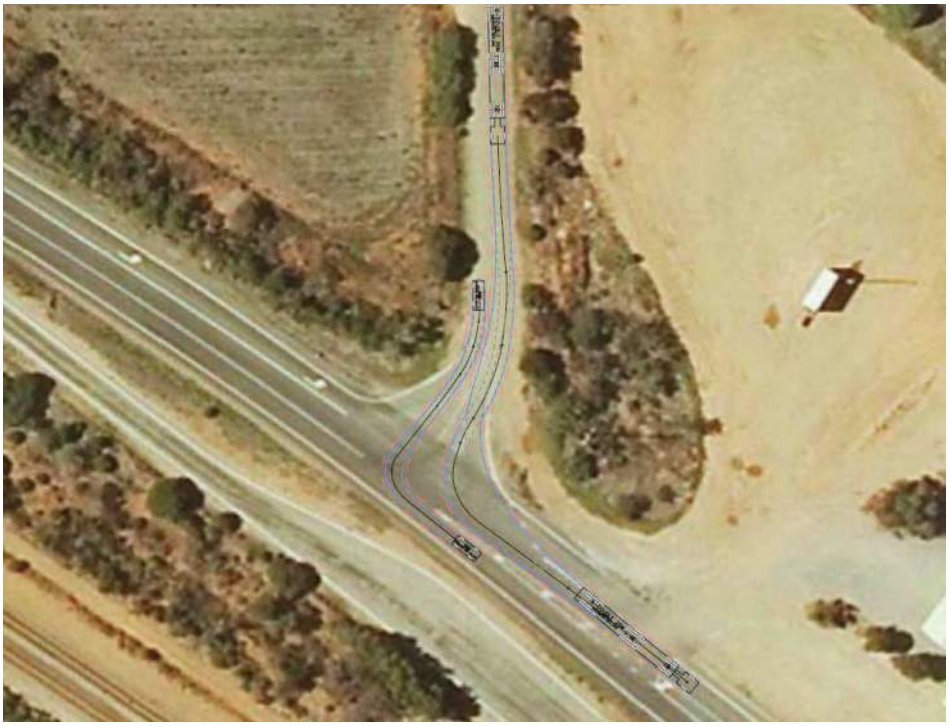
Figure 4.2: Existing 26m B-Double Approved Routes – Port Wakefield to the proposed project area

Figure 4.3: Existing 26m B-Double Approved Routes in vicinity of the project area

Turnpaths have been completed for a 26 metre B-double (PBS Level 2) combination turning between the Augusta Highway and Locks Road and are shown in Figures 4.4 and 4.5. The turn paths demonstrate that a 26 metre B-double will be able to turn simultaneously with other light traffic within the footprint of the existing intersection. Modifications to accommodate turning movements will not be required.

Figure 4.4: 26 Metre B-Double Right Turn into Locks Road

Figure 4.5: 26 Metre B-Double Left Turn from Locks Road



4.2. Traffic Generation

Traffic impacts of the proposed solar project on the surrounding road network during the construction phase are assessed based on the following two scenarios:

- Scenario 1 – considering all light vehicles and heavy vehicle movements during the construction phase
- Scenario 2 – a construction camp may be set up within the project area, which means construction light vehicles traveling to and from the site would be reduced.

Traffic in the operational phase will most likely be generated by light vehicles of staff to monitor operations and maintain the facility. It is envisaged there will be very few heavy vehicle movements, and these would likely occur on an ad hoc basis for equipment replacement.

4.3. Construction Phase Traffic Generation – Scenario 1

4.3.1. Design Rates

Traffic generation estimates during the construction phase for the project area were sourced from EPS Energy. Based on a 24-month construction period, the proposed project area is anticipated to generate a total of 4,606 heavy vehicle movements.. A summary of the anticipated heavy vehicle types and movements during the construction period is provided in Table 4.1. The average heavy vehicle and light vehicle movements per day during construction is shown in Table 4.2.

Table 4.1: Anticipated Heavy Vehicle Type and Movement Details [1]

Equipment		Delivery Vehicle	Movements
Major Equipment Delivery	Post Pounding Units and Piles.	Semi Trailer	417
	Tracking System, Framework	Semi Trailer	880
	PV Modules	B-Double Semi	840
	PCS, Inverters	L - Low Loader	56
	Combiner Boxes	Semi Trailer	16
	Other including cabling	Semi Trailer	305
Site Mobilisation / Set-up	Misc. Establishment Deliveries	L - Low Loader	12
	Earthmoving Equipment Deliveries	H - Low Loader	12
	Imported Materials for Office / Laydown	Truck and Dog	280
	Imported Materials for Roads	Truck and Dog	900
HV Trenching	Excavator Delivery	H - Low Loader	4
	Cable Laying Equipment	L - Low Loader	4
	Cable Bedding Sand	Truck and Dog	200
Substation Works	Misc. Building Materials etc	Semi Trailer	10
	Primary Transformer	O/D H-Low Loader	2
	Modular Substation	O/D L-Low Loader	2
	Switchboard	L - Low Loader	4
	Cabling	L - Low Loader	4
	Switchgear Components	Semi Trailer	10
General Construction	Waste Collection	Waste Truck	160

Equipment	Delivery Vehicle	Movements
Dust suppression	Water Trucks	488
	TOTAL	**4,606**

[1] Source: Estimated traffic movement data by EPS Energy, dated [28 August 2018].

Table 4.2: Traffic Generation Estimates

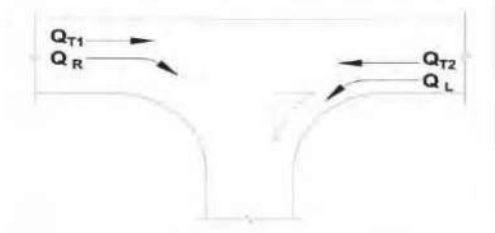
Construction Phase	Light Vehicles per day	Heavy Vehicles per day	OD Heavy Vehicles	Total movements per day
Months 1-2	10	9		19
Months 3-4	15	11		26
Months 5-6	23	13		36
Months 7-8	34	18		52
Months 9-10	32	12		44
Months 11-12	27	14	2	43
Months 13-14	30	14		44
Months 15-16	32	12		44
Months 17-18	26	13		39
Months 19-20	18	11		29
Months 21-22	15	0		15
Months 23-24	9	0		9

The estimated average vehicle movements per day across the construction scenario varies across different phases. However, a consistent level of daily movements averaging approximately 45 movements per day (31 light vehicles and 14 heavy vehicles) occurs between construction months 7 and 16.

4.3.2. Intersection Treatment Warrant Assessment

Based on the above traffic generation estimates, an assessment has been undertaken in accordance with the Guide to Road Design Part 4: Intersections and Crossings - General (Austroads, 2017) which considers the warrants for turning treatments at the intersection of Locks Road and Augusta Highway. Figure 4.6 shows the various traffic volume parameters calculated by the warrant.

Figure 4.6: Calculation of the Major Road Traffic Volume Parameter Qm



Turn type	Splitter island	Q_m (veh/h)
Right	No	$= Q_{T1} + Q_{T2} + Q_L$
Right	Yes	$= Q_{T1} + Q_{T2}$
Left	No/yes	$= Q_{T2}$

For a right turn movement, the major road traffic volume parameter (Q_M) consists of the traffic held up behind the right turning vehicles on the major road (Q_{T1}), and traffic impacting the right turn movement in the opposite direction of travel (Q_{T2} and Q_L). For a left turn movement, the major road traffic volume parameter (Q_M) considers only the traffic held up by the turning vehicle in the same lane (Q_{T2}).

The Augusta Highway has an Average Annual Daily Traffic (AADT) of 4,800 along the frontage of the project area. For this assessment a peak hour volume of 10% of the daily traffic was assumed. As such, the peak hour traffic volume is approximately 480, including 240 northbound movements and 240 southbound movements (50:50 directional split is assumed).

Turning movements into the Project Area

Given the proximity of the project area to Port Pirie, it is assumed that majority of the light vehicles would come from Port Pirie, west of the project area. It is also assumed that 30% of the light vehicles will likely arrive at the project area within a given peak hour correlating with shift work. Therefore, it is anticipated that the volume of light vehicles arriving at the project area in the peak hour is approximately 10 vehicles.

Heavy vehicles will travel westbound to the project area via the proposed route along the Augusta Highway. It is assumed that the arrival distribution of heavy vehicles is even over the hours of construction. As such a peak hour heavy vehicle volume equal to 10% of the total heavy vehicle volume has been adopted and equates to approximately 2 vehicles per hour in the peak hour.

The turning movement of vehicles at the intersection of Augusta Highway and Locks Road, excluding any existing traffic that uses Locks Road, is shown in Figure 4.7.

Figure 4.7: Turning movement in a peak hour

Warrants for turn treatments

Based on the traffic volume and distribution assumptions, Table 4.3 presents the left and right turn volume calculations with respect to the major road traffic volumes. Note that all existing traffic is shown as through traffic since turning count volumes are not available for the intersection. However, existing turning movements are expected to be low in comparison

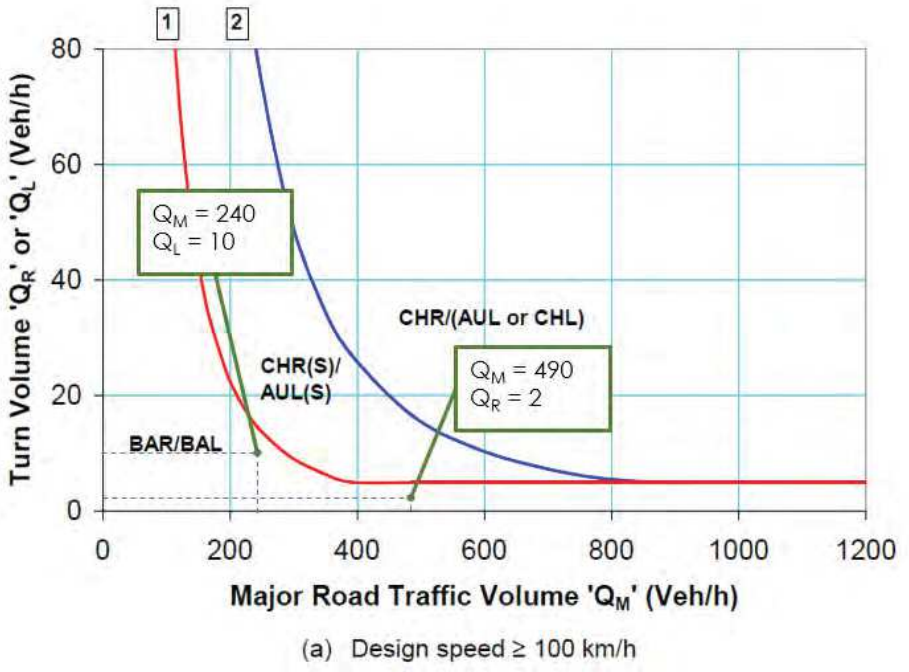
to the through traffic volumes on the Augusta Highway. The peak hour movements shown in Table 4.3 represent construction traffic volume only.

Table 4.3: Traffic Volume Parameters

Turn Type	Peak Hour Movements	Major Traffic Volume (Q_M)
Right (Q_R)	Q_R =2	$Q_M = Q_{T1} + Q_{T2} + Q_L = 490$
Left (Q_L)	Q_L = 10	$Q_M = Q_{T2} = 240$

Figure 4.8 outlines the warrant for turn treatments on the major road at unsignalised intersections for a design speed equal to or greater than 100km/h. The Peak Hour Movements (Q_R/Q_L) and corresponding Major Traffic Volumes (Q_M) are plotted on the graph to determine the type of turn treatment required.

Figure 4.8: Warrant for intersection treatment



(Reproduced based on Figure A 10b, Austroads, Guide to Road Design Part 4)

From the above assessment, it can be concluded that during the peak hour in the peak construction period, the intersection would meet the warrant for Basic Right-turn (BAR) treatment and Basic Left-turn (BAL) treatment.

Left turn treatment

Although existing intersection turning volumes are unknown, the provision of an Auxiliary Left Lane (AUL) at the intersection suggests that there is sufficient traffic from the north turning left into Locks Road to meet the AUL warrant. The AUL would therefore be able to accommodate the additional 10 left turn movements generated by the development.

Right Turn treatment

The additional 2 right turn movements into Locks Road generated by the development in the peak period is not expected to impact on the warrant for a formal right turn treatment beyond existing conditions. As the risk associated with 2 movements per hour is considered low, a formalised right turn treatment is not considered appropriate for the intersection.

4.4. Construction Phase Traffic Generation – Scenario 2

In this scenario, a construction camp is proposed within the project area so that light vehicle traffic generated during the construction phase will be reduced. The construction camp is anticipated to reduce light vehicle movements during the peak period by up to 90% compared to Scenario 1. This assumption considers that there will be some vehicle light vehicle movements during the peak period to access facilities at Port Pirie. During the busiest construction period (between months 7 and 16), the anticipated light vehicle movements will be reduced from 31 vehicles to approximately 4 vehicles per day.

Based on the assumption that 30% light vehicles will be accessing the project area during the peak hours, approximately 1 light vehicle will be accessing the site during the peak hour.

The anticipated heavy vehicle volume in this scenario will be consistent with that of Scenario 1, where approximately 2 heavy vehicles in the peak hour will travel to the project area via the proposed route from the east of the project area.

In this scenario, the increase in traffic generated by the project in the construction phase is anticipated to be marginal and will not generate any additional intersection treatment requirement.

4.5. Operational Phase Traffic Generation

Given the low trip rate generated by the operational staff, the development is unlikely to compromise the safety or function of the surrounding road network during operational phase.

4.6. Summary

In summary, the project is not anticipated to generate high volumes of traffic during both construction and operational phases. The intersection of Augusta Highway and Locks Road will not require any additional intersection treatments that it currently provides based on the low project-generated traffic volumes.

5. CONCLUSION

05

5.1. Conclusion

GTA has undertaken a transport feasibility assessment for the proposed Bungama Solar development and the following conclusions are made:

1. A Photovoltaic Energy Generation System (PVS) of approximately 280 MW (AC) generation capacity and Battery Energy Storage System (BESS) is proposed on land located 5km northeast of Robertstown SA.
2. Access to the project area will be provided primarily along Locks Road.
3. The project area has a direct connection via Locks Road to the Augusta Highway which carries approximately 4,800 vehicles per day.
4. The proposed heavy vehicle route will be from Port Adelaide via National Highway A9, National Highway A1, and Locks Road.
5. The proposed heavy vehicle route is currently gazetted for 26m B-Double combinations and therefore, with the exception of over dimensional loads, no further approvals are required.
6. Where over dimensional loads are proposed, an application to DPTI will be required and over dimensional loads will likely require a vehicle escort.
7. Turnpaths undertaken at the intersection of Augusta Highway and Locks Road demonstrate that a B-double will be able to turn in and out of Locks Road simultaneously with other light traffic within the existing footprint of the intersection and no further modification to the intersection is required to accommodate the turnpaths.
8. The proposed traffic generated by the project area during the construction phase and operational phase is low in comparison to existing traffic volumes and therefore is not expected to compromise the safety or function of the surrounding road network.
9. Review of the warrants for various intersection treatments suggests that the current intersection and traffic volume is likely to meet the warrant for a Basic right-turn (BAR) treatment and Basic Left-turn (BAL) treatment. An Auxiliary left turn lane (AUL) has been provided at the intersection.
10. The additional left turn movements associated with construction traffic will be accommodated by the existing AUL treatment at the intersection.
11. The additional right turn movements generated by the development are not expected to significantly elevate the warrant for a formal right turn treatment beyond existing traffic conditions. The risk associated with the right turn movements is low due to the low volumes, therefore a formalised right turn treatment on Augusta Highway is not considered necessary.
12. A desktop sight distance assessment at the intersection of Augusta Highway and Locks Road indicates that the SISD and MGSD meet the requirements of the AustRoads Guide to Road Design Part 4a.

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APPENDIX 11

Socio Economic Impact Assessment

SOCIO-ECONOMIC IMPACT ASSESSMENT

Prepared for Bungama Solar

EPS ENERGY

Reference No. 11297 November 18

BUNGAMA SOLAR

www.bungamasolar.com.au

QUALITY ASSURANCE AND DECLARATION

Quality Assurance and Version Control Table		
Project:	Bungama Solar Project	
Client:	Bungama Solar 1 Pty Ltd and Bungama Solar 2 Pty Ltd	
Rev:	Date:	Reference:
V01	29.11.2018	11297_Bungama Solar – Socio- Economic Impact Assessment
Checked By:	D. Carruthers	
Approved By:	S. McCall/ J. Burns	
Declaration:	*The opinions and declarations in this document are ascribed to EPS Energy and are made in good faith and trust that such statements are neither false nor misleading.* *In preparing this document, EPS Energy has considered and relied upon information obtained from the public domain, supplemented by discussions between key EPS Energy staff, representatives from governing agencies and independents, including the client and specialist consultants.*	
Applicant:	EPS Energy PO Box 195 Charlestown NSW 2290 (02) 9258 1362	
Prepared By:	L. Bryson	
Reviewed By:	S. Duffy/ A. Tipper	

EXECUTIVE SUMMARY

The following Socio-Economic Impact Assessment (SEIA) examines the baseline social and economic characteristics of the Port Pirie Local Government Area and considers the likely outcomes of the proposed Bungama Solar project.

Bungama Solar is an integrated but separately operated grid connected Photovoltaic Energy Generation System (PVS) of approximately 280MW (AC) generation capacity and a 140MW capacity Battery Energy Storage System (BESS) with 560MWh of storage that will feed into the National Electricity Market via ElectraNet's Bungama Substation. The PVS element, the BESS element and associated infrastructure, together are "the Project".

The Project area is approximately 530ha located in the suburbs of Bungama, Napperby and Warnertown in South Australia. The Project area is situated approximately 6km east of Port Pirie, and 218km north of the State's capital, Adelaide. The Project is within the Local Government Area (LGA) of Port Pirie Regional Council.

The key findings of this assessment indicate that the proposal will:

- Deliver clean and renewable energy for Australia in the face of climate change;
- Assist in meeting renewable energy targets for the State and the Nation;
- For each year of its 30-year operational life, displace the equivalent of 497,000 tonnes of greenhouse gas emissions per annum, the equivalent of offsetting the impact of 195,000 cars or providing the equivalent benefit of 69,500 trees per annum;
- Provide clean energy to power an equivalent of 86,000 homes for each year of the project's operational life;
- Create industry diversity for the Port Pirie region;
- Create substantial employment opportunities during project construction phases;
- Be located in a suitable area with access to existing infrastructure;
- Provide a flexible, low-impact alternative to the existing agricultural land use;
- Generate an estimated economic benefit in the order of $292.5 million for the broader economy and approximately $164 million as direct domestic project expenditure;
- Generate up to an estimated 275 equivalent full-time jobs during construction, and a further 410 indirect full-time equivalent jobs;
- Generate up to an estimated 8 equivalent full-time jobs during operations; and
- Provide a direct benefit to the community in the form of a community fund.

A full analysis and discussion supporting the key findings is provided within.

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1. INTRODUCTION

EPS Energy has been engaged to examine the forecast social and economic outcomes of Bungama Solar an integrated but separately operated grid connected Photovoltaic Energy Generation System (PVS) of approximately 280MW (AC) generation capacity and a 140MW capacity Battery Energy Storage System (BESS) with 560MWh of storage that will feed into the National Electricity Market via ElectraNet's Bungama Substation. The PVS element, the BESS element and associated infrastructure, together are "the Project".

The focus of this socio-economic impact assessment (SEIA) is to identify and facilitate enhanced development outcomes as well as examine and ameliorate any perceived or unintended negative social outcomes. The purpose of this assessment is to assist the project, project community and related stakeholders in understanding the relative social and economic benefits of the proposal.

1.1. LIMITATIONS AND ASSUMPTIONS

This report is subject to the limitations, assumptions and data sources presented within. The following limitations need to be considered when interpreting this SEIA.

This SEIA is intended to accompany the Planning Report documentation as part of the proposal's development application and assessment. The context for this report is the project's proposal stage and while every effort has been undertaken to ensure the data represents project forecasts, any significant changes to data inputs should be referred to the author for review, and this report refreshed.

EPS Energy has based this impact assessment on the assumption that Bungama Solar Project will operate for its entire design life of 30 years. However, this operational duration may be shortened or lengthened depending on market influence. Additionally, there may be opportunities for project expansion in the future. This SEIA is limited to the project's anticipated operation period of 30 years and current project scale and design, including cost and employment estimates.

2. BUNGAMA SOLAR PROJECT

2.1. PROJECT DESCRIPTION

Bungama Solar is an integrated but separately operated grid connected Photovoltaic Energy Generation System (PVS) of approximately 280MW (AC) generation capacity and a 140MW capacity Battery Energy Storage System (BESS) with 560MWh of storage that will feed into the National Electricity Market via ElectraNet's Bungama Substation. The PVS element, the BESS element and associated infrastructure, together are "the Project".

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The project is currently in the development application stage, with technical studies being undertaken to establish the relevant technical information required to seek development approval. This study is intended to form part of the suite of development application documents for the project.

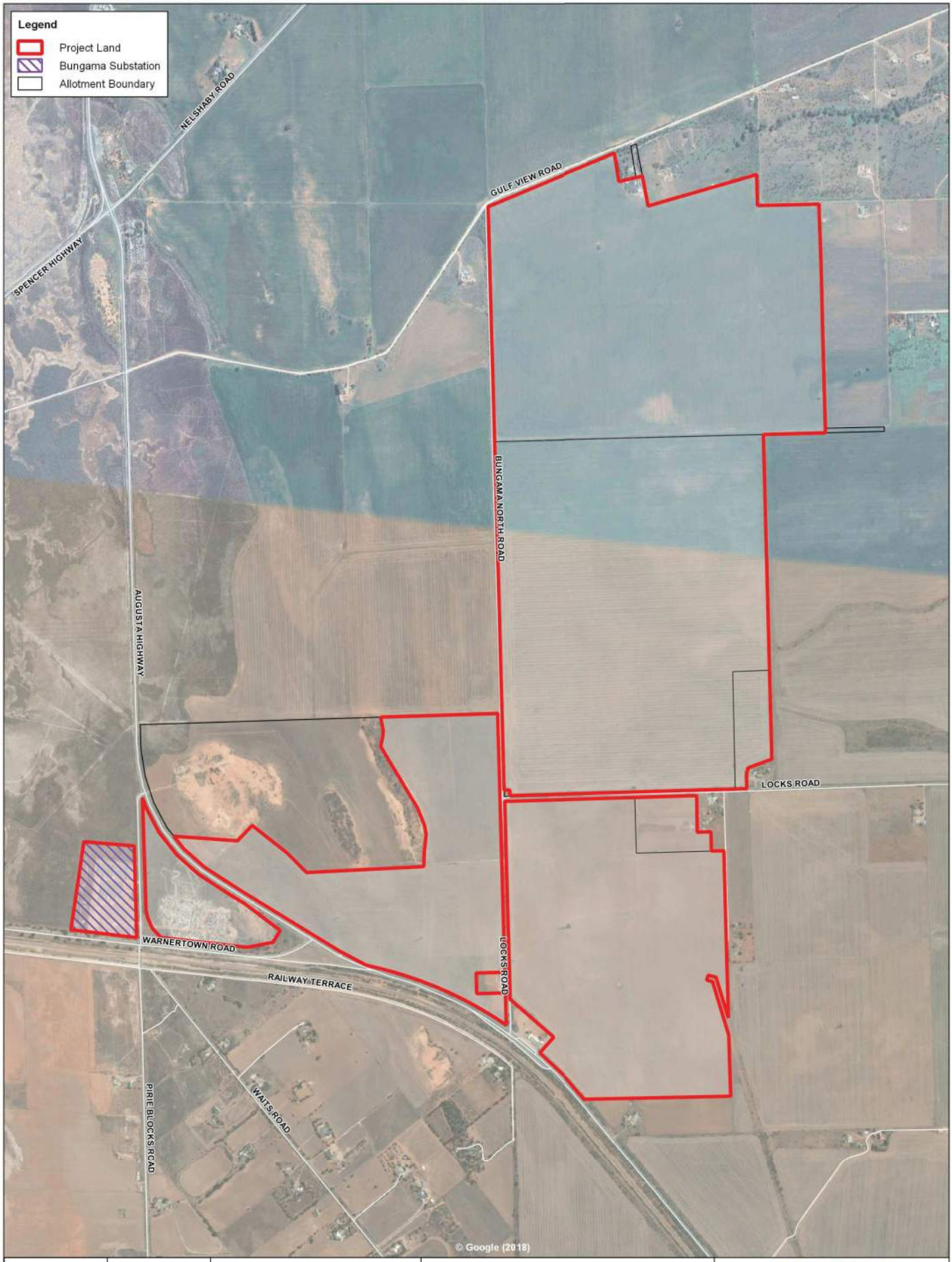
2.2. PROJECT AREA CONTEXT

The Project land comprises the Project area on which the PVS, BESS Project's substation, Operations and Maintenance buildings and associated infrastructure will be built and operated, and land required to connect the Project's elements to ElectraNet's Bungama Substation. The Project area is approximately 530 ha of cleared land, located in the suburbs of Bungama, Warnertown and Napperby, South Australia (refer to Figure 2-1). The Project area falls within the municipality of Port Pirie Regional Council.

2.3. STUDY AREA

The study area for this assessment is The Port Pirie Regional Council, in which the project is proposed to be located. Figure 2-2 as follows, demonstrates the Project area within the context of the Port Pirie Regional Council's Local Government Area (LGA).

The properties that comprise the Project area have historically been used for agricultural purposes including cereal cropping and grazing. Surrounding development is predominately agricultural land with cereal crops and pasture most prominent.



Author:	MB
Reviewer:	SMC/ JB
A3 Scale:	1:15,000
Job Ref/Version:	11297/ V04

0 100 200 300 400 500 m

Map Projection: GDA 1994 MGA Zone 54

Figure 2-1

Project Land

Bungama Solar | Bungama SA Australia

21/11/2018

BUNGAMA SOLAR

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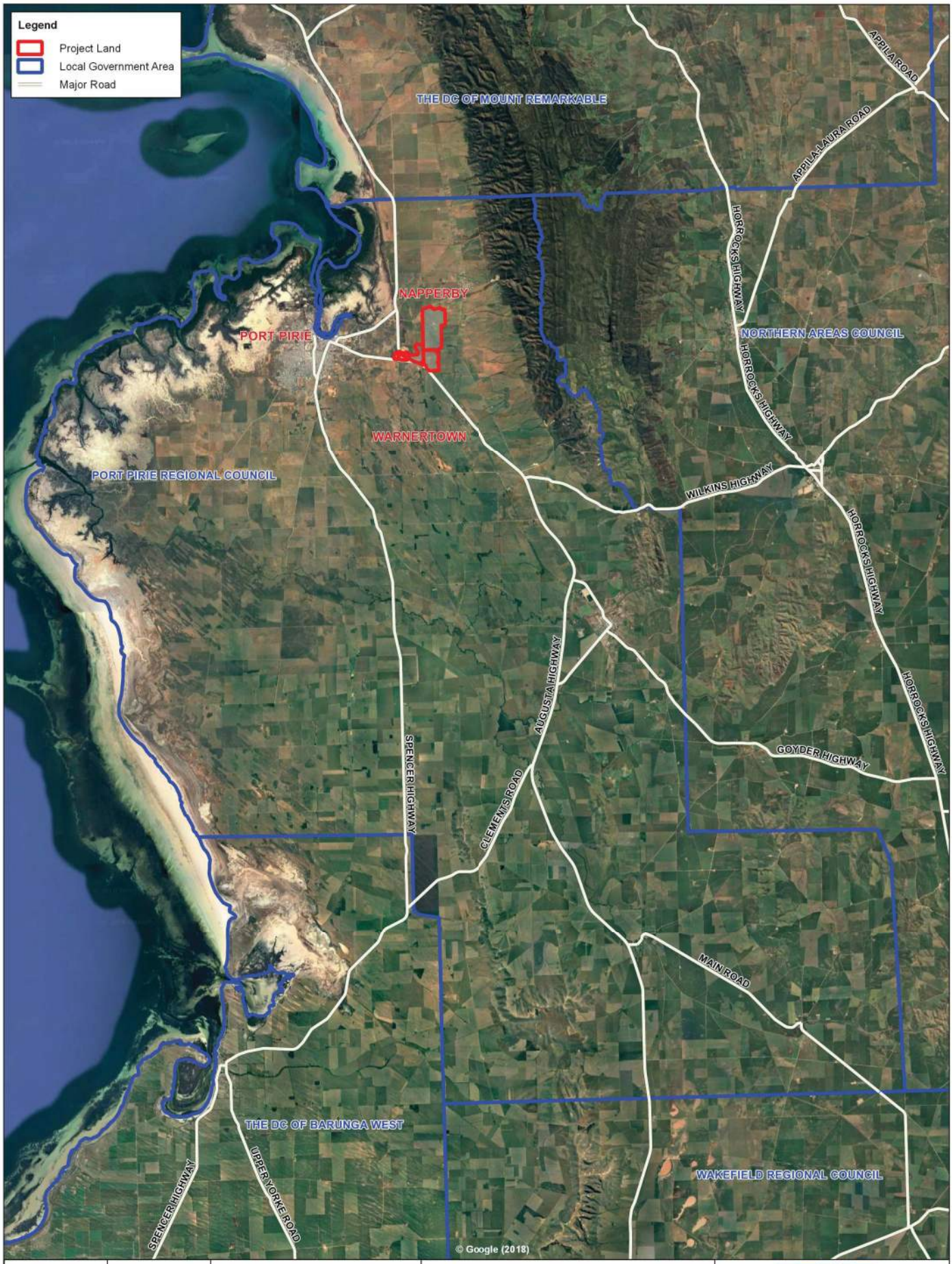

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Reviewer:	SMC/ JB
A3 Scale:	1:220,000
Job Ref:	11297/ V03

0 2.5 5 7.5 10 km

Map Projection: GDA 1994 MGA Zone 54

Figure 2-2

Study Area

Bungama Solar | Bungama SA Australia

21/11/2018

BUNGAMA SOLAR

11297_SEIA_Port Pirie LGA.qgs

3. REGIONAL PROFILE

Port Pirie Regional Council is located in the mid - north region of South Australia. The Project area is predominantly agricultural land, primarily associated with cereal crops, such as wheat and barley, as well as sheep grazing for merino wool. Port Pirie's main economic production is generated through resources and manufacturing, education, retail, hospitality and health care.

3.1. POPULATION AND GROWTH PROJECTIONS

Australian Bureau of Statistics (ABS) data re-published by South Australian Planning Portal (2018), provides population forecasting based on an analysis of growth trends considering assumptions of mortality, fertility and migration. Growth projections are not intended to predict the future, rather they provide an informed estimate of population movements.

The data indicates that the population of Port Pirie LGA is forecast to increase by 6% or 988 people (from a population of 17,627 to 18,615) between 2011 and 2031. The projection is equivalent to a + 0.3% annual projected population change. This is below the average annual growth rate of Regional South Australia of 0.4% recorded between the 2011 and 2016 census.

South Australia Planning Portal (2018) notes that growth in regional South Australia is typically dwarfed by those levels experienced in metropolitan Adelaide, generally as a result of increased housing densification in urban areas. It is noted that between the 2011 and 2016 census, 15 out of 44 regional LGA's (or 34% of regional councils) experienced population decline over that period. Low growth or population decline in regional areas can result from numerous factors including a downturn in a major industry, youth migration or an ageing population.

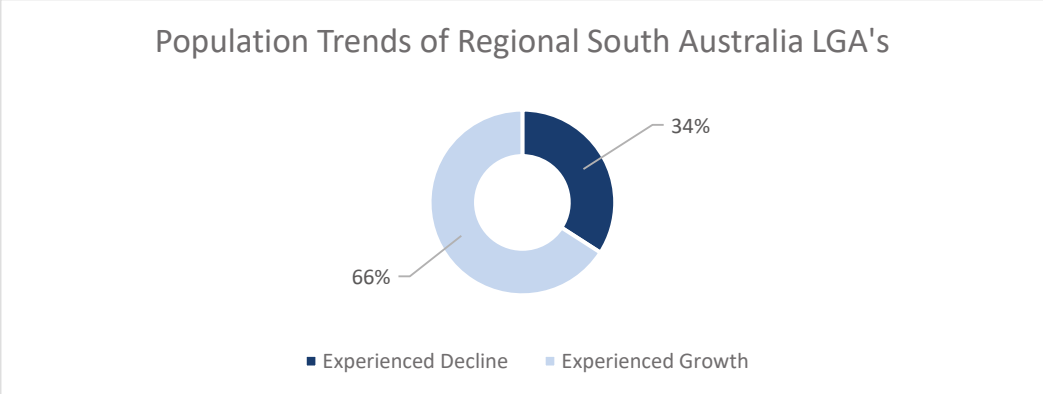

Figure 3-1: Population Trends of Regional South Australia LGA's (2011-16)

3.2. REGIONAL EMPLOYMENT CONDITIONS

The latest published data from the Small Area Labour Markets Publication, released by the Australian Department of Jobs and Small Business (2018), indicates that Port Pirie LGA has an unemployment rate of 11.6%.

This is substantially higher than the National and South Australian State averages of 5.4% and 5.6% respectively. This could be attributed the LGA's high proportion of agricultural lands as well as the recent decommissioning of proximate manufacturing and power plants.

As demonstrated in the previous aerial imagery, the immediate locality constitutes predominantly open rural and agricultural lands with the township of Port Pirie located west on the coast. Local context photos are provided at

Figure 3-2 Development Context Photos below. The LGA is serviced by several small townships, with the largest urban and employment bases located within the town of Port Pirie and further south in the Barossa Valley, and greater Adelaide.

Figure 3-2 Development Context Photos

4. SOLAR DEVELOPMENT CONTEXT

The recent momentum for large scale solar development in Australia has been predominantly driven by the improved feasibility of projects, through advances in technology and competitive construction costs. According to the Australian PV Institute (2018), there are over 1,000MW of solar projects currently commissioned and operational in Australia.

AEMO (2018) estimates that, as at the date of this report, almost 7,000MW of projects are currently proposed or in various stages of approval and development across the nation.

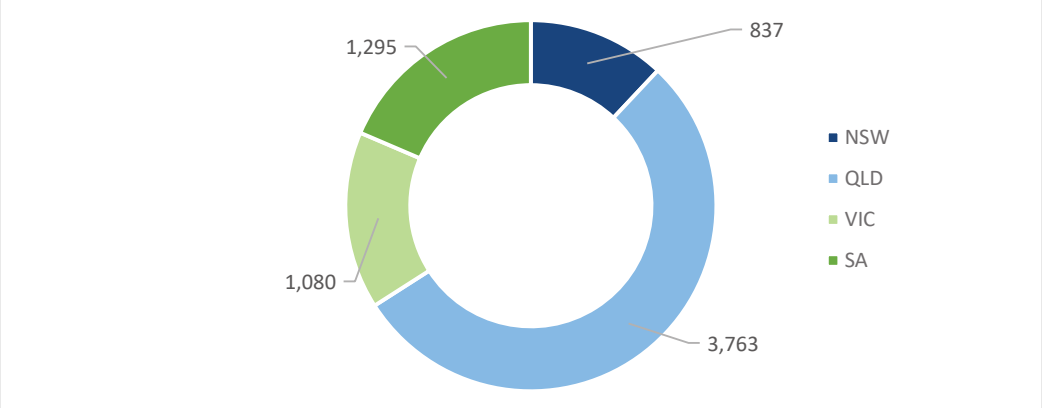

Figure 4-1: AEMO Estimate: Proposed Solar Development Pipeline Nationally (MW)

Recent growth in the industry has been encouraged by the increased focus on meeting clean energy targets, both nationally and internationally.

Solar farms, including the proposed Bungama Solar project, are considered to align with national and international policy as they:

- Fulfil the nation's commitment to reducing greenhouse gas emissions as a signatory to the Paris Agreement;
- Contribute to the Australian Commonwealth renewable energy target;
- Contribute to meeting South Australia's 50% Renewable Energy Production Target;
- Align with the Government of South Australia's, Renewable Energy Plan for South Australia; and
- Contribute to meeting the Government of South Australia's investment target of $10 billion in low carbon generation by 2025.

South Australia is considered to be a leader within the Australian market, in targeting and delivering renewable energy generation and storage, having recently met its 50% renewables target years before schedule.

4.1. SOCIAL LICENSE

A social license to operate is a concept that reflects a community's support of a development. A proposal may be able to satisfy legal requirements in order to gain approval, however attaining social support from the community can be vitally important to a project's longevity and sustainability.

Large scale solar is a relatively recent emerging industry for Australia. As such, relatively little data is available regarding community attitudes towards solar farms, in comparison to other more longstanding and prevalent types of energy projects. For this reason, long-term community attitudes towards individual solar projects, as well as the cumulative impact of projects across the Australian solar industry, are particularly difficult to gauge.

Research undertaken by the Australian Renewable Energy Agency (ARENA) suggests that the Australian public has a generally positive attitude towards the emerging large-scale solar industry. The study included a mix of the general Australian public as well as selected communities with a current or proposed large scale solar project.

Overall the ARENA research concluded that 78% of participants were either somewhat or strongly in favour of large-scale solar projects, with a small proportion (5%) being opposed to such projects. In other words, for everyone one person opposed to the solar industry in Australia, more than 15 people are in favour (ARENA 2015).

The survey suggests that the Australian community have generally demonstrated positive attitudes toward large-scale solar projects.

The community and government agency consultation undertaken to date for the Bungama Solar project, demonstrated a similar level of support, with most people consulted supporting the proposal.

5. STUDY METHODOLOGY

This report assesses both the social and economic impacts of the proposed Bungama Solar Project. The following section outlines the data sources and methodologies adopted.

5.1. SOCIAL IMPACT ASSESSMENT DATA

The social impact assessment data analysis identifies the social effects of the proposed development. The approach encourages the realisation of positive externalities and the mitigation of negative impacts. The purpose of the assessment is to ensure that decision makers have the necessary information available to promote socially responsible development. Accordingly, the social impact assessment methodology has included data sourced from a review of:

- Socio-demographic data from the Australian Bureau of Statistics (ABS);
- Additional published and publicly available social and demographic data; and
- Other strategic documentation, where relevant.

5.2. ECONOMIC IMPACT ASSESSMENT DATA

The economic impact assessment has adopted a methodology that identifies the economic effects of the proposal, allowing for the maximisation of positive externalities and mitigation of negative impacts. This assessment has considered the direct economic effects of the proposal, including employment, as well as the indirect broader effects such as investment and spending within the local economy. Accordingly, the economic impact assessment methodology has included:

- Economic and employment data from the ABS;
- Review of published and publicly available economic data; and
- Estimates provided by the project's Early Works Engineering Procurement and Construction Contractor (Early Works Contractor).

5.3. ASSESSMENT METHODOLOGY

The social and economic data provided below demonstrates the relative conditions of the study area. This SEIA assesses the opportunities and constraints of the study area and examines the likely outcomes of the Bungama Solar Project utilising published industry economic and employment multipliers.

6. SOCIAL CONTEXT

6.1. SOCIO-DEMOGRAPHIC PROFILE OF THE PROJECT AREA

6.1.1. Persons

At the time of the 2016 census, Port Pirie LGA had a population of 17,364 people, having experienced a slight increase of 31 people from the time of the 2011 census. As at the 2016 census, the population was closely divided between males and females, 49% to 51% respectively.

The average household size in Port Pirie LGA is 2.3 persons with 3.6% of the population identifying as Aboriginal or Torres Strait Islander.

6.1.2. Age

The largest proportion of the Port Pirie LGA population falls around the 40 to 59 years age brackets. There is an additional peak in population proportion around the early to mid-teen years (5 to 19 years). There is a distinct under-representation of young working-age population groups (20 to 39 years). The following figure demonstrates these trends.

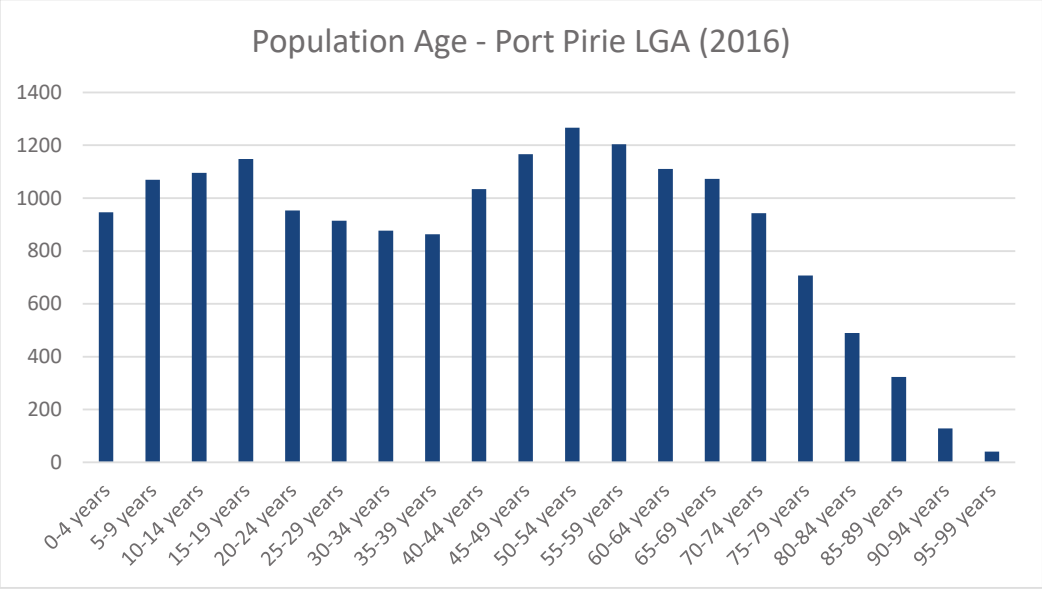

Figure 6-1: Population by Age (ABS 2016)

6.1.3. Household Types

The household type of an area is an indicator of the locality's function and role within the broader region. Household type gives significant insight into settlement patterns, demand for facilities and services and identifies opportunities for housing and employment.

The predominant household types in the Port Pirie LGA are 'lone person households' (27%), 'one family households with no children' (22%) followed by 'one family households with children' (19%). This data suggests an underrepresentation of 'traditional' settlement patterns, typified by family households which is likely a reflection of an ageing population as demonstrated above.

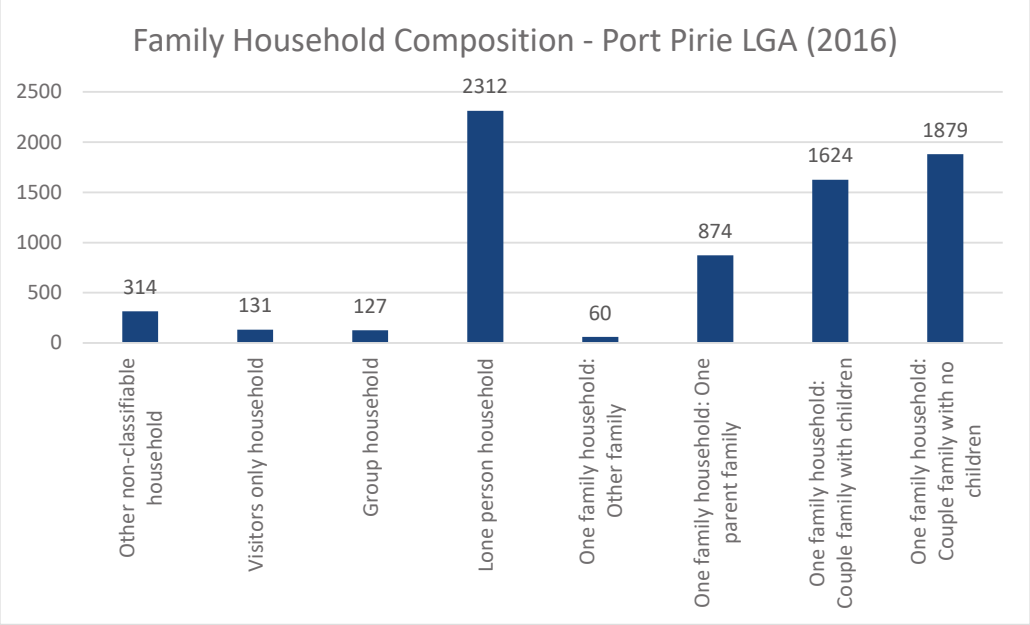

Figure 6-2: Household Composition (ABS 2016)

6.1.4. Tenure

Tenure data gives an indication of the socio-economic status of an area. Within the Port Pirie LGA, the largest proportion of residents own their residence outright (29% of the population), being slightly lower than the South Australian State average of 32%. There is a relatively even spread between those who own their home with a mortgage (26%) and those who rent (25%).

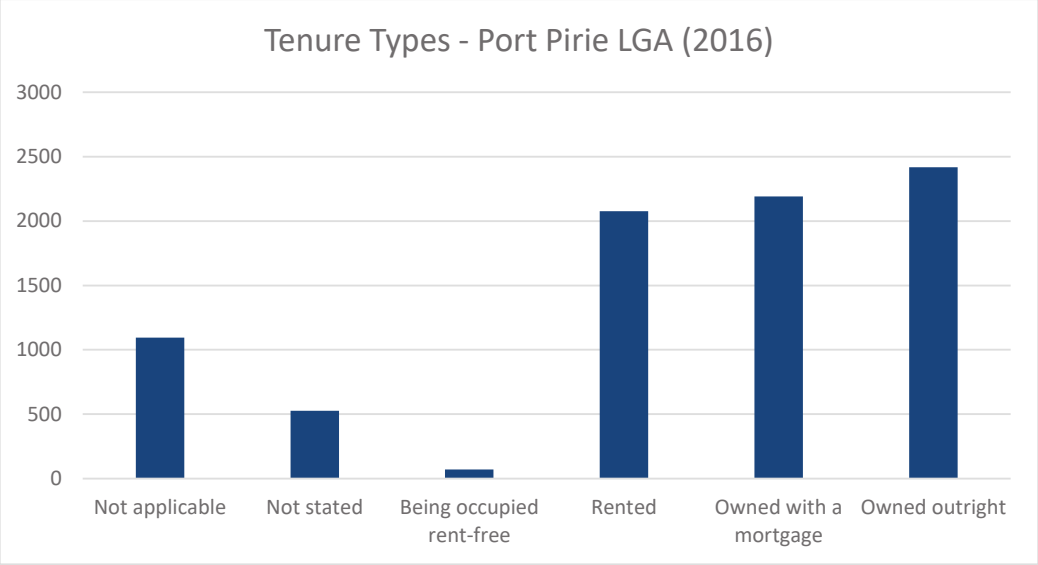

Figure 6-3: Tenure Type (ABS 2016)

6.1.5. Education

Educational levels are another important indicator of socio-economic status. Educational factors can help illustrate a regional population's skill set, work force capacity and working ambitions. Additionally, education levels can help to understand deficiencies in skill sets and help to guide strategies to nurture and retain a skilled workforce.

Within the Port Pirie LGA, approximately 8% of the population hold a bachelor's degree or higher, this is significantly lower than the South Australian state average of 18.5% (refer to Figure 6-4 below).

Of those participants who disclosed their highest educational level, the highest proportion had obtained a Year 10 (or above) high school certificate or a Certificate III or IV level training (44% and 22% respectively).

The large portion of local population with up to a Certificate III, could reflect the educational requirements of the predominant occupations in the area.

Furthermore, the low proportion of people with a higher level of education could indicate a lack of tertiary education opportunities for the locality as well as young adult migration trends.

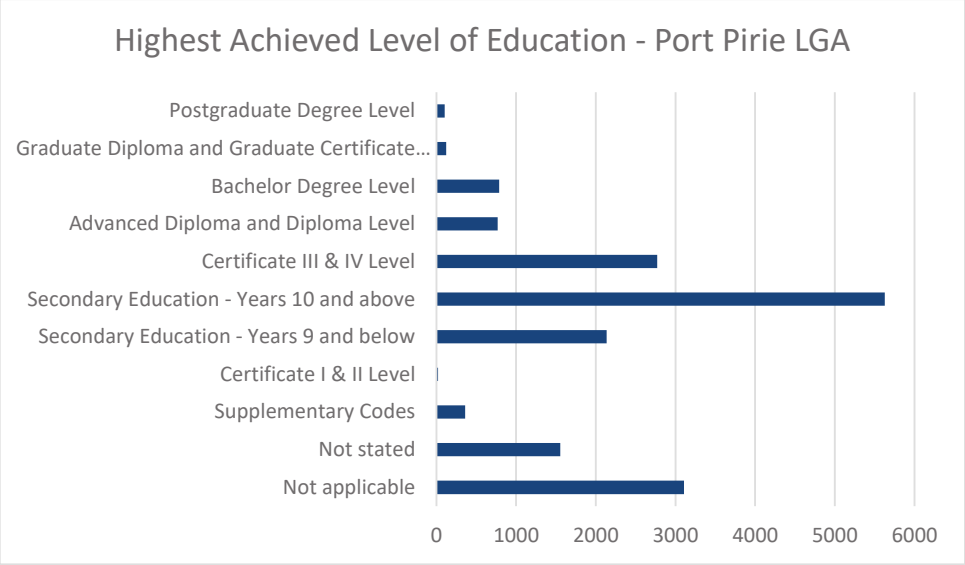

Figure 6-4 Highest Achieved Level of Education (ABS 2016)

6.1.6. Social Analysis Summary

To summarise, the data outlined above suggests that:

- Port Pirie LGA is experiencing relatively low population growth;
- Port Pirie LGA has a distinctive lack of a young working aged demographic;
- There is as a high proportion of single and family households with no children;
- There is a relatively even distribution of household tenure type; and
- The predominant level of education achievement is up to a Certificate III.

7. ECONOMIC CONTEXT

The economic statistics for an area provide valuable background information that, when combined with social considerations, allows for a robust understanding of the locality. This understanding can be used to quantify anticipated benefits to a community, as well as identify the socio-economic strengths and weaknesses of that locality, such as employment rates.

7.1. ECONOMIC PROFILE OF PORT PIRIE LOCAL GOVERNMENT AREA

The following information provides an overview of the economic and employment data for the Port Pirie Regional Council LGA. This data provides baseline information as to how the proposed development is likely to affect the community economically.

7.1.1. Gross Regional Profit

Gross Regional Product (GRP) is an objective measure of the economic output of a region. It is defined as the total market value of goods and services produced in the region within a given period, after deducting the cost of goods and services used up in the process of production, but before deducting allowance for the consumption of fixed capital.

For example, if a region manufactured a car, the GRP would equal the value of the car, less the cost of acquiring the parts or materials for the car, but no allowance is made for the depreciation in the car manufacturing plant and equipment.

Port Pirie Regional Council's Gross Regional Product is estimated at $703 million as at last financial year (June 2017) (National Institute of Economic and Industry Research 2017 data sited by Economy id).

7.1.2. Household Income

Household income can indicate the socio-economic status of an area, in particular the economic opportunities that are available to the labour force. Weekly household income depends on the number of workers in the household and their industry of employment. Income data is applicable only to persons aged 15 years and over.

Within the Port Pirie LGA, approximately 39% of households earn up to $1,000 per week, with the highest proportion of households earning between $400 to $499 total per week.

The following figure illustrates the weekly income of households in the Port Pirie LGA.

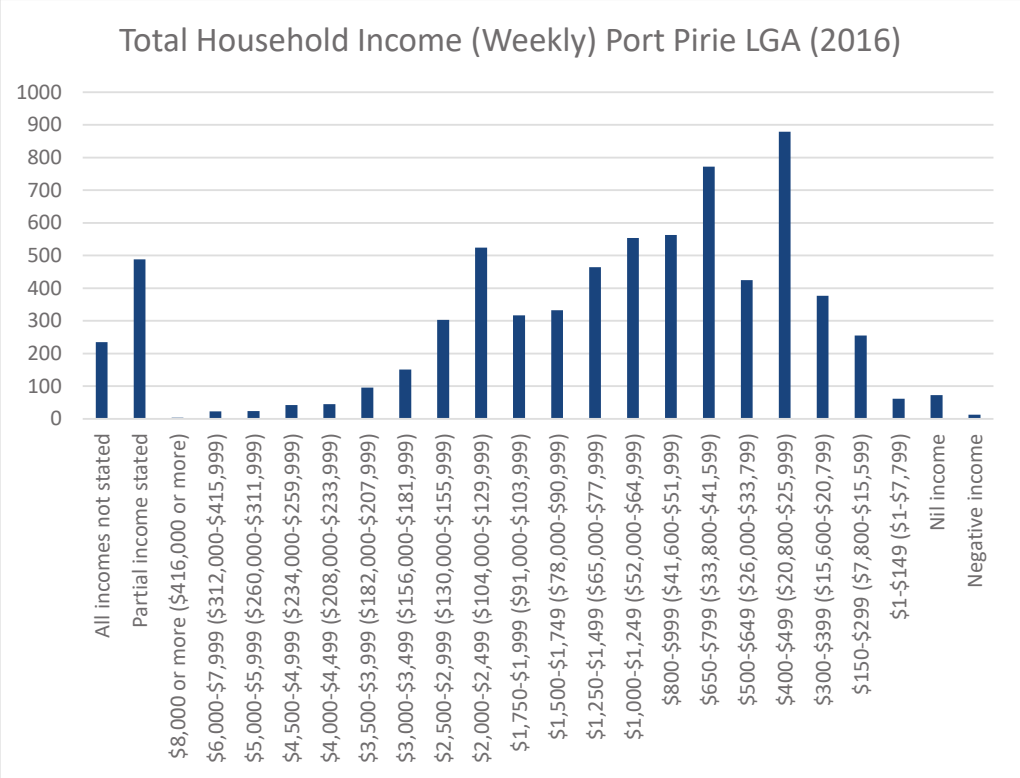

Figure 7-1: Total Household Weekly Income (ABS 2016)

The median weekly household income across South Australia at the time of the 2016 census was $1,206 with a slightly larger household size of 2.4 people.

Individual income measures can be indicative of educational qualifications and the type of employment undertaken. This data can be used to assist in the evaluation of an area's socio-economic status.

Within the Port Pirie LGA, the largest proportion of individuals earn between $300 and $399 per week. The following figure illustrates the weekly income of people in Port Pirie LGA aged 15 years and over.

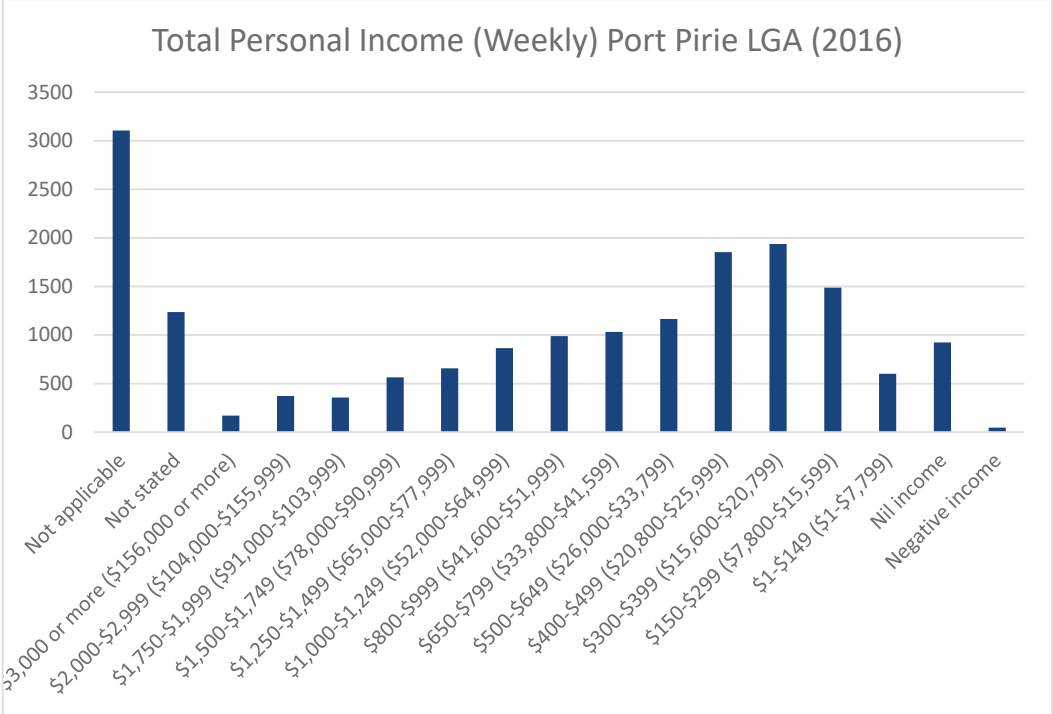

Figure 7-2: Individual Weekly Income (ABS 2016)

7.1.3. Labour Force

At the time of the 2016 census an estimated 6,112 people were reported as being currently employed in the labour force. It is noted that people who are aged 15 years and under who are either employed or unemployed, retirees, pensioners and people engaged solely in-home duties, are not classified as being in the labour force.

Information about employment type is important to determine the social and economic status of a region, and to determine the type of services that are in demand. Recognising Port Pirie's LGA's population as being 17,364 people (at 2016 census), approximately 35% of the total area is employed either fulltime or part-time.

The following figure illustrates the distribution of labour force characteristics, i.e. the spread of employment type of the working aged population only.

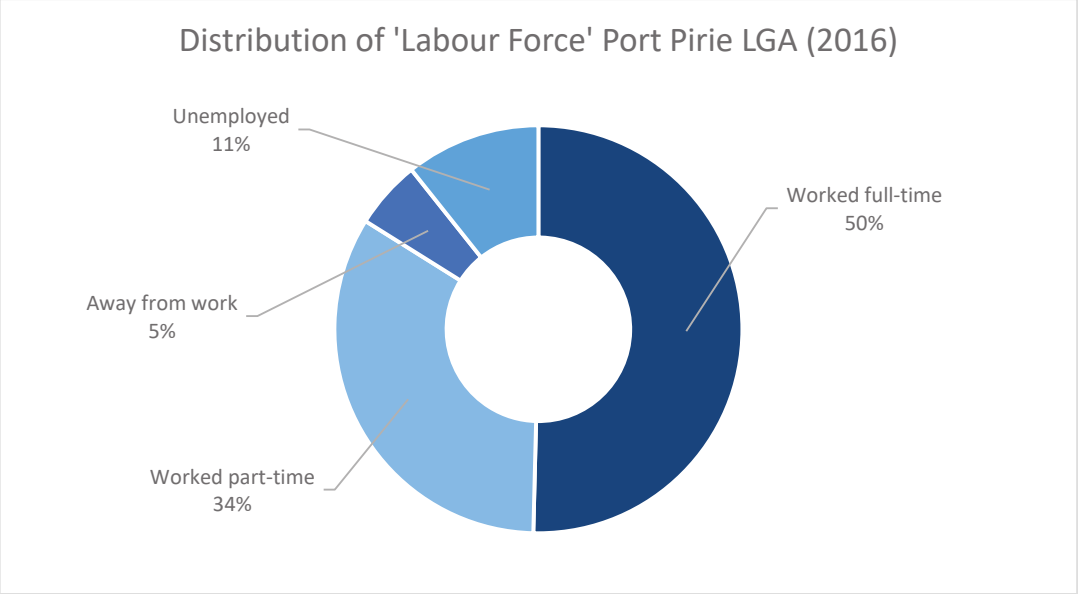

Figure 7-3: Distribution of Labour Force (ABS 2016)

7.1.4. Industry of Employment

The occupational structure of the workforce is an important indicator of the characteristics of the labour force. With other indicators, such as educational qualifications and income, occupation is a key component of evaluating the socio-economic status and skill base of an area. In general, the occupations held by a workforce are linked to a range of factors including:

- The economic base and employment opportunities available within the area;
- The educational qualifications of the population; and
- The working and social aspirations of the population.

The most common stated industry sectors within the Port Pirie LGA, as illustrated in the following figure, are:

- Health Care and Social Assistance (7%);
- Manufacturing (5%); and
- Retail Trade (5%).

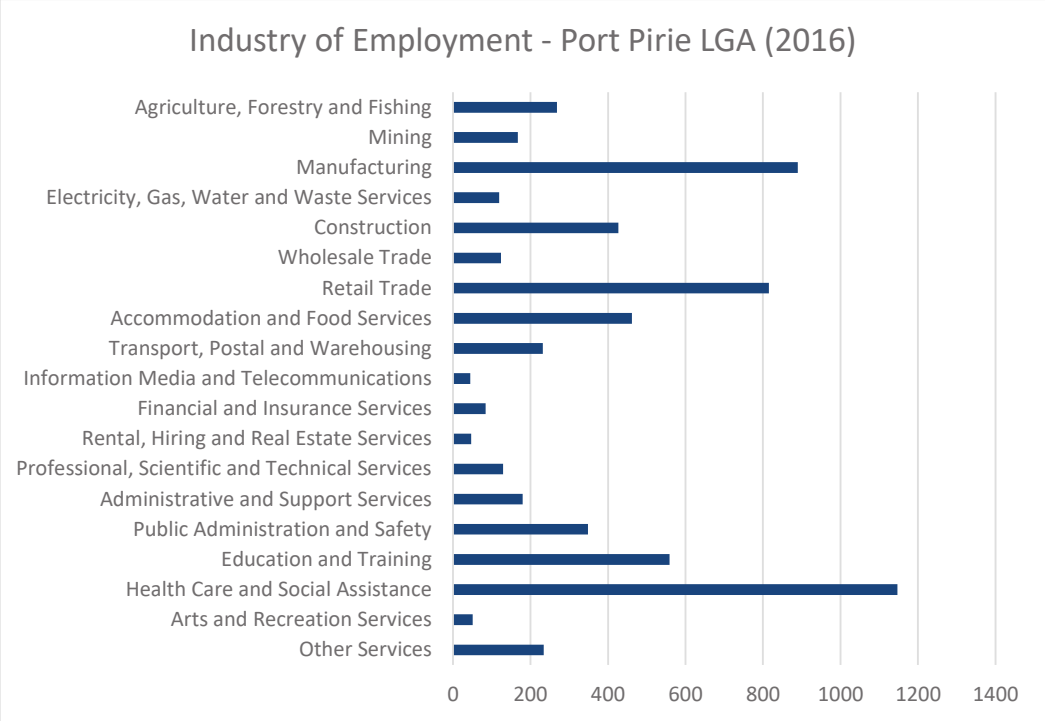

Figure 7-4: Industry of Employment (ABS 2016)

7.1.5. Occupation

The occupation of residents within an area is indicative of the opportunity for employment within the labour force, as well as the educational qualifications of a population. As demonstrated below there is a relatively even distribution of occupations types across the LGA.

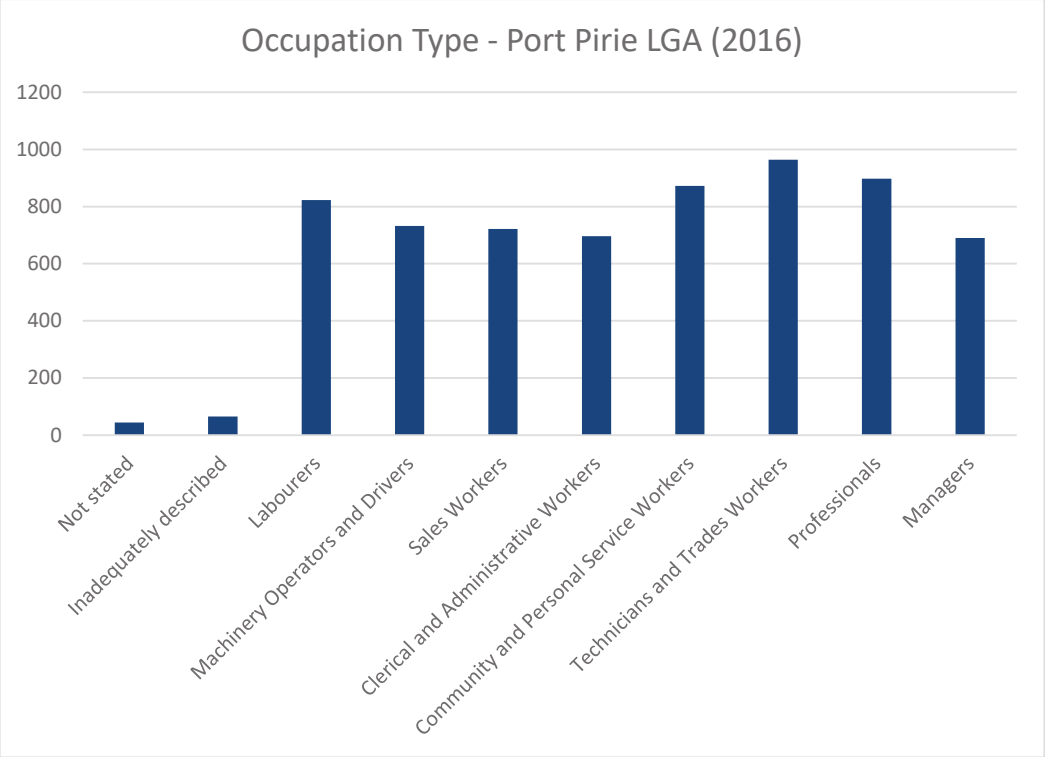

Figure 7-5: Occupation Type (ABS 2016)

7.1.6. Economic Analysis Summary

To summarise, the data provided above indicates that:

- Port Pirie LGA's GRP was approximately $703 million as at last financial year (June 2017);
- Household and individual incomes are less than the reported state average;
- Approximately 35% of the total population are in the labour force in either full-time or part-time work;
- Port Pirie LGA's largest employment provider is the manufacturing sector; and
- There is a relatively even distribution of occupation types across the LGA.

8. SOCIO-ECONOMIC IMPACT ASSESSMENT

8.1. LARGE SCALE SOLAR OPPORTUNITIES

The construction phase of a large-scale solar project offers the greatest opportunity for local/domestic employment. The project's construction requires site preparation, assembly, and installation of hundreds of thousands of Photo-Voltaic (PV) panels and over several hundred hectares of project area in addition to instillation of battery storage technology.

A typical project will also require landscaping, fencing, transportation services, electrical works, security, etc. Large scale solar projects have an innate high demand for a semi-skilled/unskilled workforce particularly for site preparation and assembly tasks, which constitute the largest aspects of construction.

Anecdotally, during the community consultation phase of the Bungama Solar Project, many community members and project neighbours indicated an eagerness to assist with the project, offering services, labour and equipment.

EPS Energy maintains a register of all interested individuals and businesses who have been in contact seeking employment opportunities. The Engineering Procurement and Construction Contractor will identify the opportunities for local engagement and employment for a variety of services and equipment required to construct the project. Where suitable local and or domestic employment will be preferred.

8.2. DIRECT DOMESTIC BENEFIT

The total cost of the project is estimated at $650 million AUD. Approximately 75% ($487,500,000) of expenditure will be used to acquire the plant and equipment internationally as the required technology is not locally manufactured and commercially available in Australia. Approximately 25% ($162,500,000) of expenditure is expected to be expended domestically, to construct the project.

The anticipated project construction cost of $162,500,000 is equivalent to approximately 23% of Port Pirie LGA's annual GRP to be spent domestically, as a direct result of the project.

In addition to this construction cost, ancillary development expenditure will occur in the form of the following:

- Legal Advice;
- Specialist Study and Design Consultants (such as engineering and ecological advice);
- Project Management Services; and
- Finance.

Typically, these costs run at up to approximately 1% of construction value, or an additional $1,600,000, which equates to a total estimated domestic spend equivalent to say $164,000,000.

Table 8-1: Estimated Total Domestic Spend

Estimated Total Domestic Spend	
Domestic Spend (Construction)	$162,500,000
Domestic Spend (Consultancy, Legal, etc.)	$1,600,000
Domestic Spend (Total Rounded)	$164,000,000

8.3. EMPLOYMENT OPPORTUNITIES

8.3.1. Development Phase Employment Benefits (Direct and Indirect)

As with economic output, the direct employment generated is only a part of the overall stimulation to employment which is created by a development project.

The production induced effect means that additional employment is created in the industries which supply goods and services to the construction project, while the consumption induced effect, means that further employment is created in all industries which benefit from the additional wages, taxes and profits generated by the project being spent throughout the economy.

Acknowledging the last published ABS input/output economic multipliers for the construction industry and making an allowance for inflation to the current day and considering the scale of the project, a fair estimation for general construction industry employment may equate to approximately: 1 full time equivalent job, and 1.5 indirect full-time equivalent jobs for each $590,000 in project value derived from domestic sources.

Adoption of these multipliers suggests that the $162.5 million domestic spend from the project's construction would yield employment generation, on an equivalent full-time basis, of up to approximately 275 direct construction jobs and 410 indirect jobs, over the intensive construction period.

It should be noted that Bungama Solar is not a traditional construction project and involves a lightweight construction typology, therefore requiring a lessened construction labour force. The employment estimates within have considered this fact.

Table 8-2: Construction Phase Employment

Construction Phase Employment - Full time equivalent (FTE)	
Domestic Project Value (Construction)	$162,500,000
Direct Employment (FTE positions)	~275
Indirect Employment (FTE positions)	~410
Total Employment	~685

8.3.2. Operational Phase Employment Benefits

Bungama Solar is expected to directly generate up to approximately 8 full time equivalent, long term jobs during the operational phase. These roles include management, maintenance and operations.

Based on the South Australian average weekly FTE earnings of $1,200/week (ABS 2016), this equates to some $500,000 in additional wages being generated in the local economy each year, or $15,000,000 over the life of the project.

Table 8-3: Operational Phase Employment

Operational Phase Employment	
Direct Employment (FTE positions)	8
South Australia Average Weekly FTE Earnings	$1,200
Wages Generated (pa)	**$500,000**
Wages Generated (project life)	**$15,000,000**

8.4. LOCAL EXPENDITURE

In addition to the direct contribution to the economy from the Project's construction and operations the Project will have 'flow-on' benefits to the activities of other industries.

An estimate of the extent of these impacts can be illustrated using published industry multipliers such as those created by the ABS. While not exact, this methodology is nonetheless useful in broadly demonstrating the magnitude of additional 'indirect' economic benefit.

Utilising the ABS input-output table for the construction industry, the total multiplier is 2.8; meaning that for every one dollar ($1.00) spent in the construction industry an additional one dollar and eighty cents ($1.80c) of value is added to other parts of the economy.

On this basis, the Project is estimated to contribute additional 'indirect' economic benefits in the order of $292 million to the wider economy.

This estimate encapsulates the entire stimulus to those sectors of the domestic economy that will contribute goods or services to the project or have an increase in employment/production as an indirect result of the project. This includes accommodation, transportation, food services, entertainment for construction workers, telecommunications etc.

8.5. DIRECT COMMUNITY FUND

In addition to the direct and indirect economic benefits afforded by the planning, construction and operation of the Project, Bungama Solar is committed to providing additional direct benefit to the community in the form of a 'Community Fund'.

A local Community Fund is proposed to be established, with the project making an annual financial contribution throughout the life of the Project. The Community Fund is intended for the local community who are hosting the Project; to assist with funding environmental, social, and economic development opportunities for the community.

Essentially the fund is envisioned to be managed by a committee, consisting of elected community members, a representative of Bungama Solar and the Local Council. The committee will be responsible for administering the fund.

The fund will be furnished with an annual monetary contribution from Bungama Solar for the duration of the operation of the project. Local community members and organisations can apply to receive funding for projects or activities that benefit the local community.

The committee will assess the merit of applications and govern the appropriate distribution of the fund.

9. RENEWABLE ENERGY AND CARBON EMISSIONS

In recent times South Australia has diversified its energy supply sources, as evidenced by its growing proportion of renewable energy sources. This transition has been significantly influenced by several coal-fired operations ceasing in the state. See relative energy generation mix by State below.

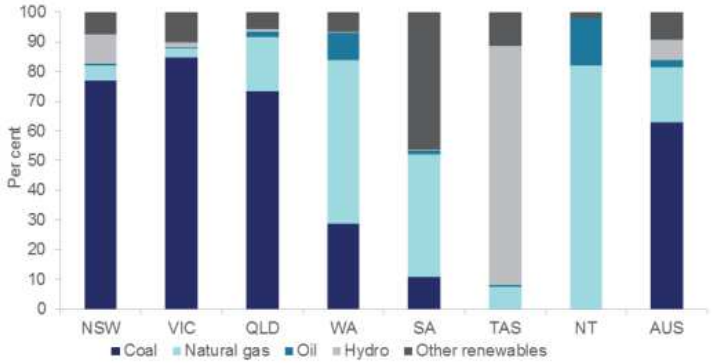

Figure 9-1: Australian Electricity Fuel Generation Mix for 2016
Source: Department of the Environment and Energy (2017)

Broadly, South Australia recognises that high levels of solar and wind generation, together with other generation sources and effective grid stability services have the potential to safely deliver affordable power. The Project will contribute to the delivery of affordable power from renewable energy.

Development of large-scale generation assets within South Australia will increase competition for dispatching power to the state's electrical network and hence assist in reducing electricity prices over the long term.

9.1. BUNGAMA SOLAR RENEWABLE ENERGY GENERATION

Based on the Project's current indicative design (including approximately 280MW single axis tracking system), the Project is anticipated to generate over 705,000MWh of renewable energy per year; enough to power 86,000 homes per annum.

This renewable energy generation equates to an annual equivalent 487,000 tonnes of Greenhouse Gas (GHG) emissions displaced, which may otherwise be sourced by non-renewable energy sources. Bungama Solar's approximate 280MW (AC) generating capacity, and GHG displacement is equivalent to offsetting the impact of 195,000 cars or the equivalent benefit of 69,500 trees per annum.

10. STRATEGIC CONSIDERATIONS

10.1. SOCIAL AND ENVIRONMENTAL ISSUES

Based on a review of the existing characteristics and profile of the Port Pirie LGA, the following impacts have been considered.

10.1.1. Port Pirie Regional Council Development Plan (Consolidated – 31 October 2017)

The Project area is zoned Primary Production. The Port Pirie Regional Council Development Plan notes Renewable Energy Facilities such as solar and ancillary development are envisaged within the Primary Production zone and constitute a component of the zone's desired character.

The Development Plan specifically contemplates the presence of Renewable Energy Facilities such as solar and ancillary development in the Council area and in the Primary Production Zone.

10.1.2. Positive Impacts

The Project will deliver clean and renewable energy in the face of climate change and will assist to meet renewable energy targets for the nation.

Climate change is arguably one of the most topical social and environmental issues of today, with the globalised unsustainable dependence on fossil fuels becoming ever more apparent. As described in sections above, large scale solar projects have the capability to contribute substantially to meeting renewable energy targets and improving sustainable energy generating practices. Bungama Solar will make a substantial contribution in providing renewable energy for the nation to meet renewable energy targets.

The Project will create employment opportunities for the study area.

The Project will generate considerable employment for the Port Pirie LGA, particularly during the construction phase and as a flow on effect from the heightened investment and spending in the locality. The economic impact assessment section of this report illustrates the anticipated employment generation.

Members of the community who attended the Bungama Solar information sessions identified that the project locality experiences high levels of unemployment. Many local individuals and businesses expressed interest in being involved in the Project.

The Project provides a suitable alternative land use for the Project area that meets the needs of the wider community and promotes industry diversity.

The Project is considered a suitable alternative land use for the Project area as it is temporary in nature, has minimal long-lasting effects, and upon project completion the land can be returned to its original condition. Further, the project site location is proximate to existing substation infrastructure, allowing the project to be localised and minimise adverse environmental impacts.

Bungama Solar provides an opportunity for the Port Pirie LGA to diversify its industry by adopting an innovative, high-tech industry such as solar. Further, the use of the Project area for the development does not preclude other concurrent agricultural uses, such as grazing of lambs on low-lying pasture underneath the solar panels.

Solar farms typically have a minor physical disturbance footprint. As such, investigations into co-agriculture opportunities are underway to ascertain opportunities within Bungama Solar for other forms of traditional agriculture such as sheep grazing and apiculture to co-exist with the Project.

The Project provides income diversification to Project land-holders, assisting land-holders to mitigate seasonal agricultural enterprise risk. Bungama Solar will provide Project land-holders with an income stream that is stable and defined for a significant period of time.

10.1.3. Perceived Negative Impacts

Notwithstanding the positive impacts noted above, a number of potentially negative impacts have also been identified, through the site assessment and community engagement process. These issues are identified below.

Perceived visual impacts including general amenity and glint/glare.

It is recognised that the Project area is exposed to Augusta Highway, Gulf View Road, Bungama North Road and neighbouring properties. A Visual Impact Assessment (VIA) attached as Appendix 7 considers the Project's potential visual impacts and appropriate mitigation measures. Based on the Visual Impact Assessment the Project's potential to adversely impact the existing and planned visual landscape is low.

A Glint and Glare Assessment attached as Appendix 12 considers the Project's potential glint and glare impacts and appropriate mitigation measures. Based on the Glint and Glare Assessment the Project's potential to adversely impact area beyond the Project area is minimal.

Perceived impact on agricultural land.

It is acknowledged that the Project on the Project area has the potential to impact on the agricultural viability of the Project area. However, given that the Project of this type is temporary in nature and has minimal long-lasting negative impacts, it is considered that Bungama Solar will not affect the long-term viability of agricultural land at the Project area.

Solar farms in general are considered a relatively 'non-invasive' development as the mounting system which connects the support frames to the ground are small in diameter.

Notwithstanding any perceived impacts, the change of use will act to provide diversity and security of income for farmers in this seasonally difficult agricultural area. Upon decommissioning the land use will revert back to dry land agriculture.

Impacts arising from construction phase including dust and noise.

It is recognised that development requiring construction works has the potential to generate noise and dust.

Noise and dust will be managed through a construction environmental management plan. Specific dust and noise impacts will be explored in more detail in the Project's Planning Report.

Health Impacts from electromagnetic fields and radio frequency interference.

Electromagnetic field (EMF) radiation is generated by all electrical appliances and other sources that carry an electrical current. Radio Frequency Interference (RFI) can be generated by a range of electrical apparatus.

EMF and RFI potential impacts are explored in in the Planning Report. The Project's potential to adversely impact the existing EMF and RFI environment is low.

11. CONCLUSION

This SEIA has been prepared to ascertain the social and economic outcomes of the construction and operation of Bungama Solar. The analysis concludes that the project will provide significant positive social, environmental and economic outcomes for both the LGA and the state of South Australia. The assessment has been framed by considering the existing social and economic conditions of the Port Pire LGA.

As examined, the most prevalent industry within the Port Pirie LGA is manufacturing. Income levels in the study area are lesser than that of the recorded state average, and the demographic profile indicates a predominantly semi-skilled workforce. These statistics potentially reflect the migration of skilled working age young adults away from region, the prevalence of agricultural-based employment or the decline of manufacturing in recent years.

This study revealed that Regional South Australia has recently experienced a general population decline and that the Port Pirie LGA is experiencing low population growth, possibly as a result of limited employment or study opportunities in addition to an ageing population.

The Project will provide significant economic stimulus and diversification of the region's economic base. Anecdotal evidence collected during community consultation for the project, indicates that the local community are generally supportive of the project and have expressed interested to participate in the Project's construction and operation. Based on the analysis, assumptions, discussion and data provided within, the following key findings are identified. The Project will:

- Deliver clean and renewable energy for Australia in the face of climate change;
- Assist in meeting renewable energy targets for the State and the Nation;
- For each year of its 30-year operational life, displace the equivalent of 497,000 tonnes of greenhouse gas emissions per annum, the equivalent of offsetting the impact of 195,000 cars or providing the equivalent benefit of 69,500 trees per annum;
- Provide clean energy to power an equivalent of 86,000 homes for each year of the project's life;
- Create industry diversity for the Port Pirie region;
- Create substantial employment opportunities during project construction phases;
- Be located in a suitable area with access to existing infrastructure;
- Provide a flexible, low-impact alternative to the existing agricultural land use;
- Generate an estimated economic benefit in the order of $292.5 million for the broader economy and approximately $164 million as direct domestic project expenditure;
- Generate up to an estimated 275 equivalent full-time jobs during construction, and a further 410 indirect full-time equivalent jobs;
- Generate up to an estimated 8 equivalent full-time jobs during operations; and
- Provide a direct benefit to the community in the form of a community fund.

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APPENDIX 12

Glint & Glare Assessment

GLINT AND GLARE ASSESSMENT

Prepared for Bungama Solar

Prepared by BV Consulting

BUNGAMA SOLAR

www.bungamasolar.com.au

EPS ENERGY

Reference No. 11297

November 18

Glint & Glare Analysis

Bungama Solar
South Australia

Analysis of optical effects of solar panels onto air planes, cars, trains and houses

Prepared by **BV** Consulting

Client	Bungama Solar 1 Pty. Ltd.
Status	FINAL
Date	25 November 2018
Version	3.1
Classification	CONFIDENTIAL
Author	BERNHARD VOLL

BV CONSULTING | Nora-Platiel-Str. 4 | 34253 Lohfelden, Germany | ☎ +49 561 4751 3339
💻 Bernhard.voll@bdesolutions.com

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2 EXECUTIVE SUMMARY

The following report describes the results of a Glint & Glare calculation performed for the Bungama Solar Project in South Australia.

Bungama Solar is a Photovoltaic Energy Generation System (PVS) and Battery Energy Storage System (BESS) located approximately 6 km east of Port Pirie, directly North and East of the Augusta Highway (A1) passing east of the suburb of Bungama. The PVS will comprise of solar panels and associated equipment in single axis horizontal tracking arrangement tracking the movement of the sun from east to west.

The report has been prepared by BV Consulting upon request by the Client to assess the potential Glint and Glare impact of the PVS Solar Panels. To represent a worst case scenario this report has been based on the conservative assumption that the PVS Solar Panels will cover approximately 413 ha as shown in Figure 10.

The Glint & Glare Analysis ("GGA") determines the effect on both drivers on roads or railway tracks (Roads "RO") as well as airplanes approaching nearby airports (Flight Paths "FP") and houses (Observation Points "OP").

The Glint and Glare analysis categorises glint and glare into three major categories:

Hazard Level	Description
GREEN	Low potential for after image[1]
YELLOW	Moderate potential for after image
RED	Potential for permanent retinal damage

Table 1: Hazard levels SGHAT

Considering that Port Pirie Airport is approximately 10 km away from Bungama Solar it is unlikely that the proposed PVS solar panels will create any issues for pilots approaching this airport.

The Project area is traversed by Locks Road, a small local traffic road. Augusta Highway (A1) follows the southern and western project area boundaries. This is a major highway with significant traffic and it is therefore important to analyse potential Glint and Glare impact on drivers on this road. Any glint & glare for drivers on this road may also affect train drivers on the railway line to the south of the development. Also several houses in the immediate vicinity of the project area may be affected. Therefore glint & glare impact on these houses has also been analysed.

The worst case scenario calculation does not factor in any directional views and only assumes views of the whole of the PVS solar panels. It does not consider the actual geometry of the solar modules but assumes a continuous reflective surface within the project area boundaries. No existing vegetation or any other obstacles have been considered in the calculation to represent the absolute worst case.

The glint and glare analysis has provided the following overall results which are described in detail in this report.

Drivers on Roads (RO)	Train Drivers (RO)	Houses (OP)	Airplanes (FP)
GREEN	NO	GREEN	NO

Table 2: GGA Summary – Glare Results

The worst case scenario calculation has shown no impact on pilots, only some very minor impact on drivers and minimal impact on houses during the morning/evening hours of the day can be expected. When considering the existing vegetation, buildings or other existing obstacles in the PVS solar panel region these obstacles and vegetation are likely to substantially reduce potential glare.

[1] After image = lingering image of the glare in the field of view

Glint & glare for drivers can be easily mitigated by hedges, scrubs or small trees alongside the project boundaries and/or in the road reserves and/or private properties to prevent direct view onto the panels.

As the PVS solar panels will be built with single axis tracking systems glint & glare impact will be very low. In addition to the existing vegetation around the project area and some residences the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m tall landscape screen around several parts of the Project Area boundary[2]. This visual buffer and landscape screen together with the existing vegetation surrounding many parts of the project area and adjacent residences is considered to ameliorate any GREEN GLARE calculated.

Therefore no additional mitigation measures are considered necessary.

[2] Landscape Masterplan – Bungama Solar 11297, presented by Client

3 GLINT & GLARE FROM SOLAR PANELS

Glare describes the difficulty seeing in the presence of bright light such as direct or reflected sunlight or artificial light such as car headlamps at night. Glare is caused by a significant ratio of luminance between the task (that which is being looked at) and the glare source. Factors such as the angle between the task and the glare source and eye adaptation have significant impacts on the experience of glare.

Glint is defined as a tiny quick flash of light that can cause discomfort to the viewer. Solar Panels are designed to absorb as much light as possible for power generation and therefore reflectivity of solar panels is minimised. Nevertheless the glass front and potential metal frames may cause some reflection of sunlight. However, compared to other objects such as sheds, ponds, railway tracks, windows, cars etc. solar panels reflect less light than even grass, crops, forest and water.

3.1 Reflectivity of Photovoltaic Panels

Photovoltaic panels (PV Panels) are commonly made of polysilicon covered with treated high transmission low iron glass allowing high absorption of light for power generation. Therefore standard solar PV modules[3] are considered to produce less glare and reflectance than standard window glass. Photovoltaic panels also reflect significantly less light than other common surfaces as shown below[4].

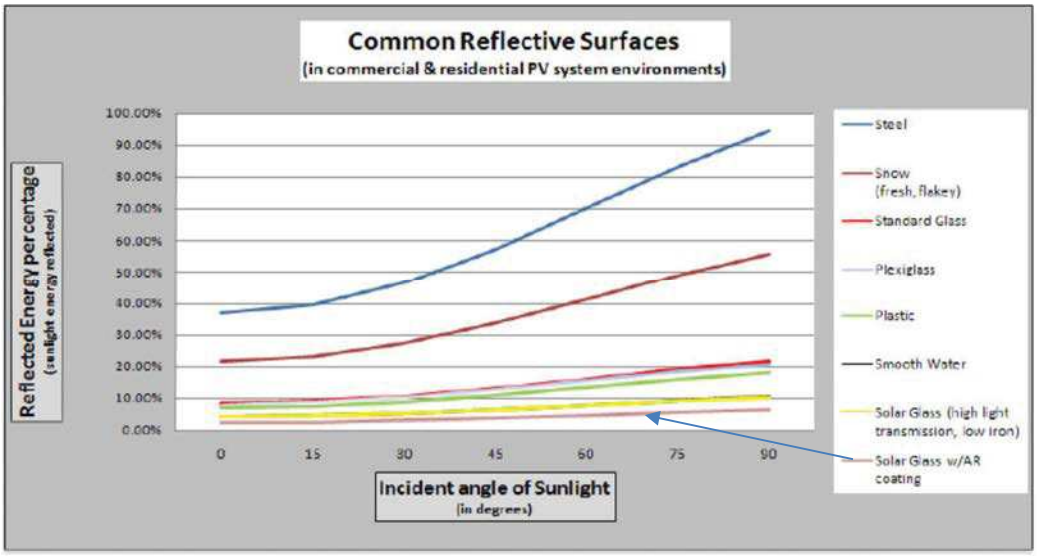


Figure 1: Reflected Energy in % of sunlight

[3] Module consists of a number of panels and a frame holding them
[4] Source: Sunpower Corporation Tech Note T09014, September 2009

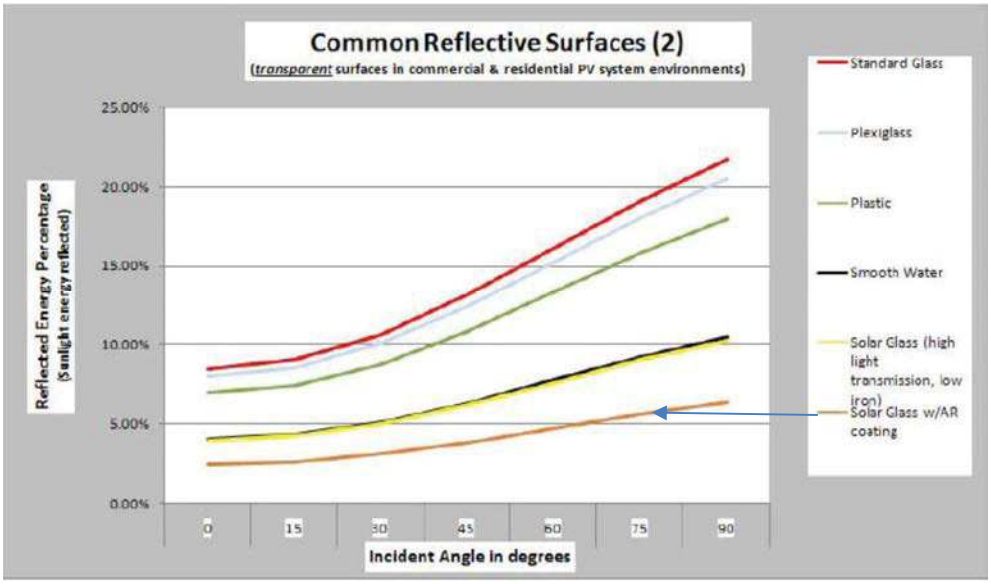


Figure 2: Reflected Energy in % of sunlight (Detail)

It can therefore be concluded that the maximum reflectance of a solar PV Panel can be considered as 11% (assuming uncoated glass) and as low as 6% when using anti-reflective coating. This is significantly below the maximum reflectance of a standard steel surface with 94.4%. Modern solar PV Panels use coated glass to further reduce reflection. Therefore impact will be significantly less. Such coated glass has been used for the calculation.

Compared to typical surfaces frequently occurring in rural areas this reflectivity (albedo = reflection coefficient) is considered very low and thus of no significant concern.

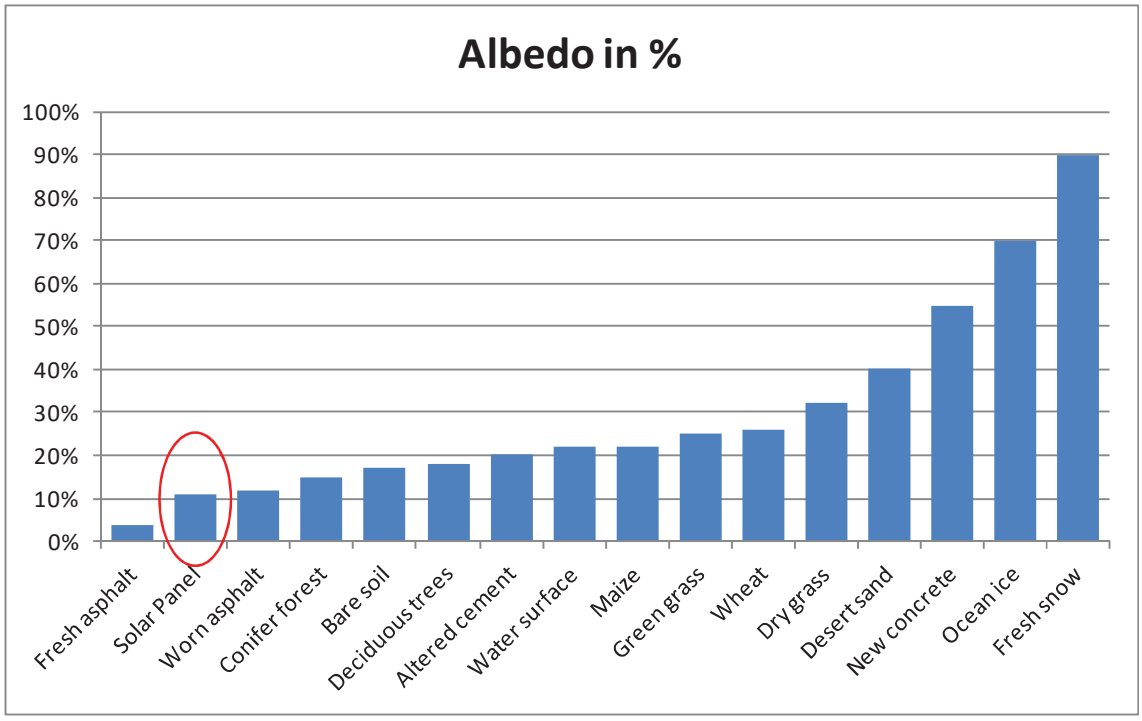


Figure 3: Sample albedos for various surfaces[5]

In a typical agricultural environment roof constructions are commonly made of corrugated steel. Whilst the corrugation itself reduces the glare potential of the surface such roofs still will reflect substantially higher amounts of light than solar PV panels considering the significant difference in reflectivity as shown in Figure 1 to Figure 3 above.

3.2 Glint

Glint results of the direct reflection of sunlight from a reflective surface when the sun reflects of the surface of the PV panels at the same angle as a person is viewing the PV panel surface. Considering the low reflectivity of solar PV panels and the requirement for direct reflection glint is not considered to be an issue for the proposed project area.

[5] Source: Wikipedia, www.apesimulator.org

3.3 Glare

Sunlight reflection from the solar PV Panels will be in a diffuse pattern potentially resulting in glare or difficulty seeing in the presence of a very bright light[6]. Glare may, depending on its intensity, result in slight irritation of view and temporary after images to permanent damage of the retina in case of prolonged intensive glare. A number of factors determine intensity and extent of glint and glare such as:

- distance between panels and viewpoint;
- horizontal tilt angle of panels;
- time of day and season;
- cloud cover;
- Screening vegetation.

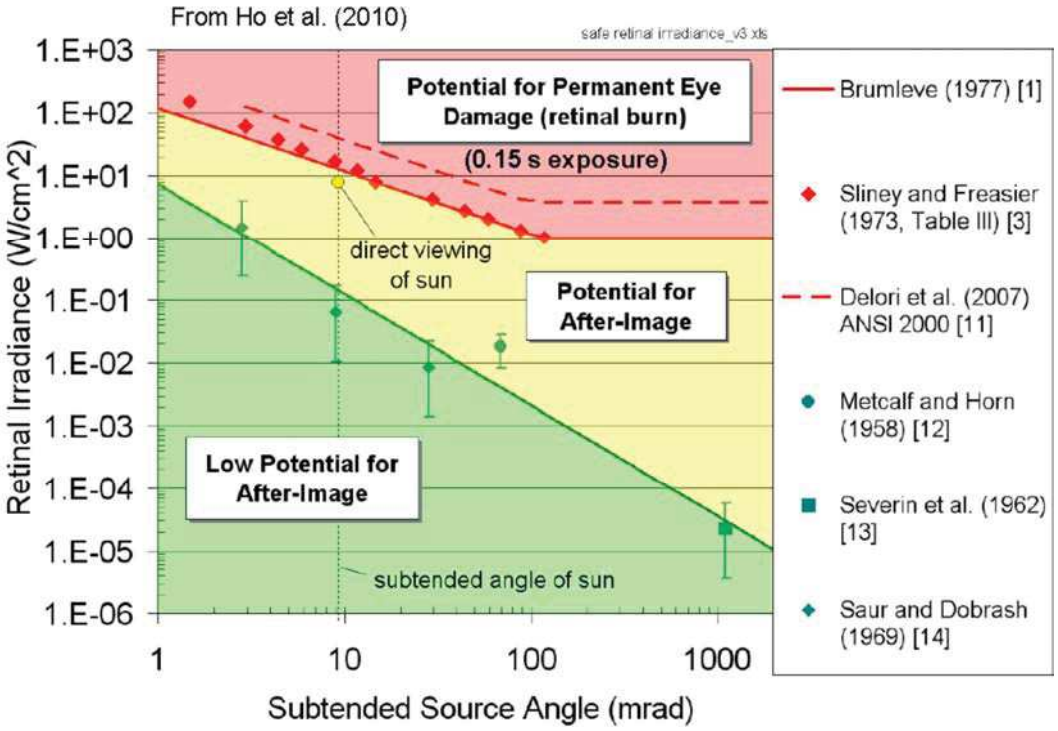


Figure 4: Hazard Plot for visual impact of glare[7]

Figure 4 shows the calculated hazard zones for various sunlight source angles and sunlight intensities as developed through studies commissioned by the US Department of Energy. This plot allows categorizing the glare hazard based on the calculated energy and angle of the projected image caused by the PVS solar panels. In the "low potential for after image zone" it is considered that glare within that range does not cause significant air traffic or other traffic related safety hazards.

[6] Source: Wikipedia
[7] Source: Sandia National Laboratories, US Department of Energy, subtended arc is a reflection of the image size experienced

4 METHODOLOGY

The Solar Glare Hazard Analysis Tool (SGHAT V3.0), developed by Sandia Laboratories and licensed by Forge Solar[8] has been used to calculate Glint & Glare impact for this study. This tool is considered industry standard and is also the software required by the US Federal Aviation Administration and recognised by the Australian Civil Aviation Safety Authority (CASA).

Once Glare can be found the tool calculates the retinal irradiance and subtended angle of the glare source to predict ocular hazards from temporary after images to permanent eye damage. Results are grouped into three categories:

Hazard Level	Description
GREEN	Low potential for after image[9]
YELLOW	Moderate potential for after image
RED	Potential for permanent retinal damage

Table 3: Hazard levels SGHAT

The model has some limitations resulting in the model describing a worst case scenario:

- Clear day solar irradiation is used;
- No trees of other obstacles between viewer and PVS solar panels are considered;
- No directional views, always views of the whole PVS solar panels;
- The model does not consider the actual geometry of the solar modules but assumes a continuous reflective surface within the project area boundaries.

4.1 Modelling

A number of observation points alongside the project area have been defined, described as “OP” in the detailed results section of this report. These observation points are generally set at 1.5 m above ground level representing the typical position of a person on a property.

Roads and railway tracks have been defined as Routes “RO” simulating the viewshed of a driver with a view angle of approximately 50° representing a driver looking at the road ahead.

Flight paths have been defined with typical approach angles. Flight paths are described as “FP” in the detailed results section of this report.

4.2 Modelling limitations

Several limitations exist due when simulating large arrays. Although this may limit the accuracy of the result the overall outcome is considered conservative and therefore represents a worst case scenario.

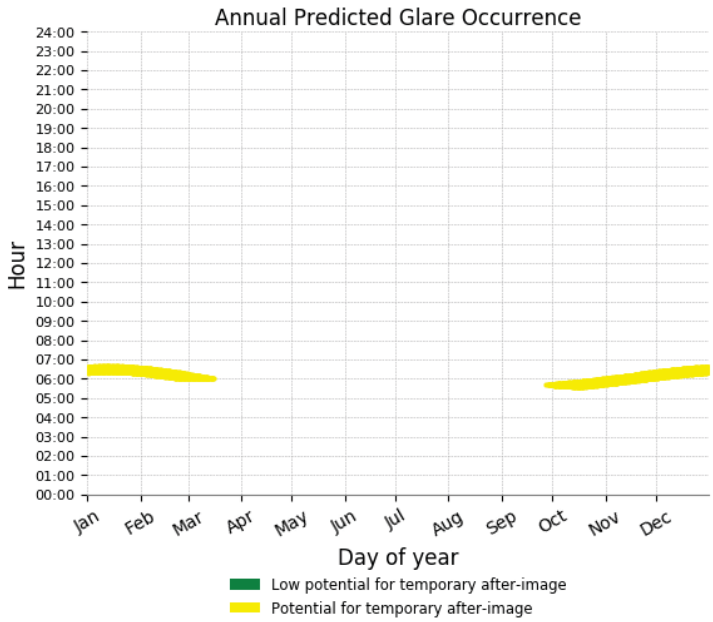
- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- 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.

[8] www.forgesolar.com
[9] After image = lingering image of the glare in the field of view

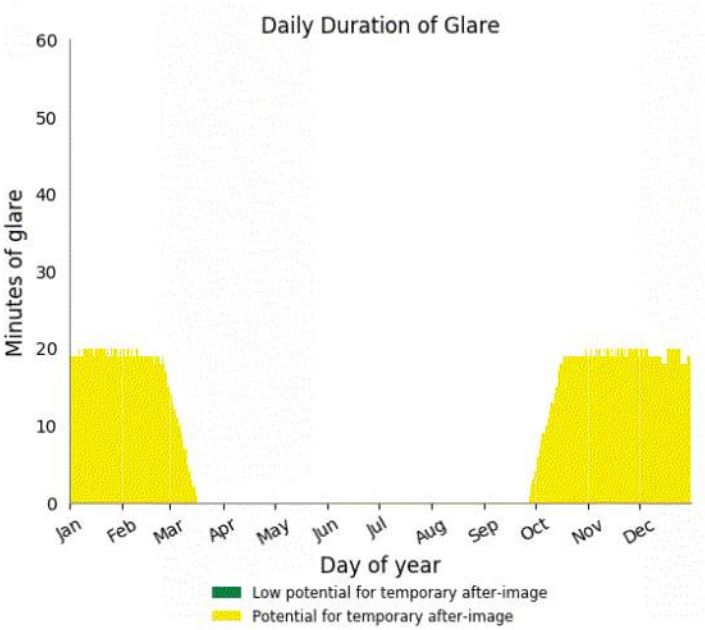
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (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.

4.3 Model outputs

For each observation point a glare occurrence plot and glare hazard plot was developed. These plots are described below.



Graph showing the hours of the day per month glare is expected



Graph showing the duration per month glare is expected

Figure 5: Glare Occurrence Plot (example)

Glare occurrence plots are a graphical depiction showing the expected glare hazard at any time throughout the day and for what duration.

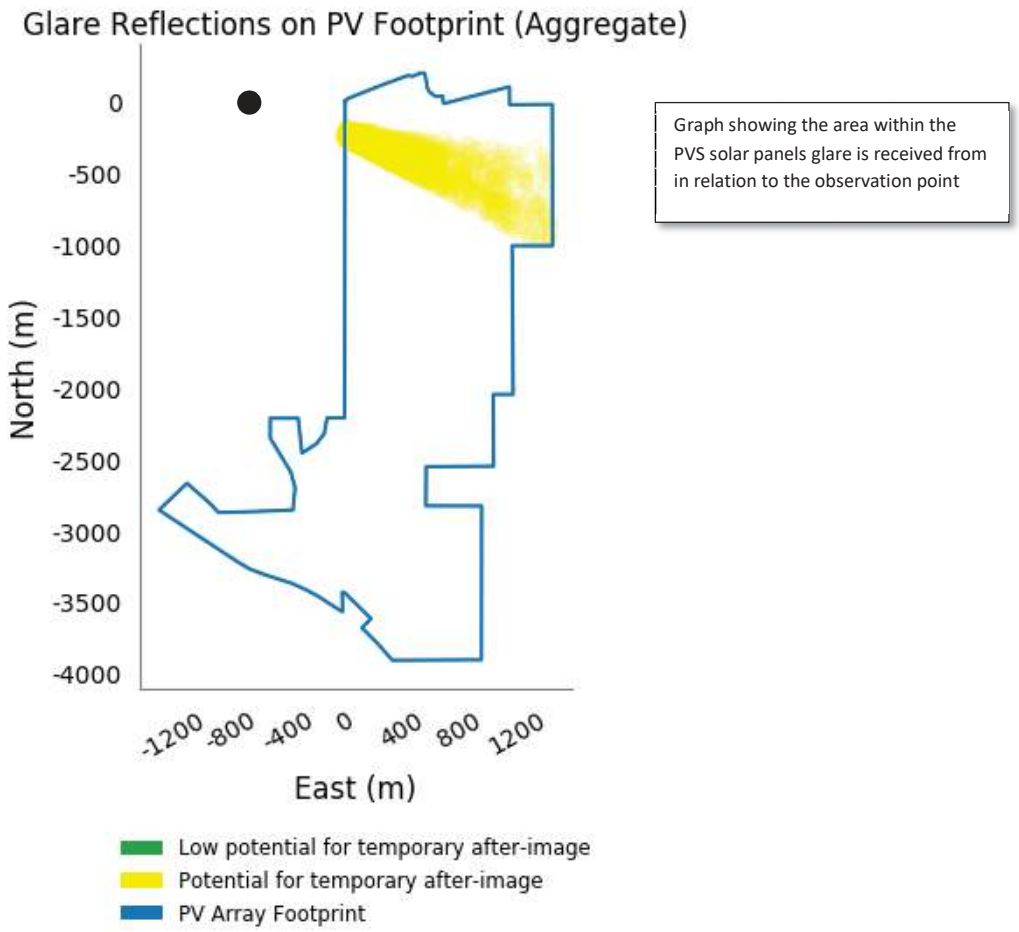


Figure 6: Glare reflection locations (example)

The Glare reflection location plot shows the parts of the PVS solar panels generating glare for the viewer at a specific observation point (marked by black dot).

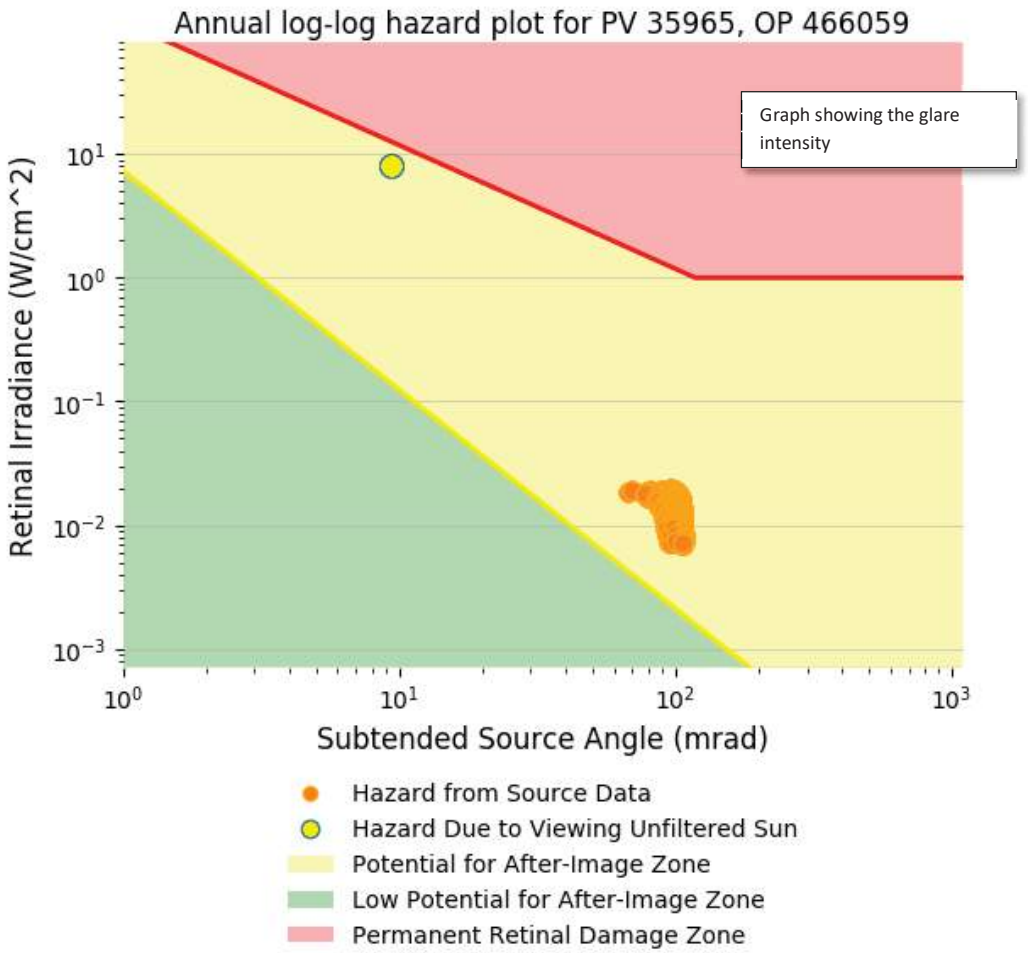


Figure 7: Glare hazard plot (example)

The Glare hazard plot shows the expected glare as compared to the hazard when viewing the unfiltered sun. It plots the intensity of light hitting the eye (retinal irradiance) as a function of size & distance (subtended source angle) to the Glare source.

For Routes a special plot has been developed showing the glare vectors for a driver. For clarity these vectors are placed at the PV centroid. The actual glare spot locations may vary.

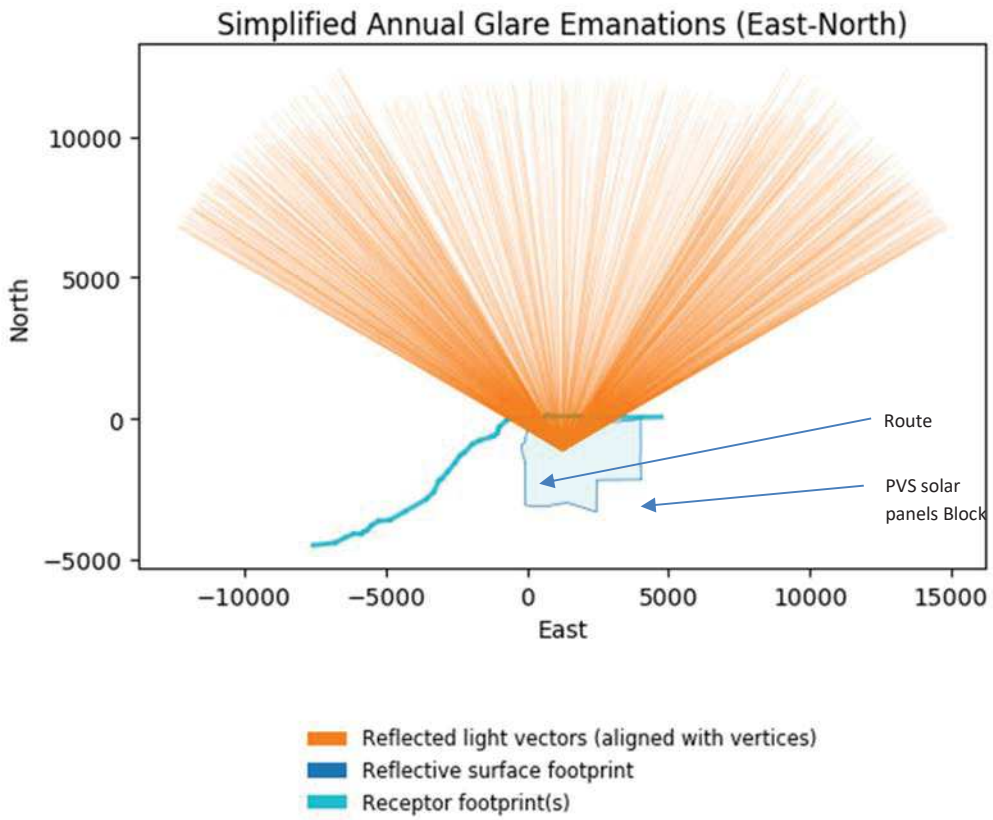


Figure 8: Route glare plot

4.4 Modelling Inputs

Bungama Solar is located just east of the suburb of Bungama in South Australia. The project area centre coordinates are approximately 33° 11.084' S, 138° 5.415' E with an average ground elevation of 24 m above sea level. The SGHAT model uses Google Earth to determine project area boundaries, elevation and Observation points for the calculation and then simulates the sun path during the day and year for the chosen location. A number of inputs is required to compute the solar calculation. The input data shown in Table 4 has been used for all calculations.

Input	Unit	Value	Comment
Time zone	h UTC	9	SA time zone[10]
Peak DNI	kW/m²	1,000	Typical peak irradiance based on generic data
Solar panel surface material	-	Smooth glass with Anti Reflective Coating	Industry standard
Time interval	min	1	
Single axis tracking system			
Tilt of tracking axis	deg	90	Horizontal
Orientation of tracking axis	deg	0	North
Offset angle of panel	deg	0	Angle between tracking axis and panel
Tracking range	deg	-60 ... 0 ... +60	Range of tracking system
Height of panel above ground	m	1.2	Centre of tracking axis above ground

Table 4: Modelling Inputs

The average height of the panels above ground was estimated to be 1.2 m based on client input and a design assumption using tables with one row of modules per module table.

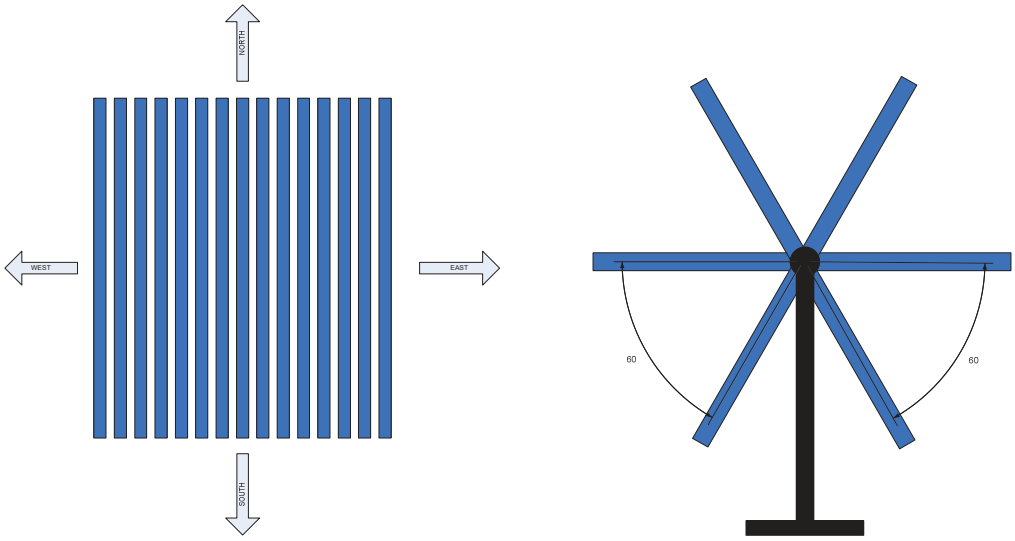


Figure 9: Depiction of input parameters (Panel Orientation and tracking system)

[10] Partial time zones are not possible, only full hours

4.5 Observation Point and Route locations

The observer locations (OP) are described in Table 5 and shown as white markers in Figure 12. The points were chosen to represent potential areas where the residents of houses may be confronted with Glint and Glare when looking towards the PVS solar panels. Glare was calculated for typical viewing heights of 1.5 m.

Route locations (RO) are described in Table 6 and shown as orange lines in Figure 12. Routes were chosen to represent potential areas where the public (car or train drivers) may be confronted with Glint and Glare when looking towards the PVS solar panels. Glare was calculated for typical viewing heights of 1.5 m for all roads and 2.5 m for the Railway track.

5 RESULTS

5.1 Project Area

Bungama Solar is proposed to be located just east of the suburb of Bungama in South Australia. The project area occupies an area of approx. 530 ha. Average elevation of the project area is approx. 25 m above mean sea level.

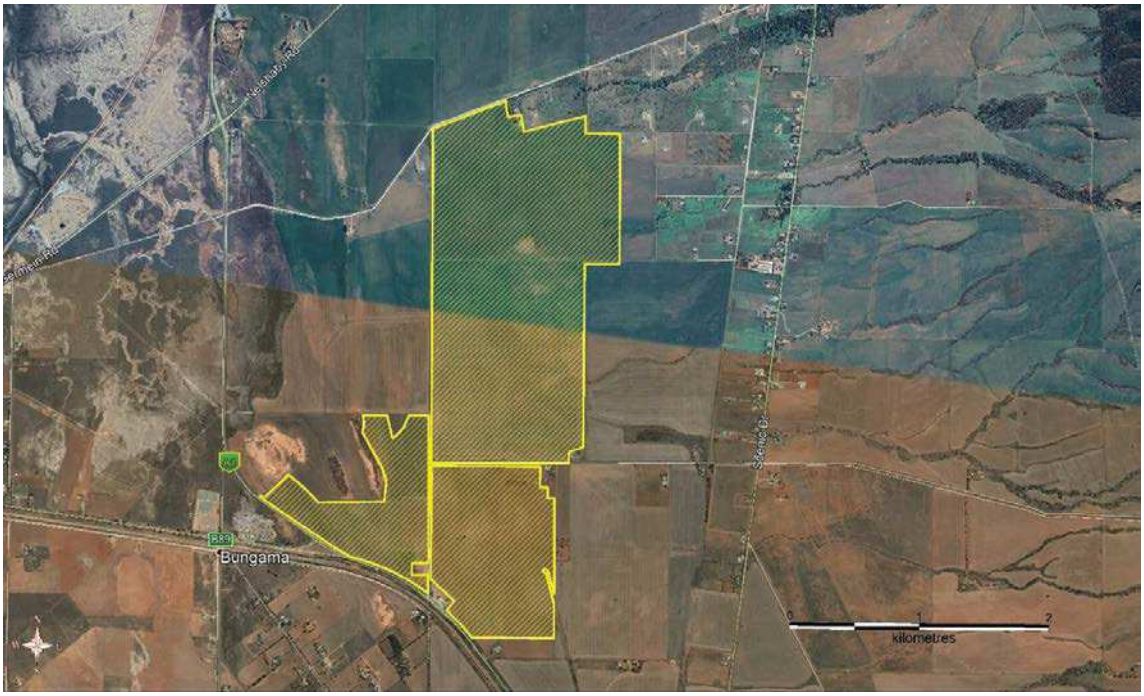


Figure 10: Bungama Solar Project Area

To allow accurate calculation of this very large array, the PVS Solar Panels area was split up into four different sub-arrays as shown in Figure 11. They are subsequently being called according to their colours.

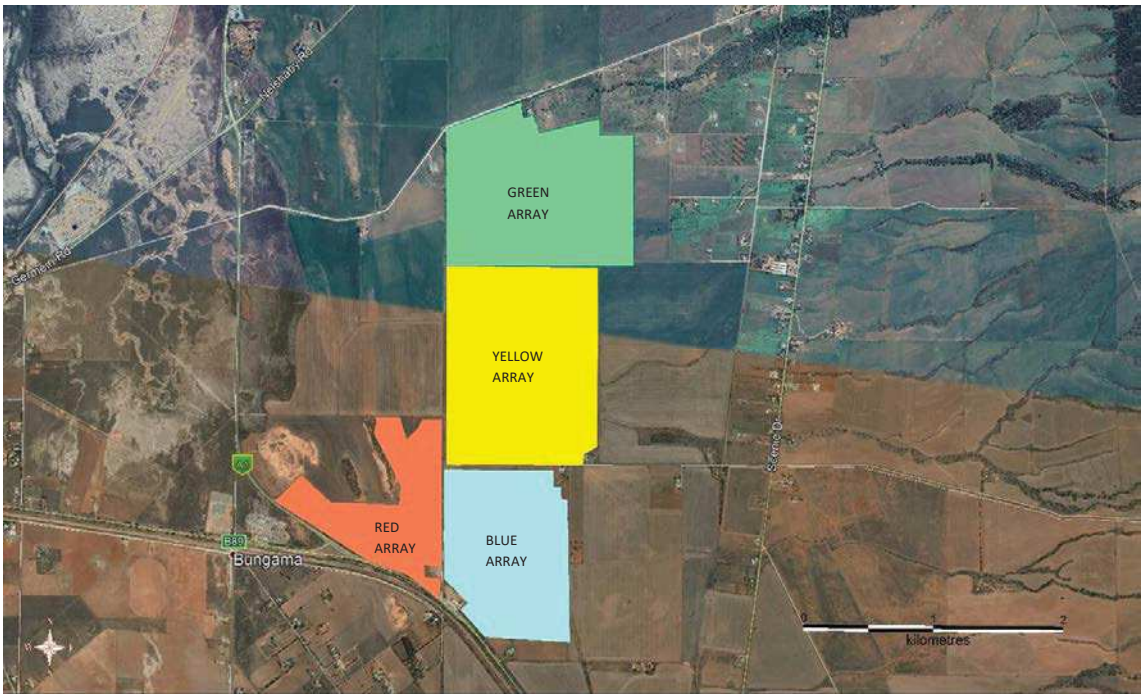


Figure 11: Sub Arrays

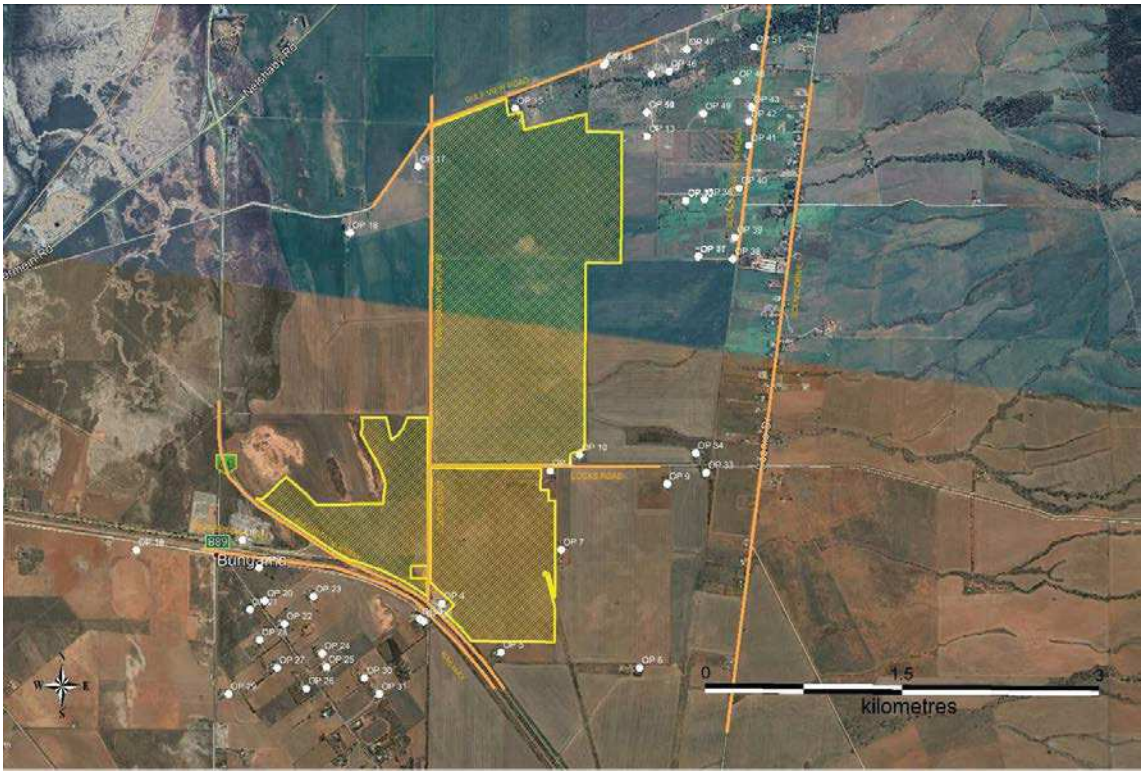


Figure 12: Observation Points (OP) and Roads (Orange lines), yellow lines mark a worst case development footprint

Observation Point	Latitude (deg)	Longitude (deg)	Elevation (m)	Height Above Ground (m)
OP 1	-33.196350	138.070070	9.41	1.5
OP 2	-33.198234	138.071440	12	1.5
OP 3	-33.201664	138.084637	19.33	1.5
OP 4	-33.200586	138.086418	18.95	1.5
OP 5	-33.203908	138.091267	22.29	1.5
OP 6	-33.204895	138.102640	35	1.5
OP 7	-33.196852	138.096159	29.42	1.5
OP 8	-33.191465	138.095237	27.77	1.5
OP 9	-33.192309	138.104807	39.98	1.5
OP 10	-33.190369	138.097618	29.98	1.5
OP 11	-33.176732	138.107239	49.04	1.5
OP 12	-33.172888	138.106209	50.88	1.5
OP 13	-33.168470	138.103011	44.34	1.5
OP 14	-33.166835	138.102990	49.35	1.5
OP 15	-33.166638	138.092218	31.74	1.5
OP 16	-33.163476	138.099578	44.18	1.5
OP 17	-33.170661	138.084279	17.86	1.5
OP 18	-33.175241	138.078764	14.71	1.5
OP 19	-33.197093	138.061397	10.23	1.5
OP 20	-33.200493	138.071941	13.6	1.5
OP 21	-33.201104	138.070718	10.48	1.5
OP 22	-33.202055	138.073550	16.01	1.5
OP 23	-33.200188	138.075910	19.34	1.5
OP 24	-33.204066	138.076662	18.07	1.5
OP 25	-33.205000	138.077005	20.02	1.5
OP 26	-33.206454	138.075353	18.04	1.5
OP 27	-33.205054	138.072971	14.66	1.5
OP 28	-33.203168	138.071512	11.78	1.5
OP 29	-33.206867	138.069001	10.46	1.5
OP 30	-33.205718	138.080116	23.67	1.5
OP 31	-33.206795	138.081339	23.95	1.5
OP 32	-33.201822	138.084944	19.77	1.5
OP 33	-33.191524	138.107982	44.88	1.5
OP 34	-33.190195	138.107124	43.14	1.5
OP 35	-33.172834	138.106201	50.85	1.5
OP 36	-33.172789	138.107757	52.38	1.5
OP 37	-33.176659	138.107274	49.27	1.5
OP 38	-33.176839	138.110085	54.52	1.5
OP 39	-33.175348	138.110235	56.51	1.5
OP 40	-33.171972	138.110565	61.17	1.5
OP 41	-33.169062	138.111359	66.26	1.5
OP 42	-33.167418	138.111338	68.31	1.5
OP 43	-33.166430	138.111574	69.99	1.5
OP 44	-33.163666	138.099416	43.81	1.5
OP 45	-33.164241	138.103365	55.16	1.5

Observation Point	Latitude (deg)	Longitude (deg)	Elevation (m) (m)	Height Above Ground (m)
OP 46	-33.164026	138.104781	59.95	1.5
OP 47	-33.162517	138.106240	62.25	1.5
OP 48	-33.164672	138.110360	69.7	1.5
OP 49	-33.166899	138.107613	57.93	1.5
OP 50	-33.166828	138.102978	49.35	1.5
OP 51	-33.162301	138.111733	75.26	1.5

Table 5: Observation Points

The following roads were assessed as Routes (RO):

Augusta Highway (1.5 m)		Railway (2.5 m)	
Warnertown Road (1.5 m)		Locks Road (1.5 m)	
Bungama North Road (1.5 m)		Scenic Drive (1.5 m)	
Side road off Scenic Drive (1.5 m)		Gulf View Road (1.5 m)	

Table 6: Routes

5.2 Calculation Results

The PVS solar panels are proposed to operate as single axis tracking system. Only this operation has therefore been assessed.

Observation Point	Green Glare (min/year)	Yellow Glare (min/year)	Red Glare (min/year)	Summary
OP: OP 1	-	-	-	NO GLARE
OP: OP 2	-	-	-	NO GLARE
OP: OP 3	-	-	-	NO GLARE
OP: OP 4	313	-	-	GREEN
OP: OP 5	-	-	-	NO GLARE
OP: OP 6	-	-	-	NO GLARE
OP: OP 7	-	-	-	NO GLARE
OP: OP 8	-	-	-	NO GLARE
OP: OP 9	-	-	-	NO GLARE
OP: OP 10	11	-	-	GREEN
OP: OP 11	-	-	-	NO GLARE
OP: OP 12	1,618	-	-	GREEN
OP: OP 13	4,309	-	-	GREEN
OP: OP 14	3,123	-	-	GREEN
OP: OP 15	7,791	-	-	GREEN
OP: OP 16	1,738	-	-	GREEN
OP: OP 17	4,121	-	-	GREEN
OP: OP 18	786	-	-	GREEN
OP: OP 19	-	-	-	NO GLARE
OP: OP 20	-	-	-	NO GLARE
OP: OP 21	-	-	-	NO GLARE
OP: OP 22	-	-	-	NO GLARE
OP: OP 23	-	-	-	NO GLARE
OP: OP 24	-	-	-	NO GLARE
OP: OP 25	-	-	-	NO GLARE
OP: OP 26	-	-	-	NO GLARE
OP: OP 27	-	-	-	NO GLARE
OP: OP 28	-	-	-	NO GLARE
OP: OP 29	-	-	-	NO GLARE
OP: OP 30	-	-	-	NO GLARE
OP: OP 31	-	-	-	NO GLARE
OP: OP 32	-	-	-	NO GLARE
OP: OP 33	-	-	-	NO GLARE
OP: OP 34	-	-	-	NO GLARE
OP: OP 35	1599	-	-	GREEN
OP: OP 36	577	-	-	GREEN
OP: OP 37	-	-	-	NO GLARE
OP: OP 38	-	-	-	NO GLARE
OP: OP 39	-	-	-	NO GLARE
OP: OP 40	123	-	-	GREEN
OP: OP 41	374	-	-	GREEN
OP: OP 42	281	-	-	GREEN
OP: OP 43	10	-	-	GREEN
OP: OP 44	1,779	-	-	GREEN
OP: OP 45	-	-	-	NO GLARE
OP: OP 46	-	-	-	NO GLARE
OP: OP 47	-	-	-	NO GLARE
OP: OP 48	-	-	-	NO GLARE
OP: OP 49	1,394	-	-	GREEN
OP: OP 50	3,038	-	-	GREEN
OP: OP 51	-	-	-	NO GLARE

Observation Point	Green Glare (min/year)	Yellow Glare (min/year)	Red Glare (min/year)	Summary
RO: Gulf View Road	2	-	-	GREEN
RO: Locks Road	-	-	-	NO GLARE
RO: Railway	-	-	-	NO GLARE
RO: Scenic Drive	-	-	-	NO GLARE
RO: Scenic Drive Side Road	-	-	-	NO GLARE
RO: Warnertown Road	66	-	-	GREEN
RO: Augusta Highway	-	-	-	NO GLARE
RO: Bungama North Road	-	-	-	NO GLARE

Table 7: Glare Calculation Results

No YELLOW GLARE or RED GLARE has been calculated and therefore no issues with glare are expected.

Only some observation points and Warnertown Road experience measurable GREEN GLARE. This is considered acceptable. With a maximum of 7,791 min or 130 h per year only OP15 on Gulf View Road may experience considerable GREEN GLARE. However, this property is surrounded by vegetation providing sufficient screening so no glare is expected to be relevant at the actual house.

With effectively only one hour of GREEN GLARE on Warnertown Road during the late afternoon hours separate screening is not considered necessary from a glare & glint point of view. Gulf View Road experiences two minutes per year of GREEN GLARE which is negligible.

5.3 Air Traffic

The Australian Civil Aviation Safety Authority (CASA) provides guidelines to planning authorities in relation to referring solar projects for assessment to ensure there is no likelihood of any glare and glint issues for pilots on approach to or on departure from an airport or as impact on traffic controllers.

Bungala Solar is approximately 10 km from Port Pirie Airport and it is therefore considered unlikely that any glint or glare issues will be created for pilots on approach to or departure from Port Pirie Airport. However, CASA requires an assessment for any solar farm within a distance of around 5 nautical miles from an airport and therefore a calculation for potential glint and glare issues was performed.

Figure 13: Port Pirie Airport

Port Pirie Airport (YPIR[11]) is located at 33° 14.3' S and 137° 59.7' E. It consists of three runways of which the east west facing runway 80/26 is sealed and used for commercial aircrafts. The two other runways facing SW/NE, 35/17 and 03/21 are unpaved and most likely only used for private airplanes. All three runways have been assessed using the approach parameters shown in Table 8 and an approach length of two nautical miles.

Runway	Type	Orientation (deg)	Glide Slope (deg)	Threshold Crossing height (m)
03 SW	Grass	43.4	3	15.24
21 NE	Grass	222.3	3	15.24
17 N	Sand	180	3	15.24
35 S	Sand	0	3	15.24
26 E	Sealed	270	3	15.24
80 W	Sealed	90	3	15.24

Table 8: Flight Paths Port Pirie

5.3.1 Result of Calculation

The calculation for all six approach paths did not indicate any Glint or Glare issues for pilots.

[11] Data sourced from AIP Australia Port Pirie AVFAX Code 5032

6 CONCLUSIONS

6.1 Houses, Railway and Roads

With single axis tracking systems only GREEN GLARE can be expected for a small section of Warnertown Road.

Some houses in the surrounds of the project area may experience limited GREEN GLARE. These houses are located at Gulf View Road and Scenic Drive and are mostly surrounded by trees so while there may be some GREEN GLARE the vegetation likely ameliorates the potential glare.

GREEN GLARE is not considered to be critical and therefore no mitigation measures for houses are required.

6.2 Port Pirie Airport

No glint & glare is created for the Port Pirie Airport Control Tower nor for any flight paths during approach to or departure from Port Pirie Airport for any of the three runways.

7 RECOMMENDATIONS

No higher levels of glare can be expected and only a few properties may theoretically be affected by some levels of GREEN GLARE. As properties are mostly surrounded by vegetation this is not considered to affect the actual property itself as vegetation screens all potential glare. As only minimal glare can be expected for Warnertown Road for approximately 1 h per year no additional screening is considered necessary.

Figure 14: View onto house OP15 from Gulf View Road[12]

House OP15 is already surrounded by trees therefore limiting the view towards the PVS solar panels. No further screening is considered required with regards to Glint & Glare. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP15. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.

[12] Photo taken from Google Earth™ Street View

Figure 15: View onto house OP17 from Gulf View Road[13]

House OP17 is surrounded by some trees and scrub towards the PVS solar panels therefore limiting the view. No further screening is considered required with regards to Glint & Glare. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP17. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.

[13] Photo taken from Google Earth™ Street View

8 OBSERVATION POINTS

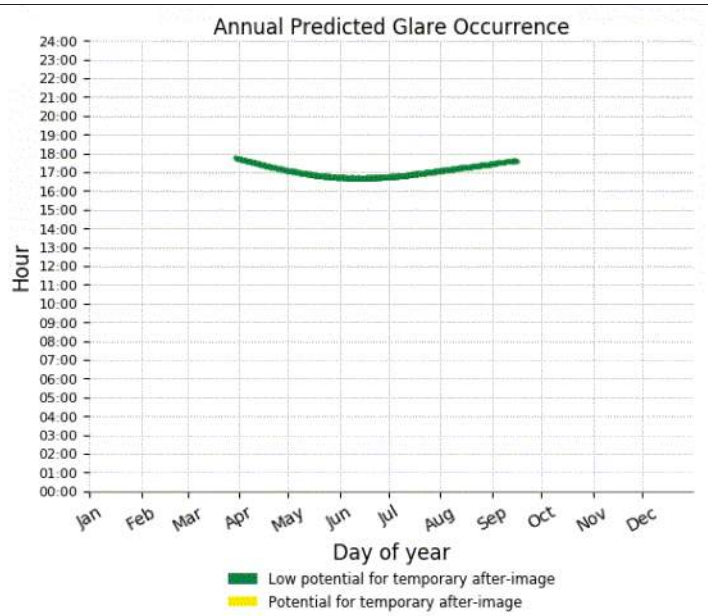
In the following section typical observation points with higher Glare impact are shown.

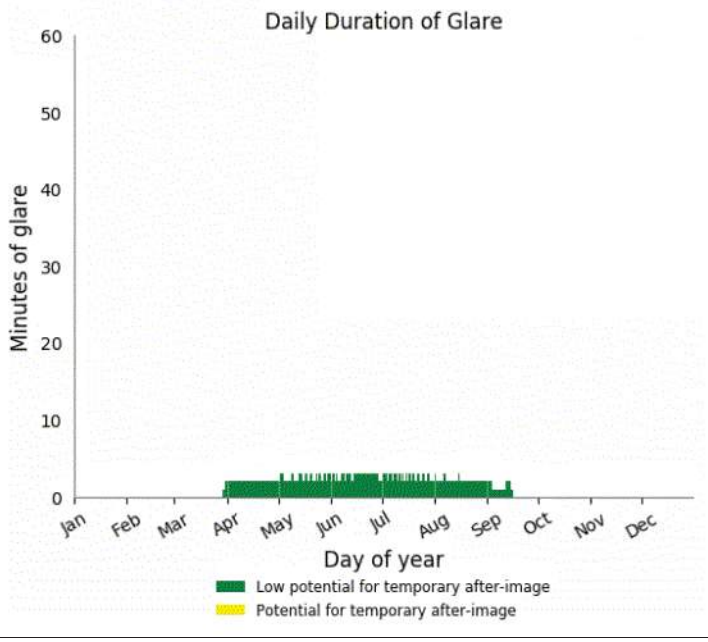
8.1 OP04 Warnertown Road[14]

Figure 16: OP04 Warnertown Road Petrol Station looking NORTH

With only a few minutes of potential GREEN GLARE per day for this location impact is considered negligible. In addition some trees at the back of the property help screening the PVS solar panels and therefore further reduce any glare impact.

[14] All road images downloaded from Google Earth™ Street View


Annual Predicted Glare Occurrence
Hour
24:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Day of year
Low potential for temporary after-image
Potential for temporary after-image


Daily Duration of Glare
Minutes of glare
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Day of year
Low potential for temporary after-image
Potential for temporary after-image

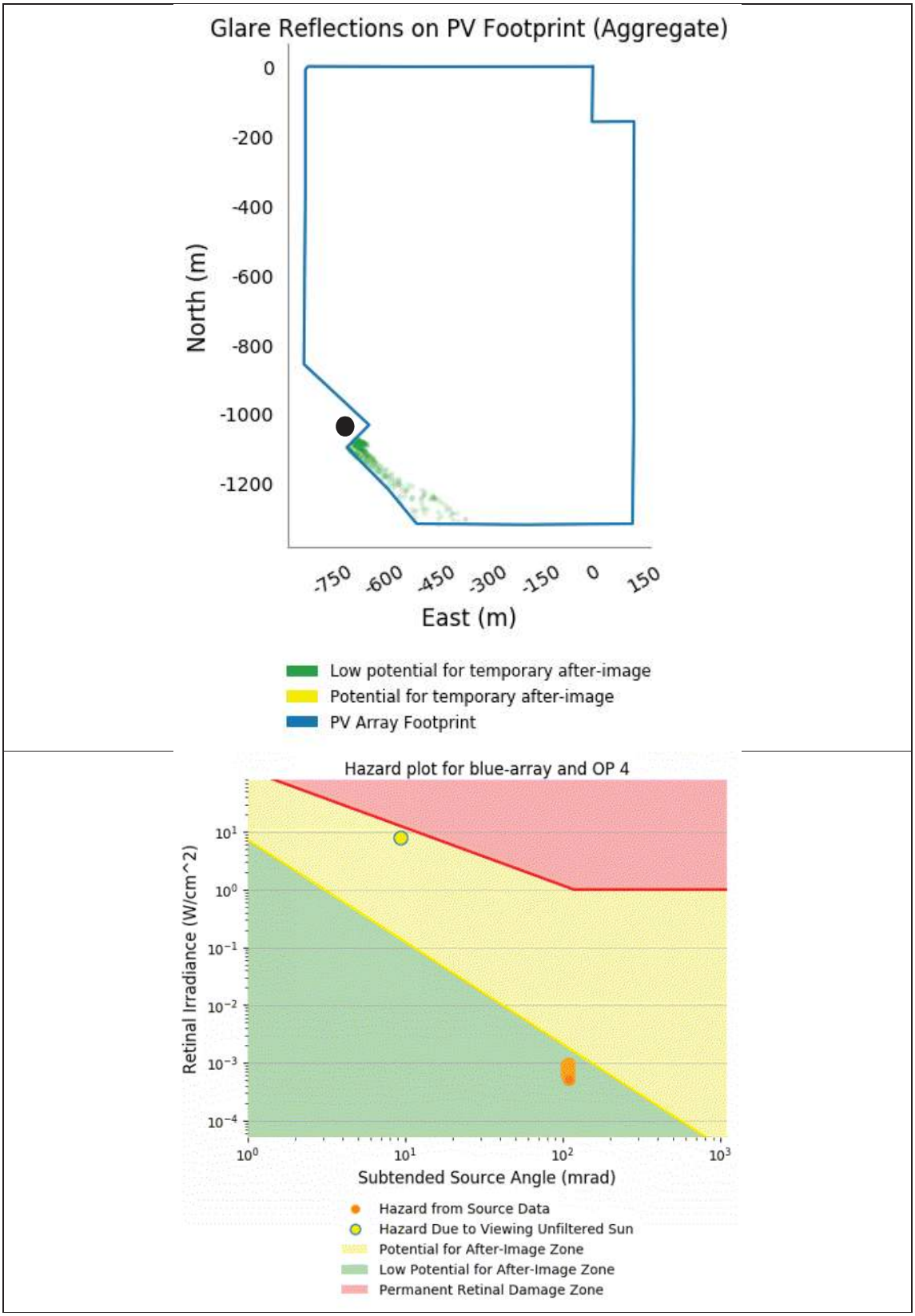
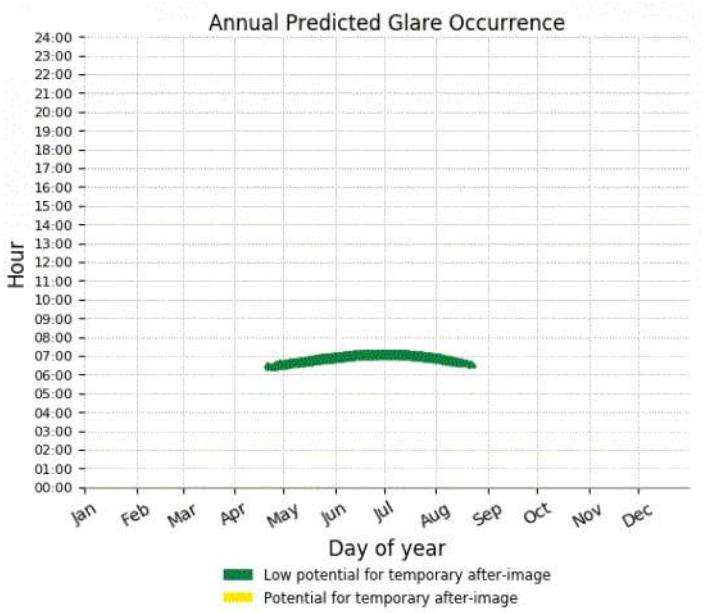
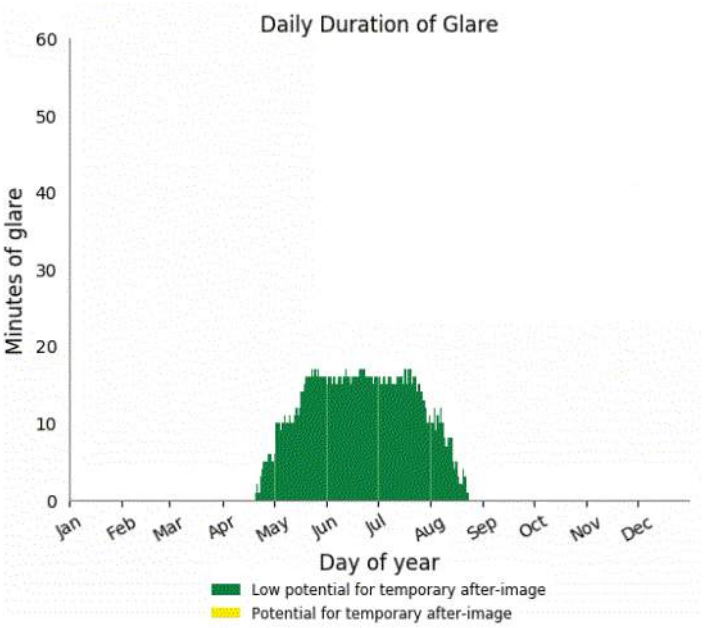


Figure 17: SGHAT Results OP05 Warnertown Road Petrol Station[15]

8.2 OP12 Side Road off Scenic Drive

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 18 min/day. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP12. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





[15] Black dot marks approximate location of Observation Point

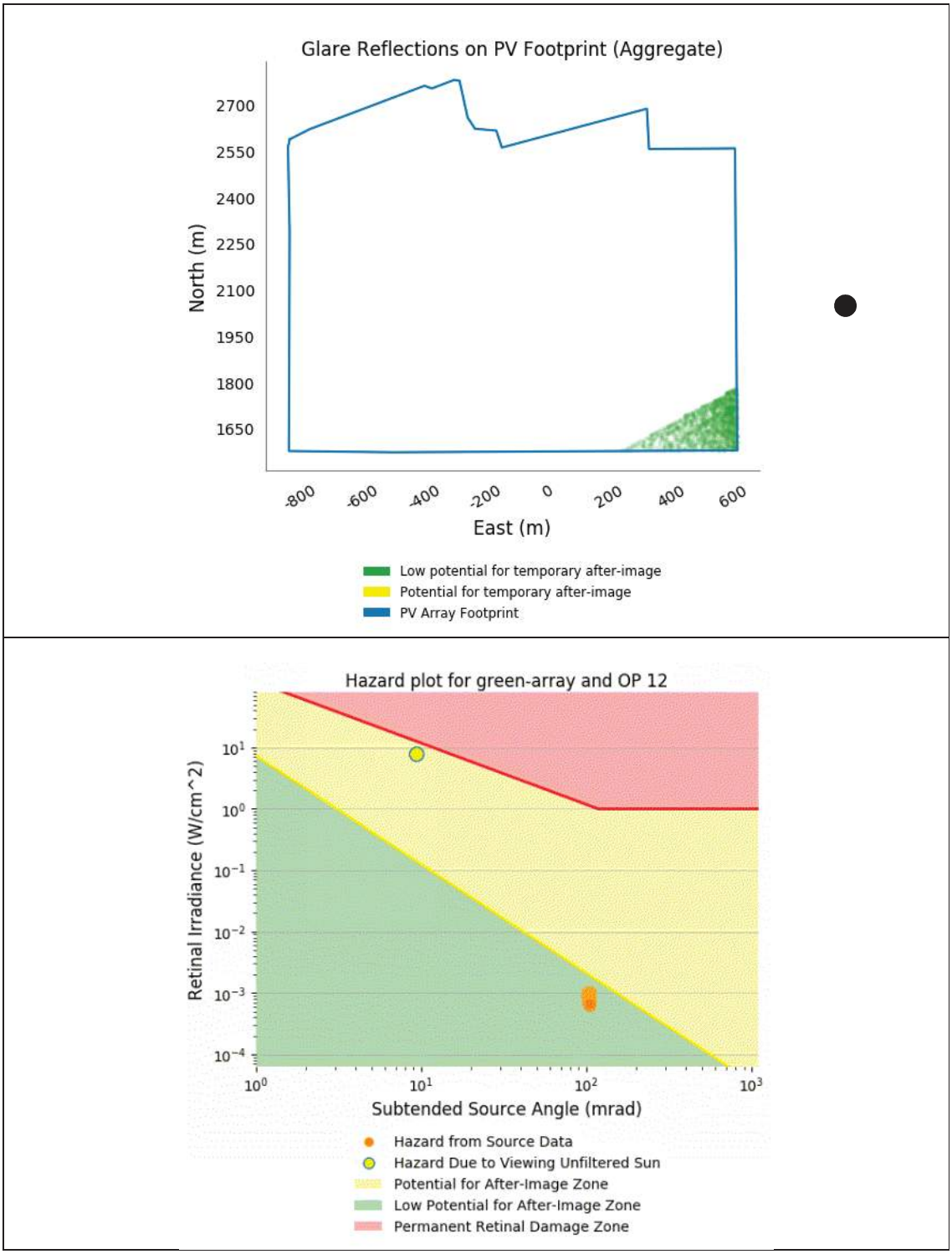
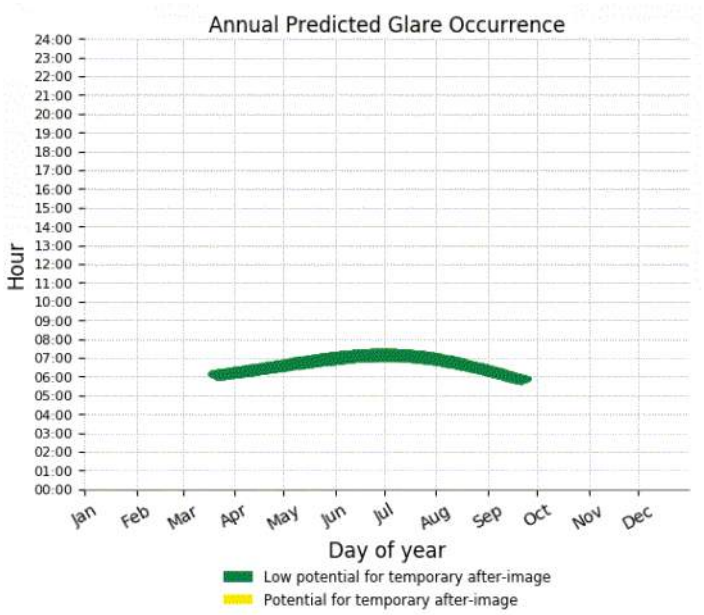
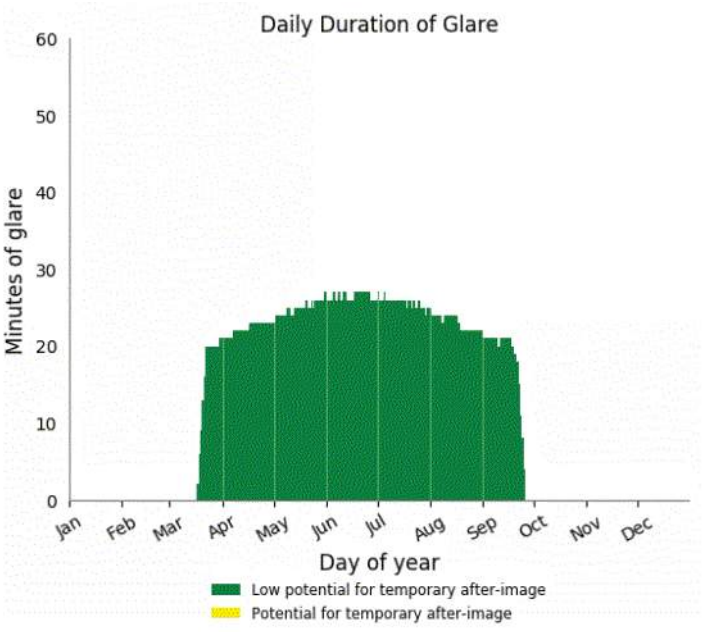


Figure 18: SGHAT Results for OP12

8.3 OP13 off Gulf View Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 30 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP13. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





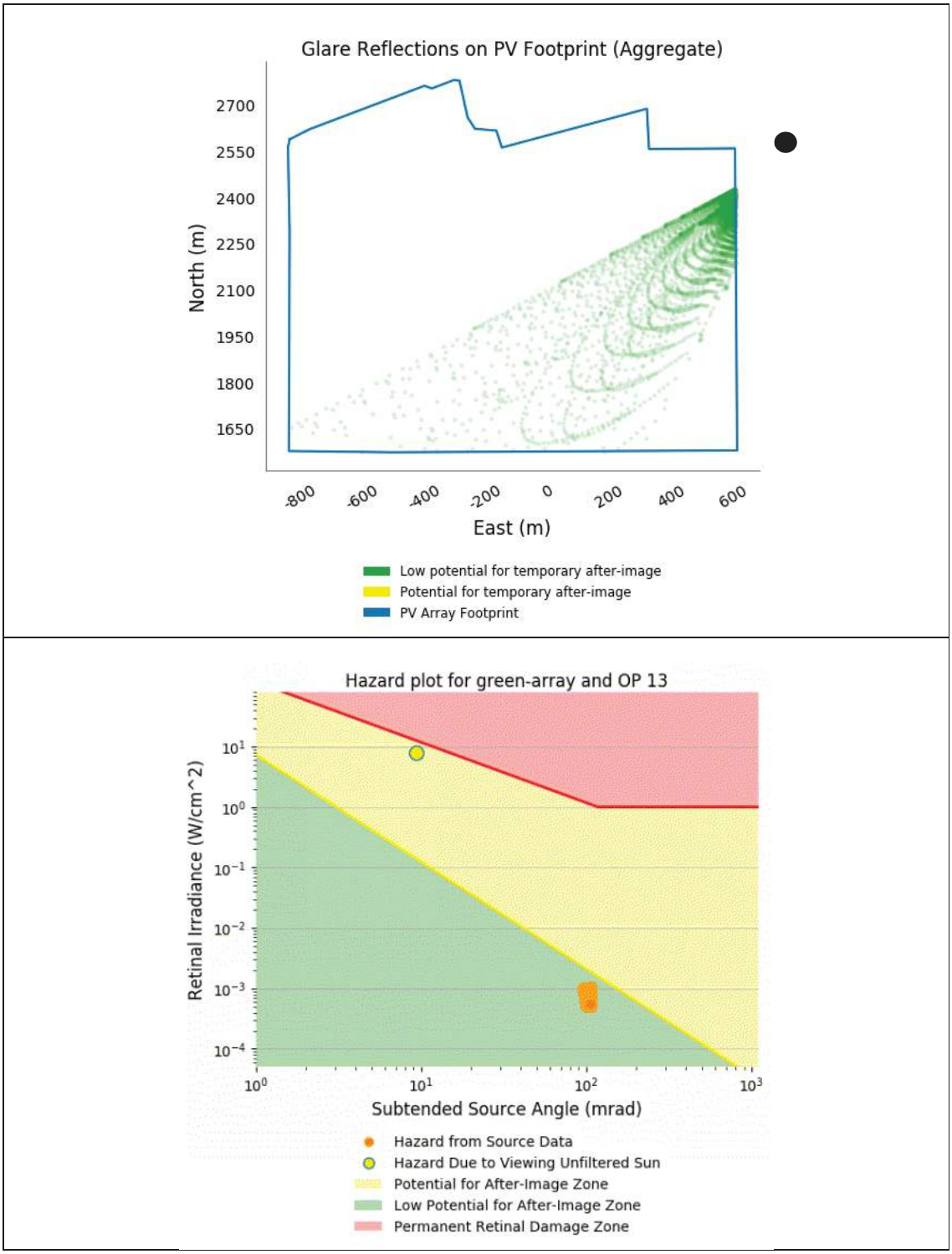
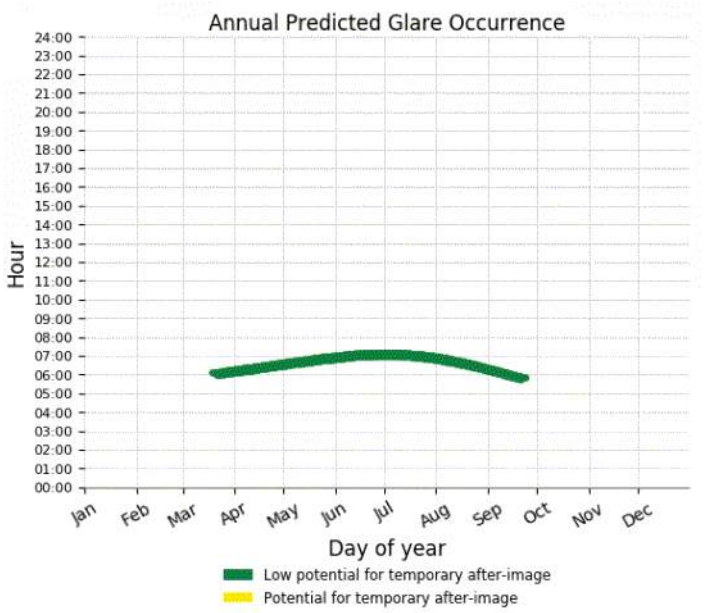
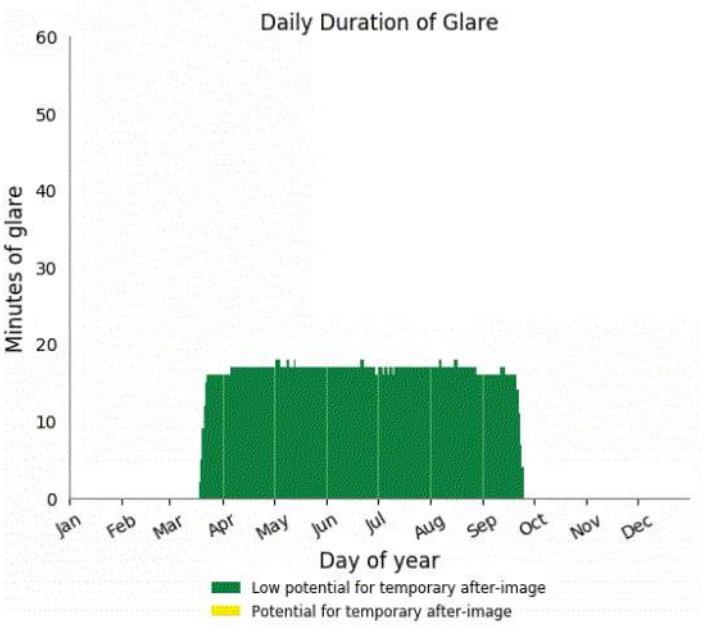


Figure 19: SGHAT Results OP13

8.4 OP14 – off Gulf View Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 20 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP14. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





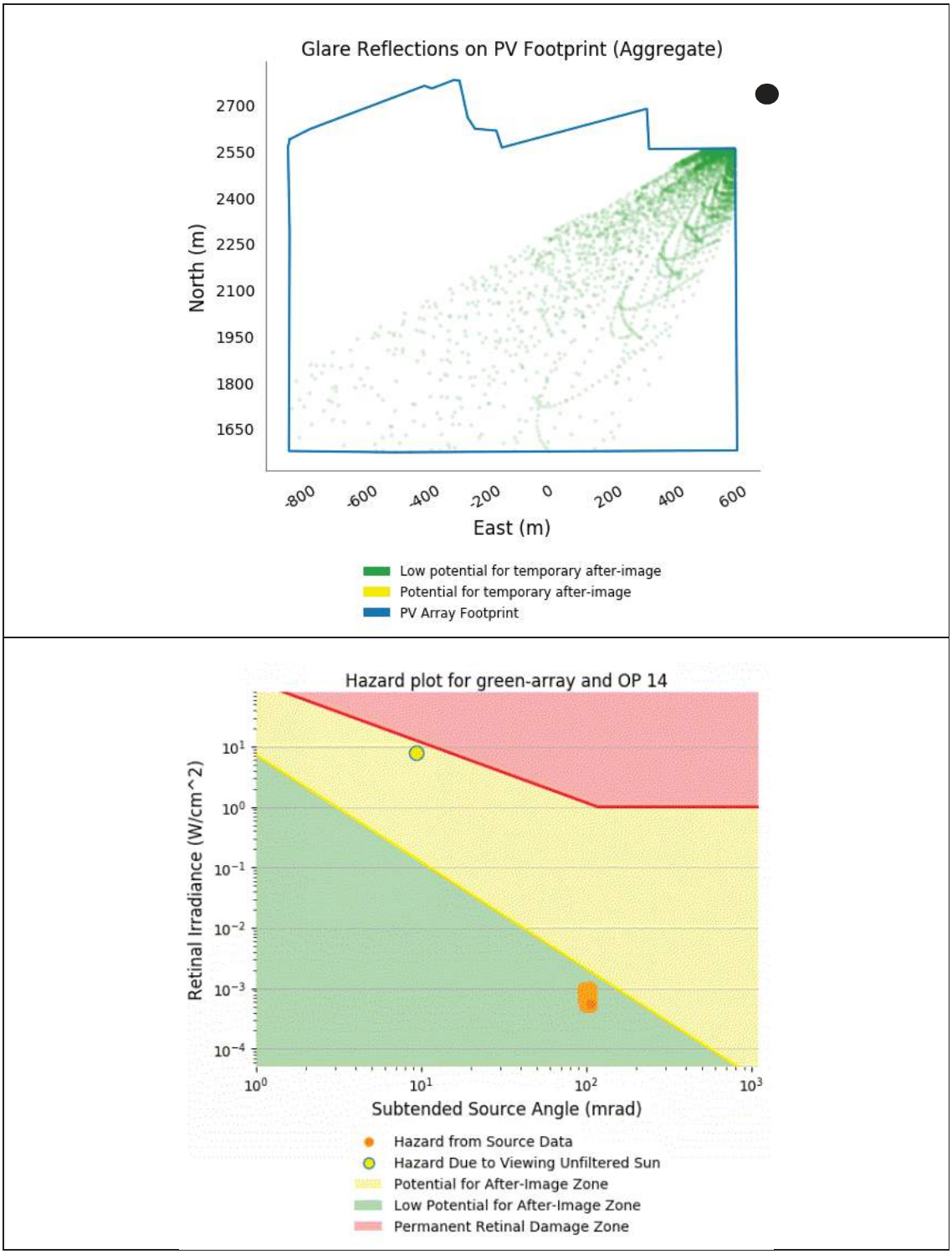
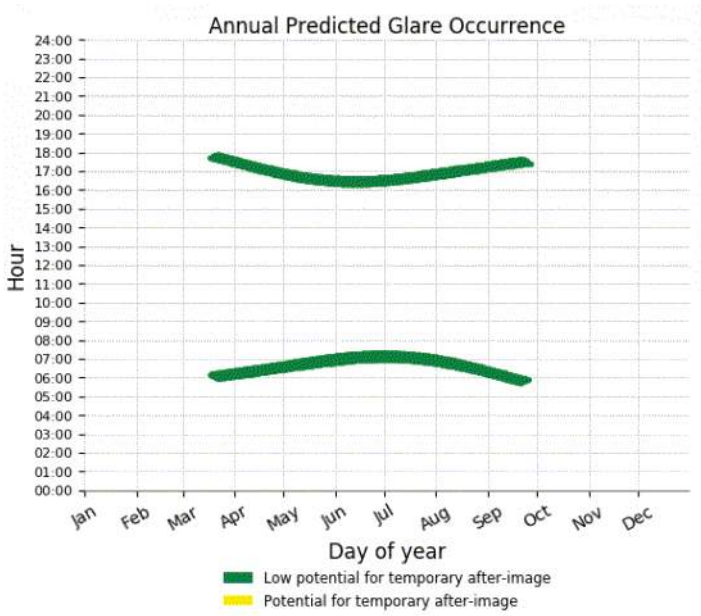
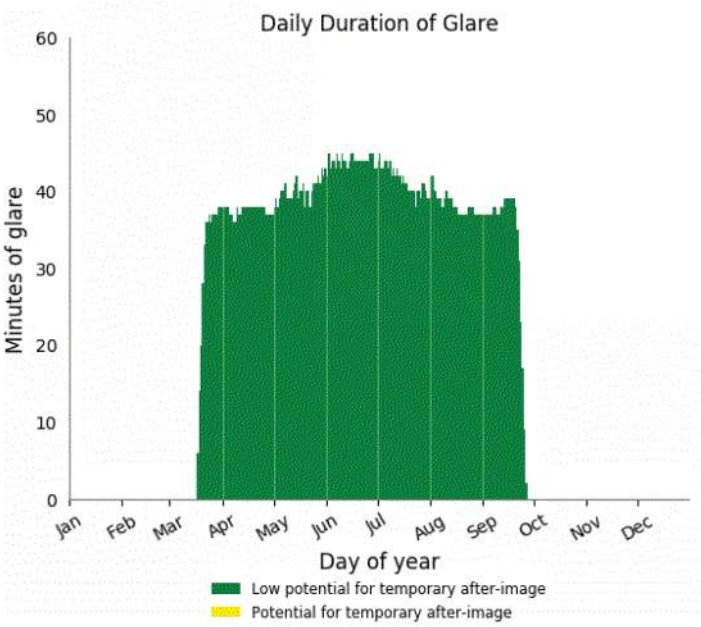


Figure 20: SGHAT Results OP14

8.5 OP15 – Gulf View Road

This property may experience some GREEN GLARE during the early morning hours and later afternoon of each day for up to 45 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property.





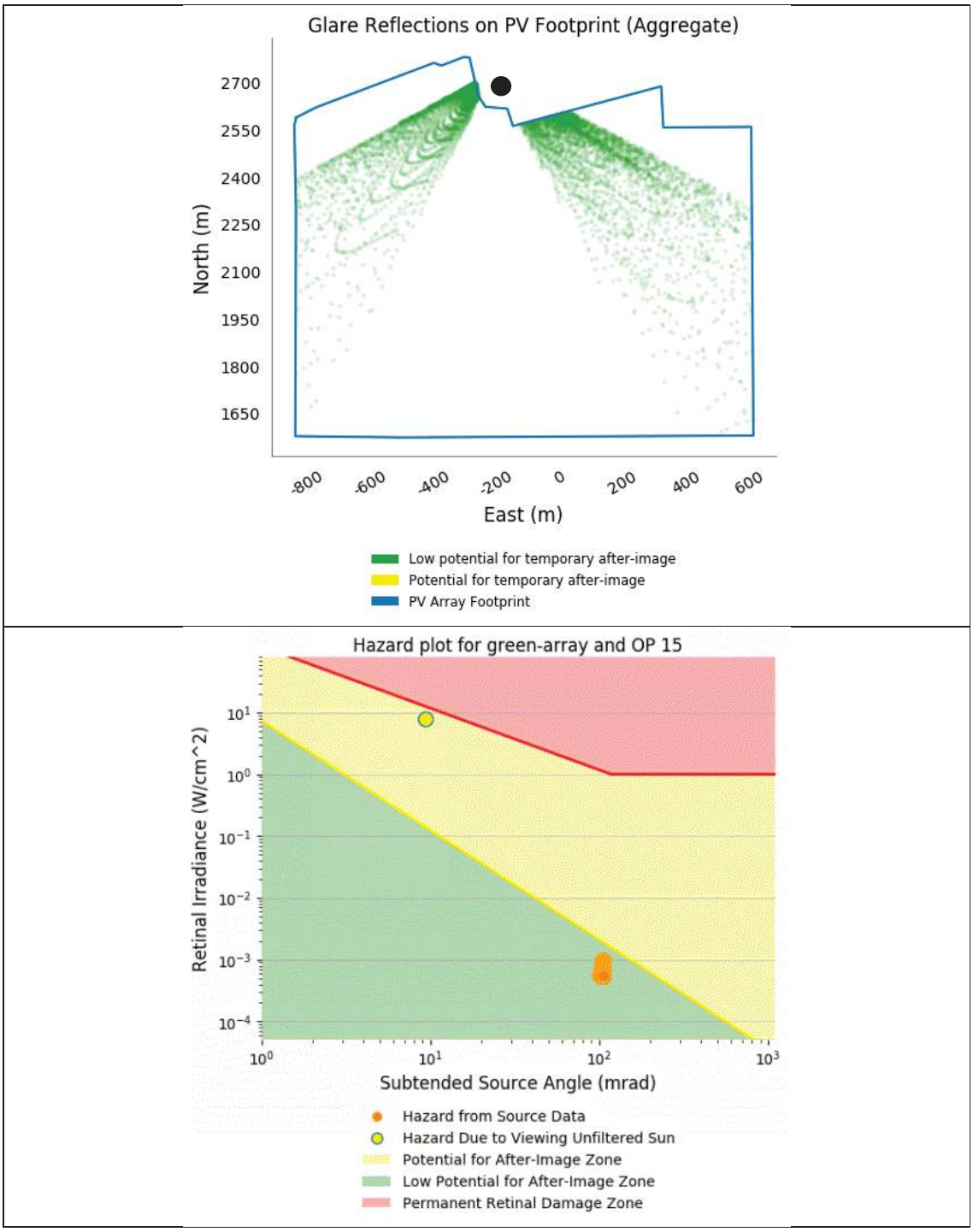
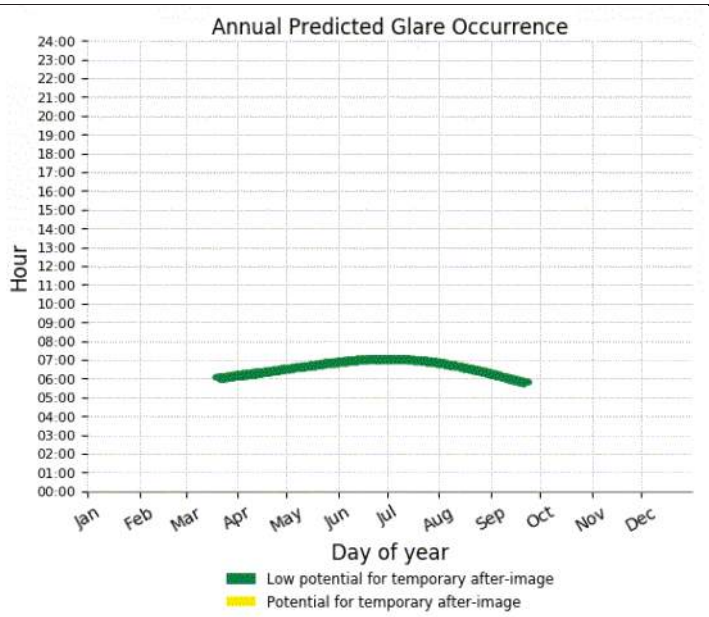
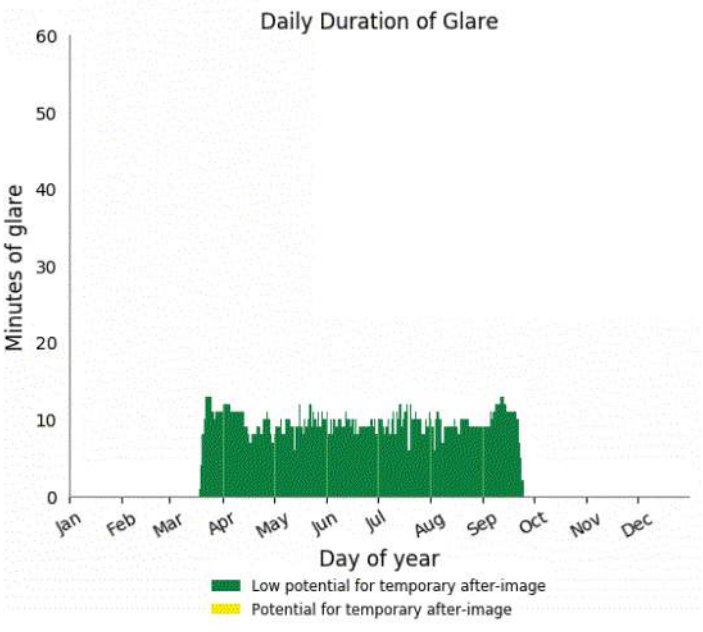


Figure 21: SGHAT Results OP15

8.6 OP16 – Gulf View Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 15 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP16. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





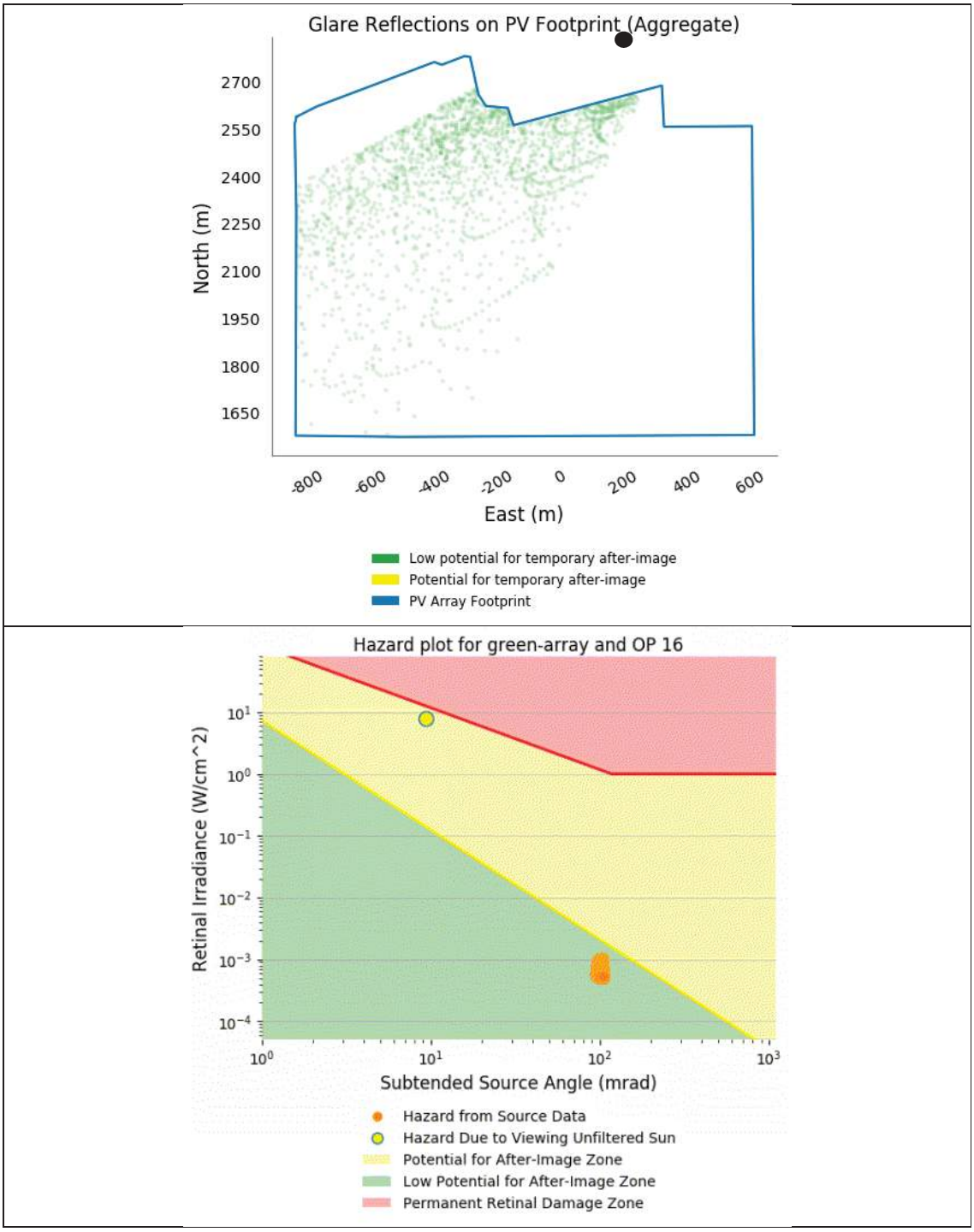
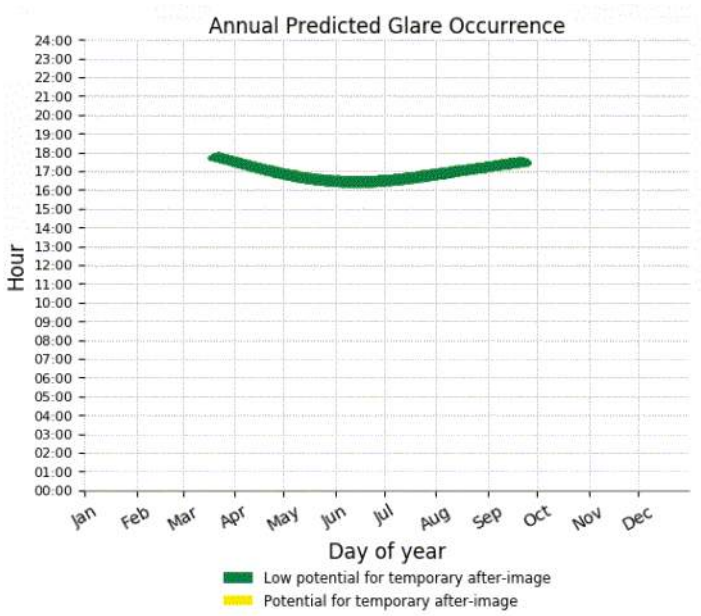
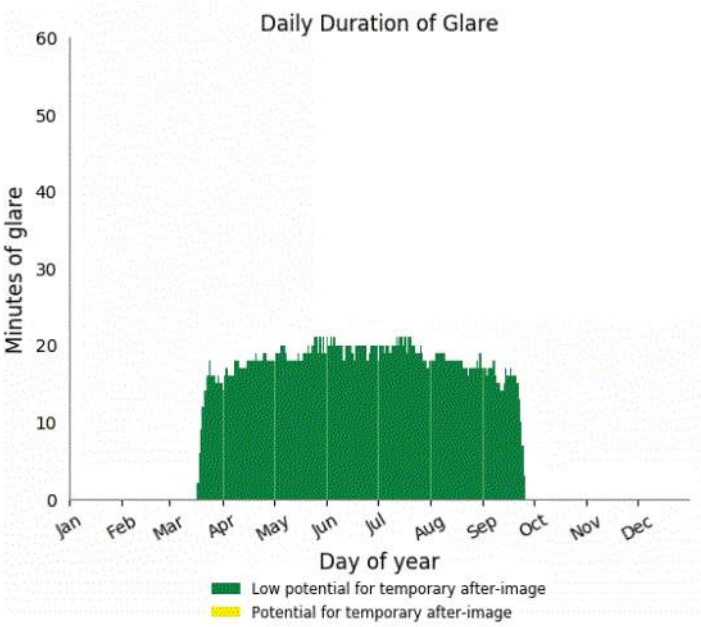


Figure 22: SGHAT Results OP16

8.7 OP17 – Gulf View Road

This property may experience some very limited GREEN GLARE during the late afternoon hours of each day for up to 20 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property.





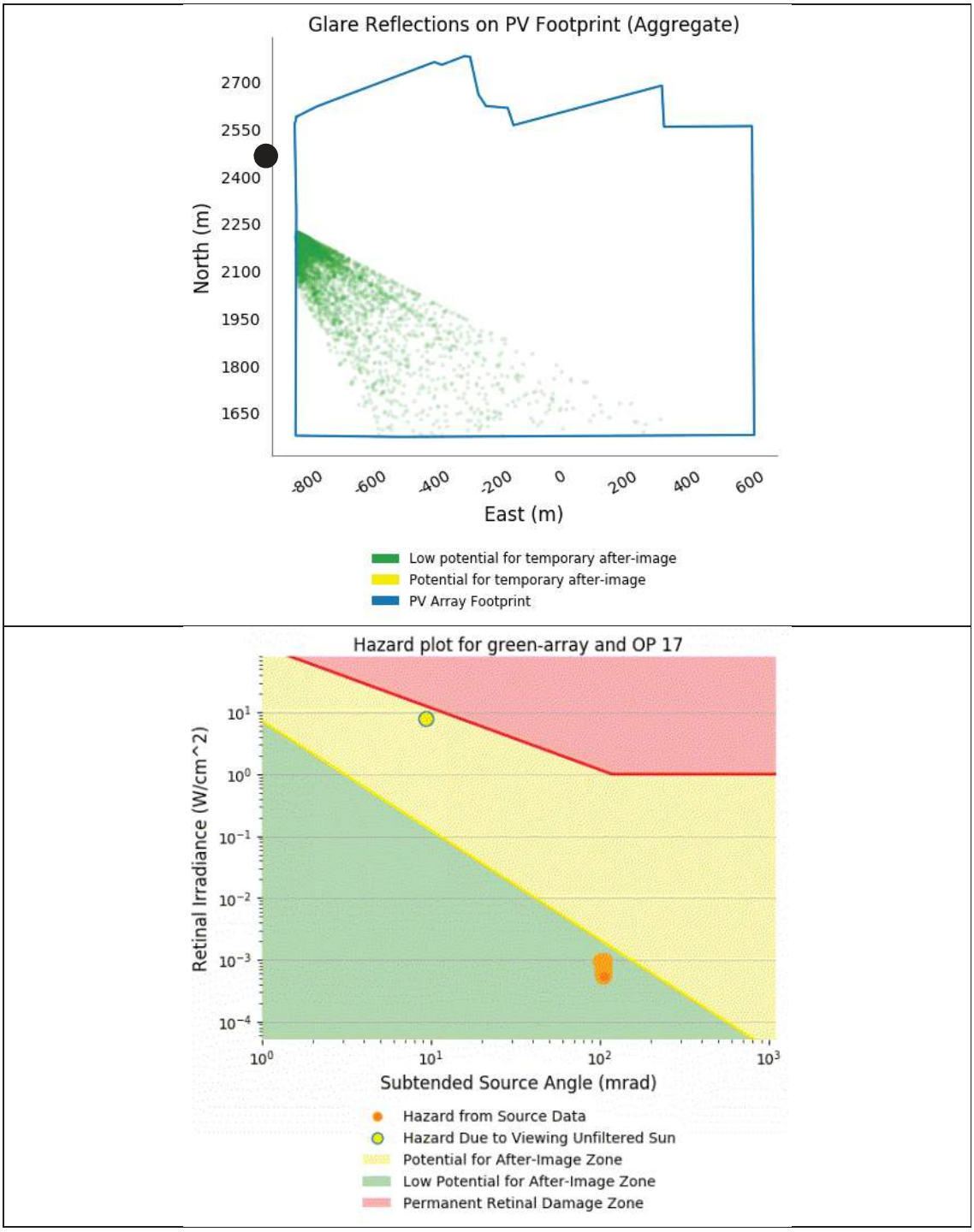
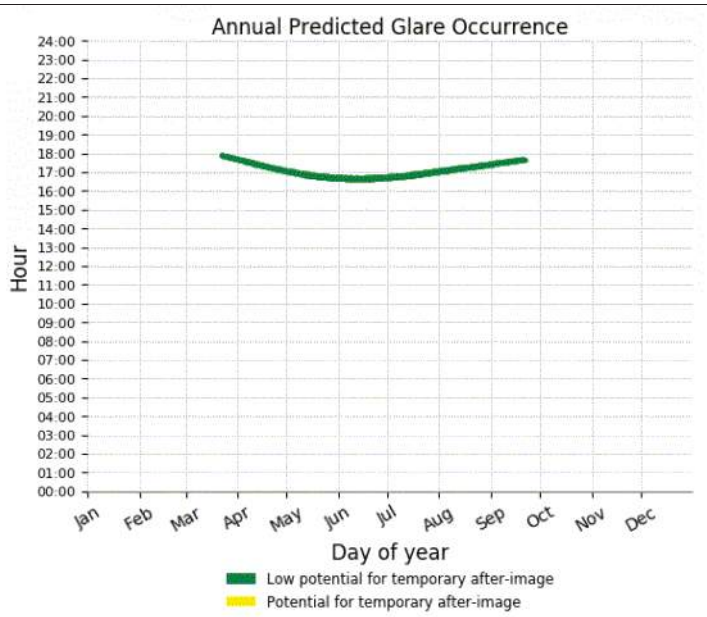
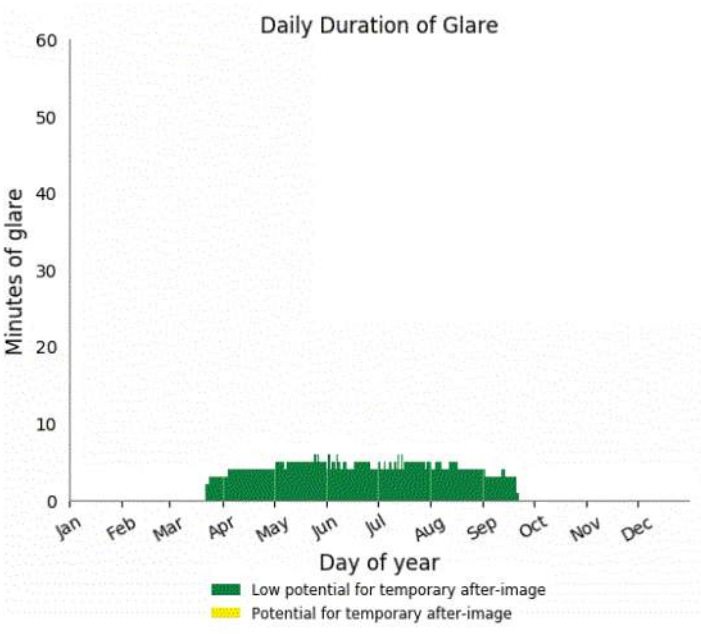


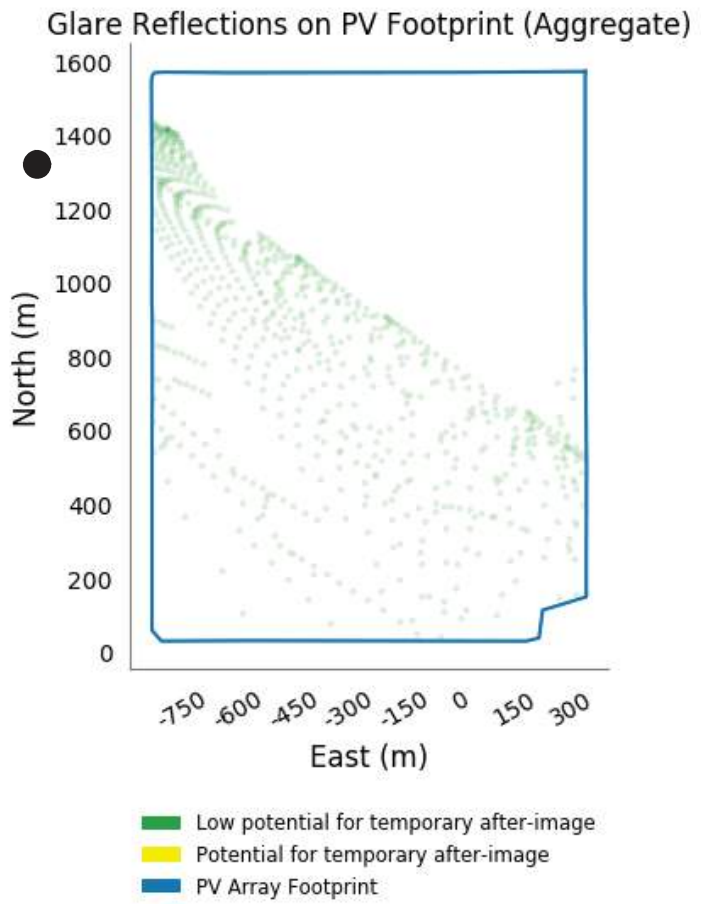
Figure 23: SGHAT Results OP17

8.8 OP18 – Gulf View Road

This property may experience some very limited GREEN GLARE during the late afternoon hours of each day for up to 5 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate
visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP18. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.







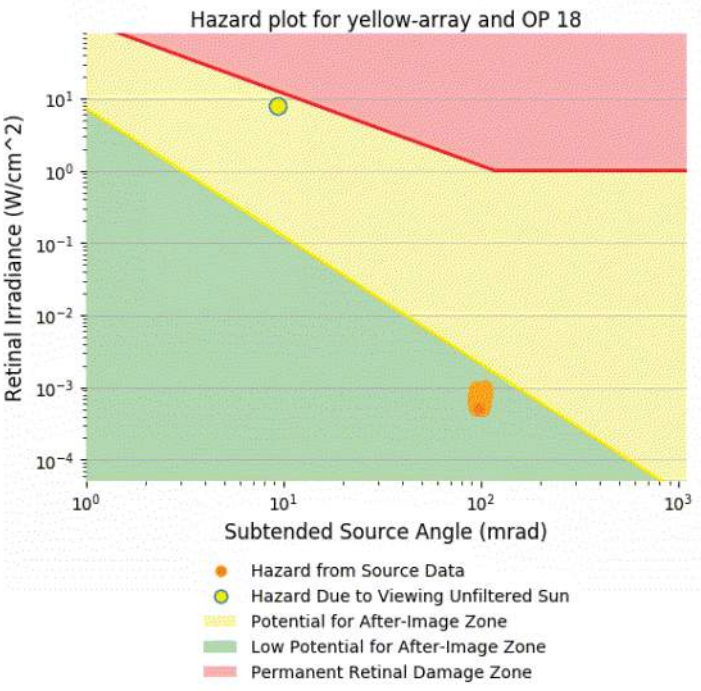
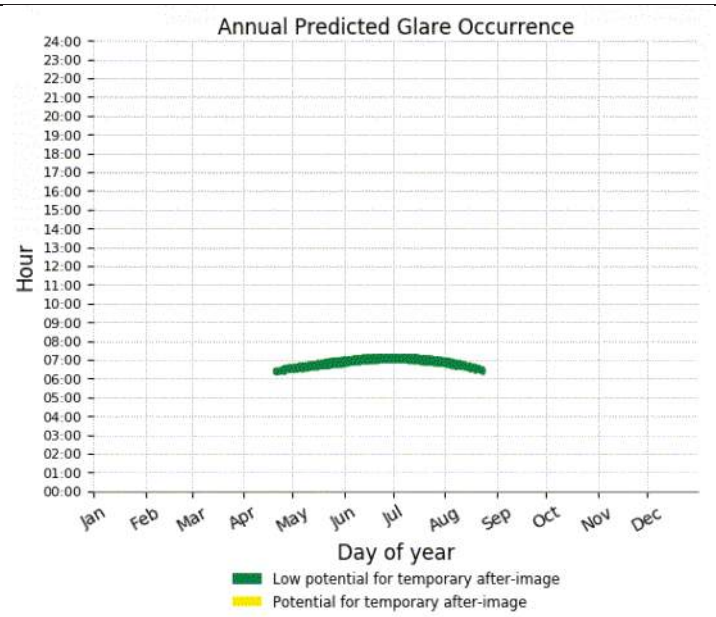
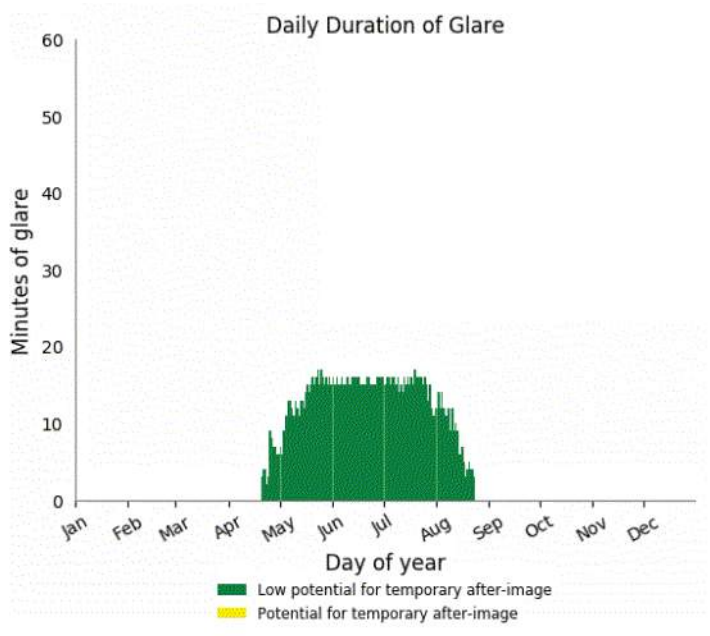


Figure 24: SGHAT Results OP18

8.9 OP35 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 20 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP35. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





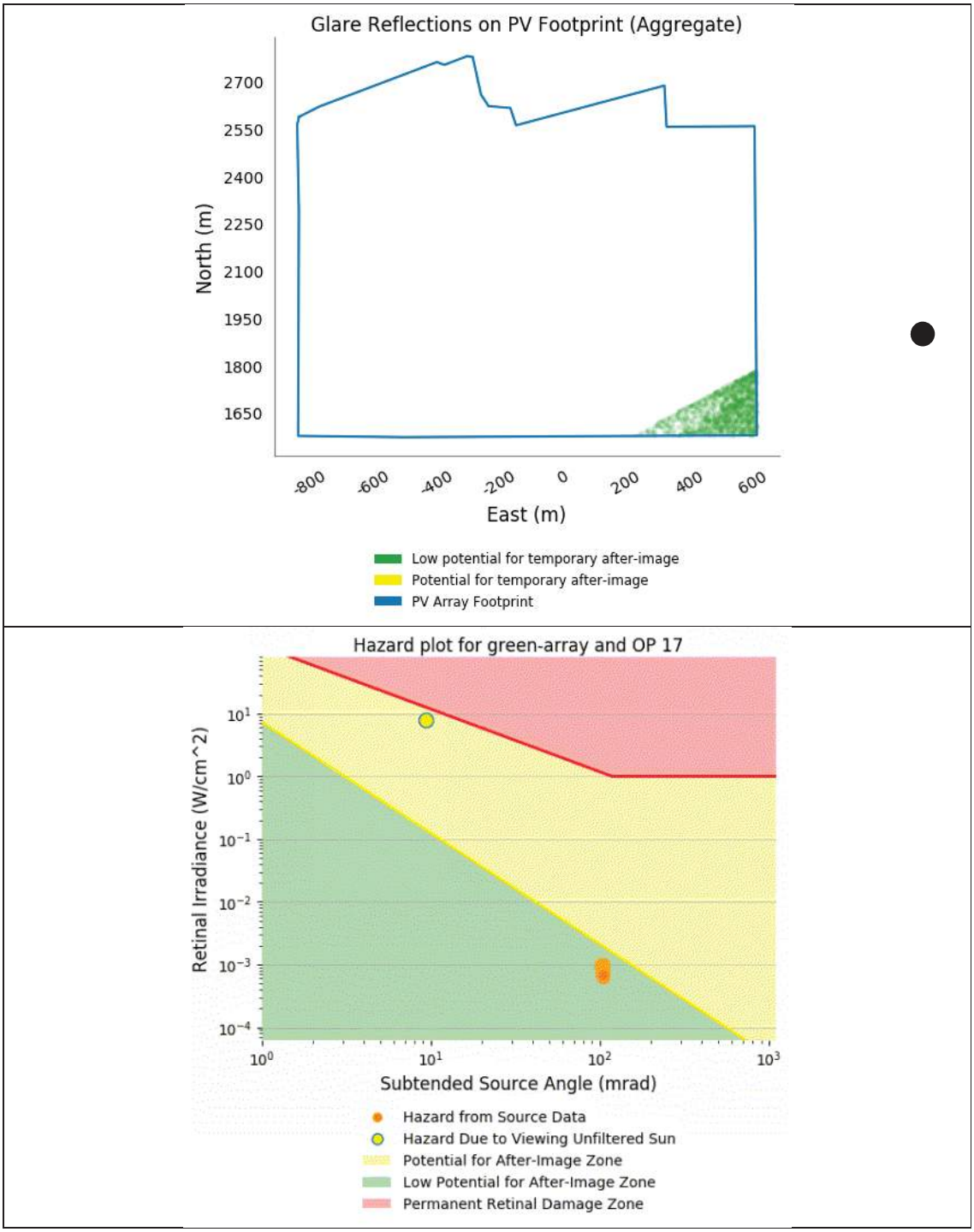
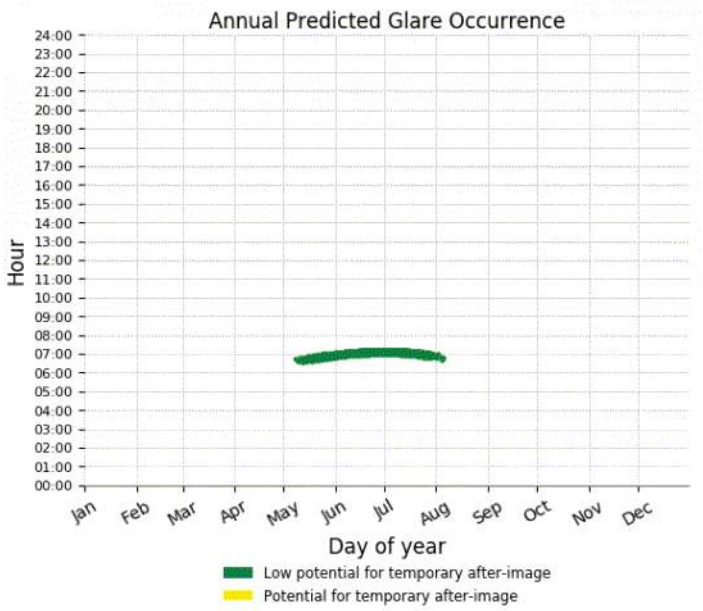


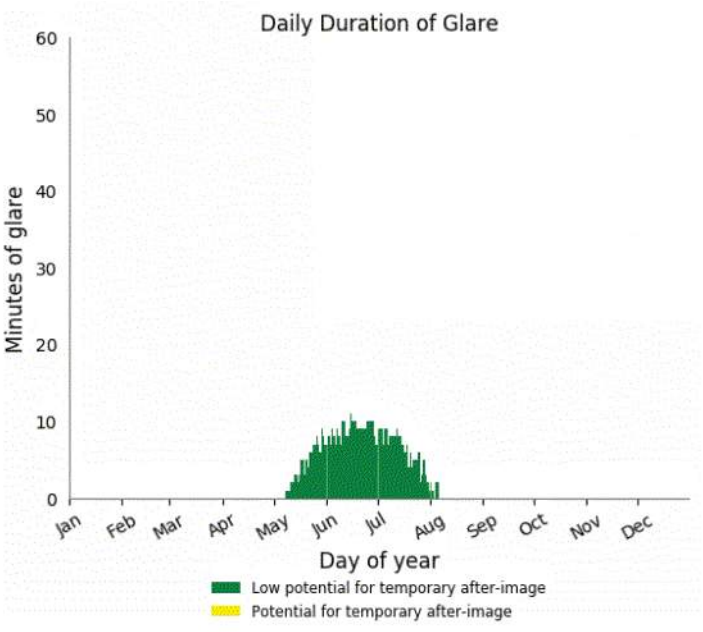
Figure 25: SGHAT Results OP35[16]

[16] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.10 OP36 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 10 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP36. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





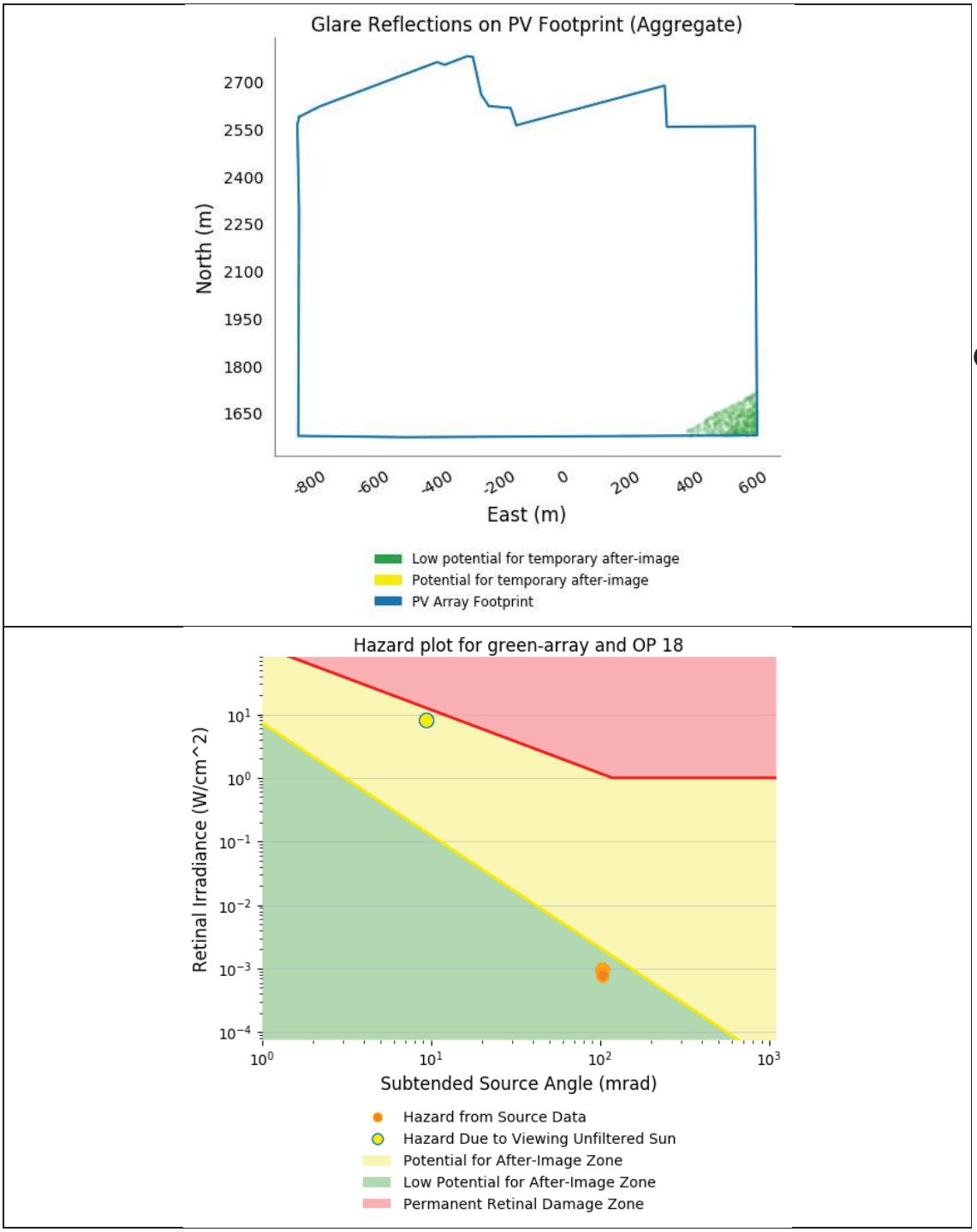
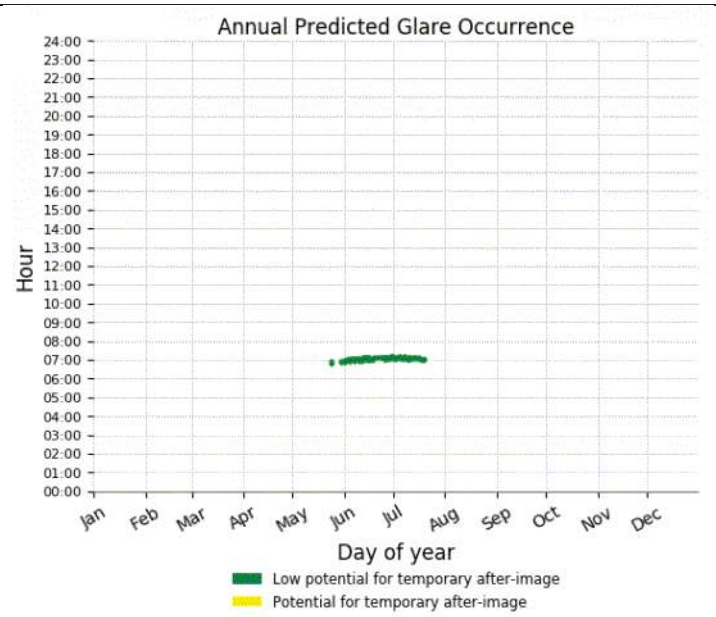


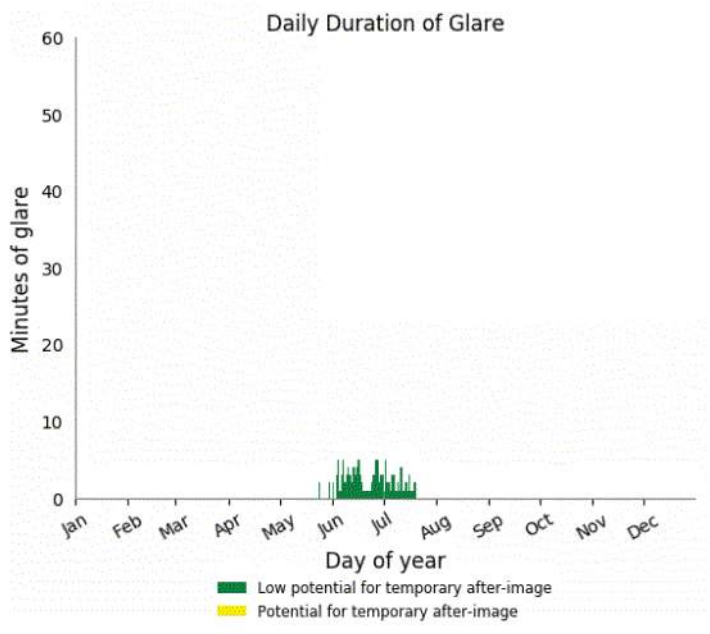
Figure 26: SGHAT Results OP36[17]

[17] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.11 OP40 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 5 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP40. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





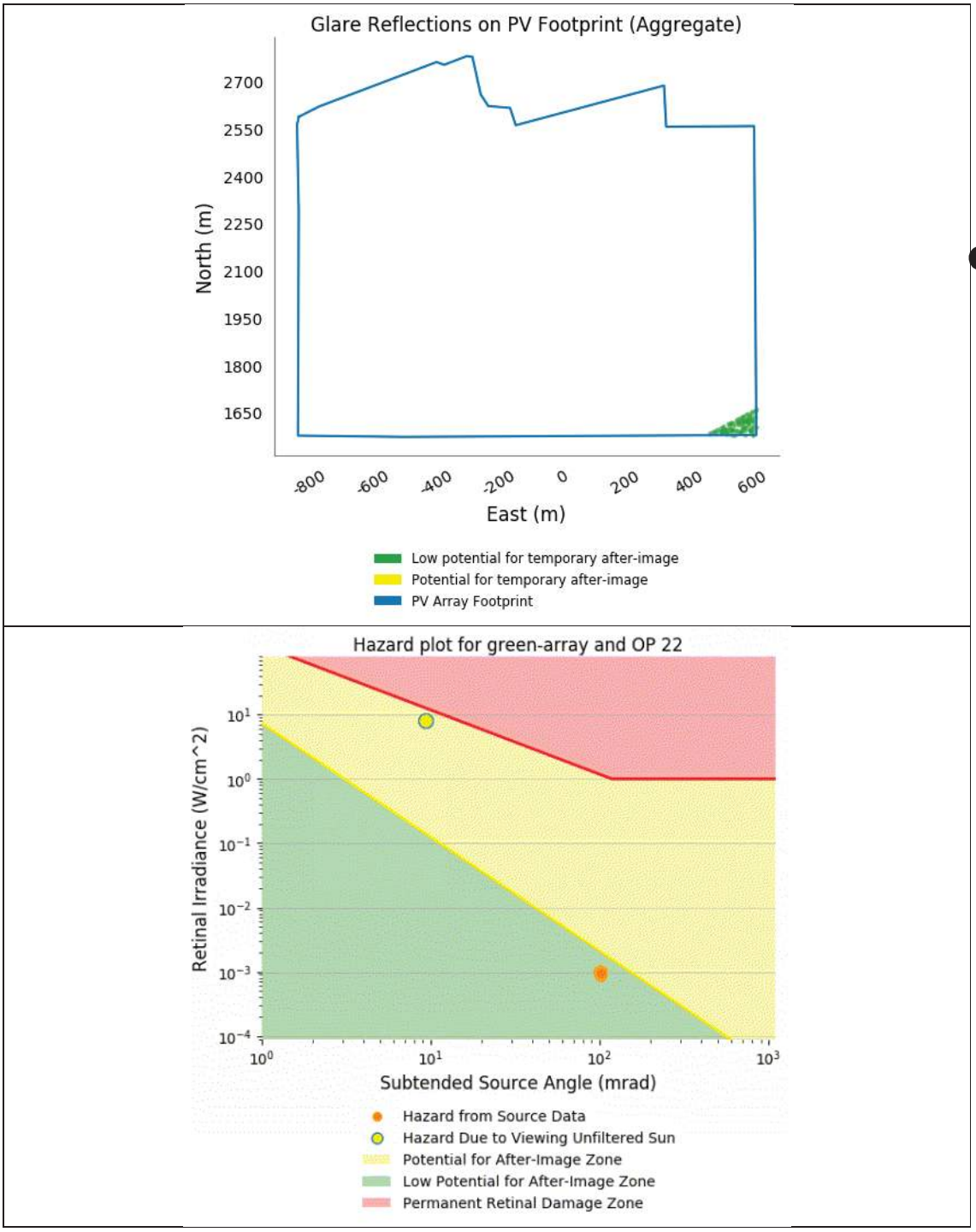
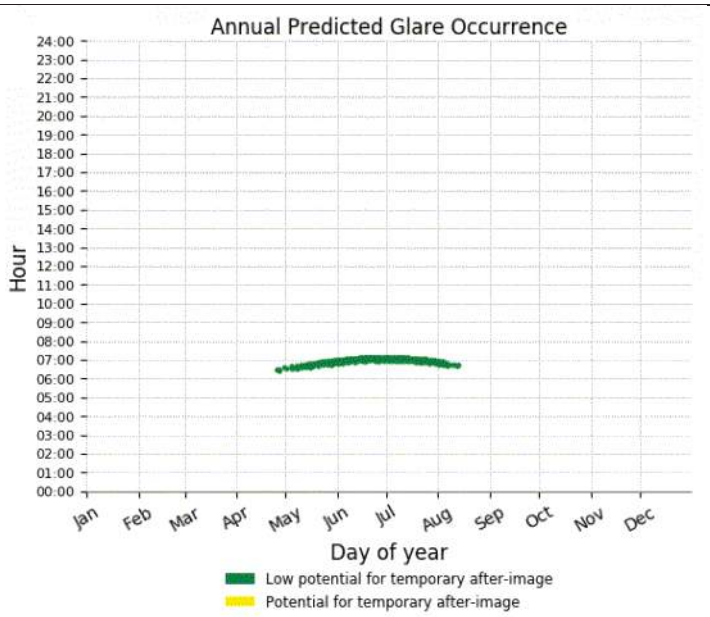


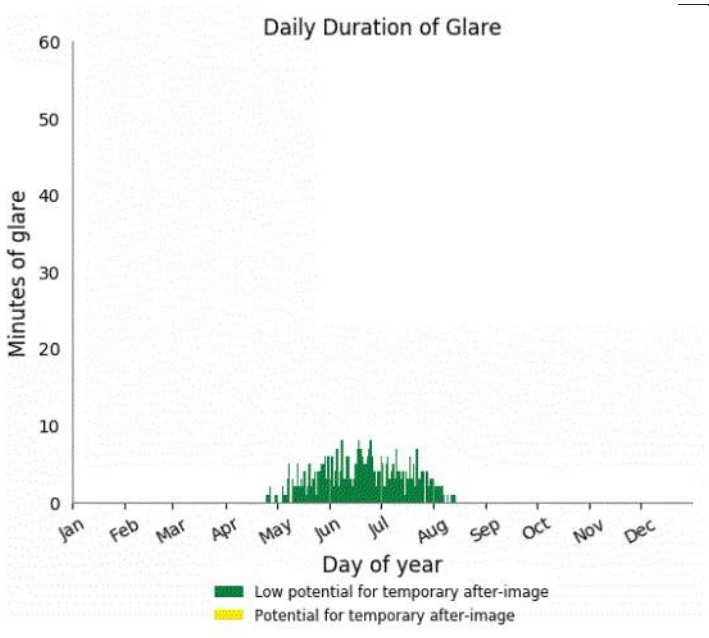
Figure 27: SGHAT Results OP40[18]

[18] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.12 OP41 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 5 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP41. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





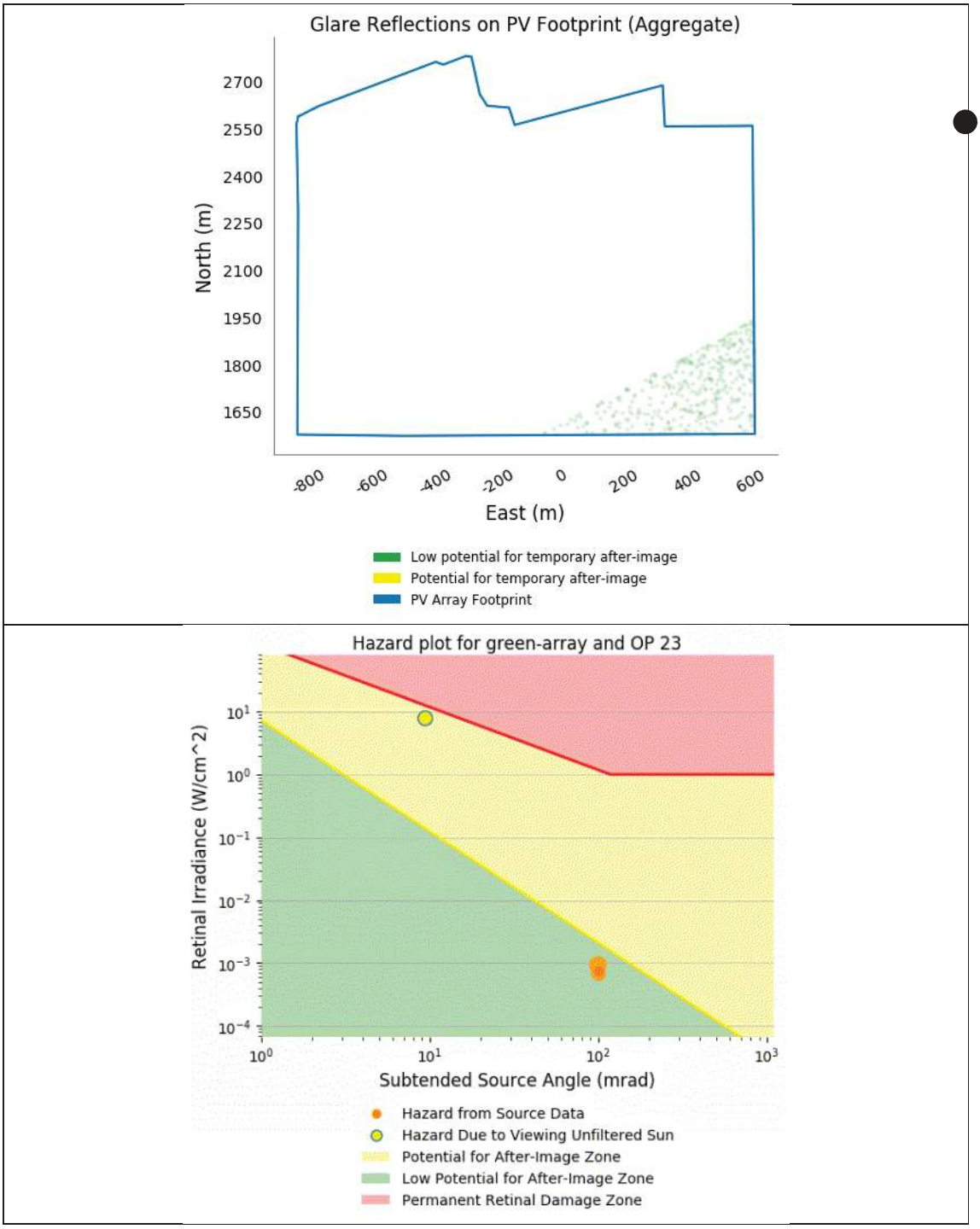
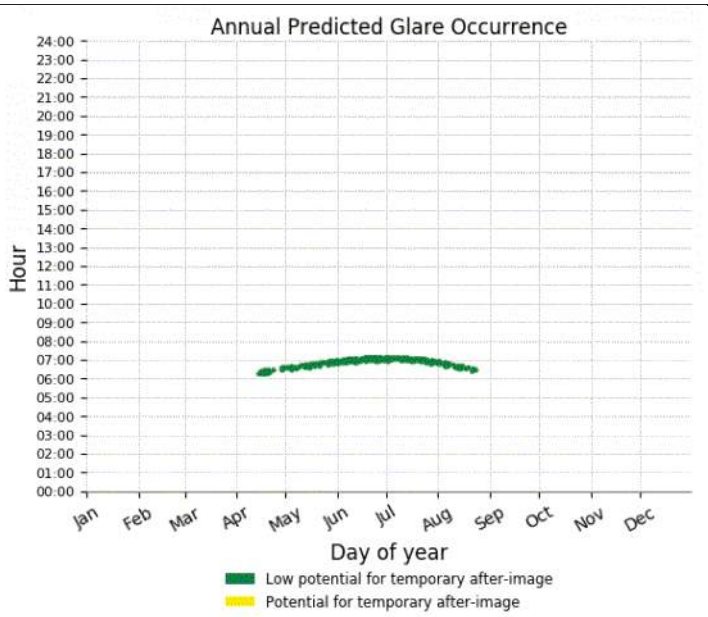


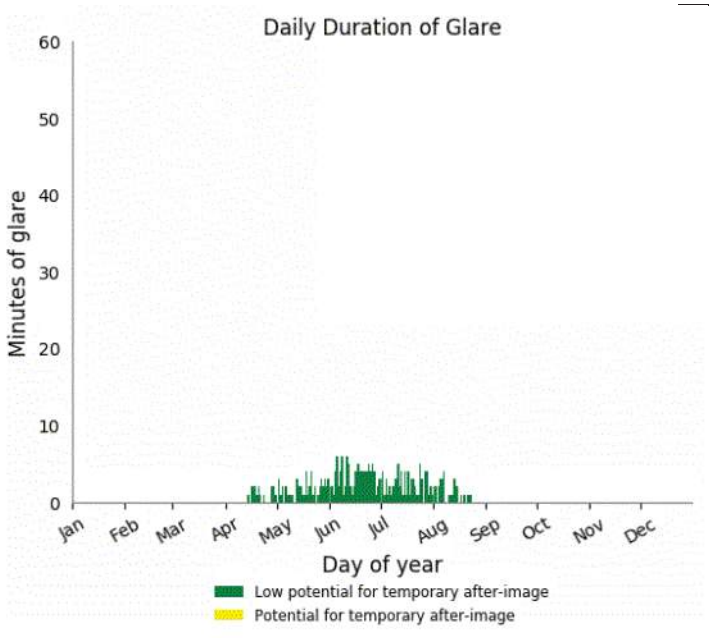
Figure 28: SGHAT Results OP41[19]

[19] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.13 OP42 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 5 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP42. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





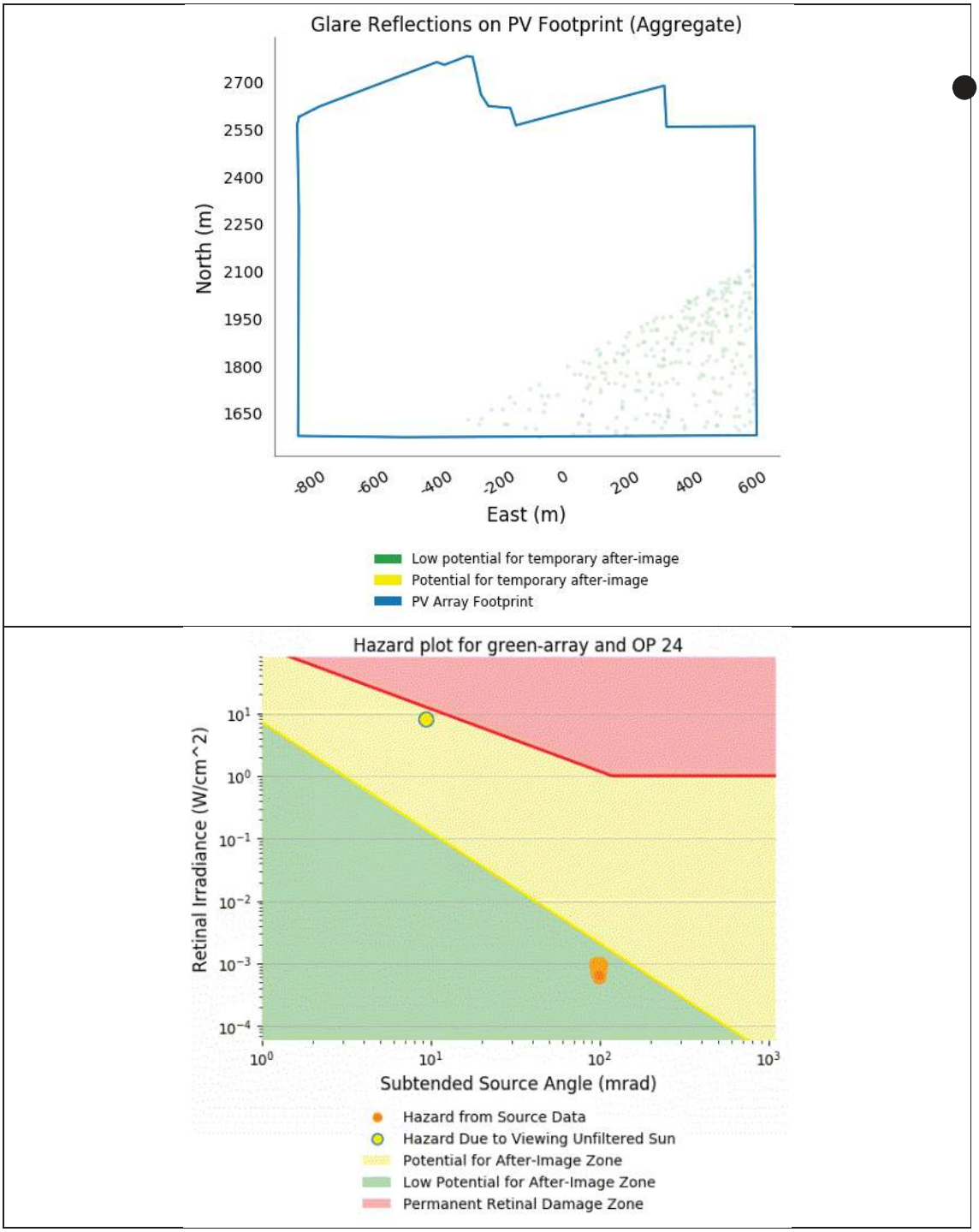
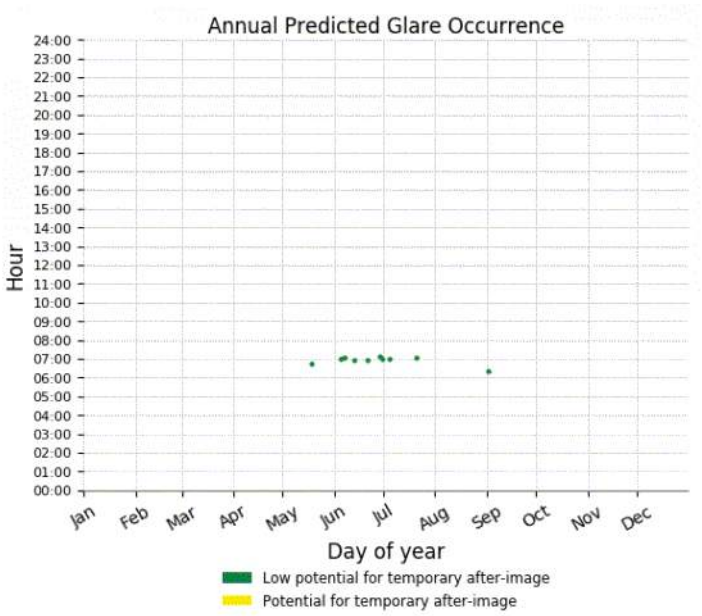


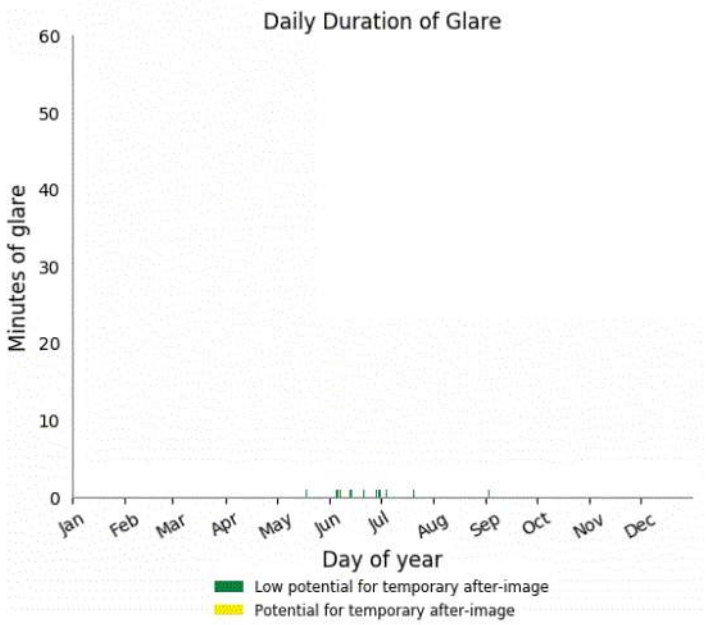
Figure 29: SGHAT Results OP42[20]

[20] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.14 OP43 – Scenic Drive Side Road

This property may experience some very limited GREEN GLARE during the early morning hours of each day for up to 2 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property.





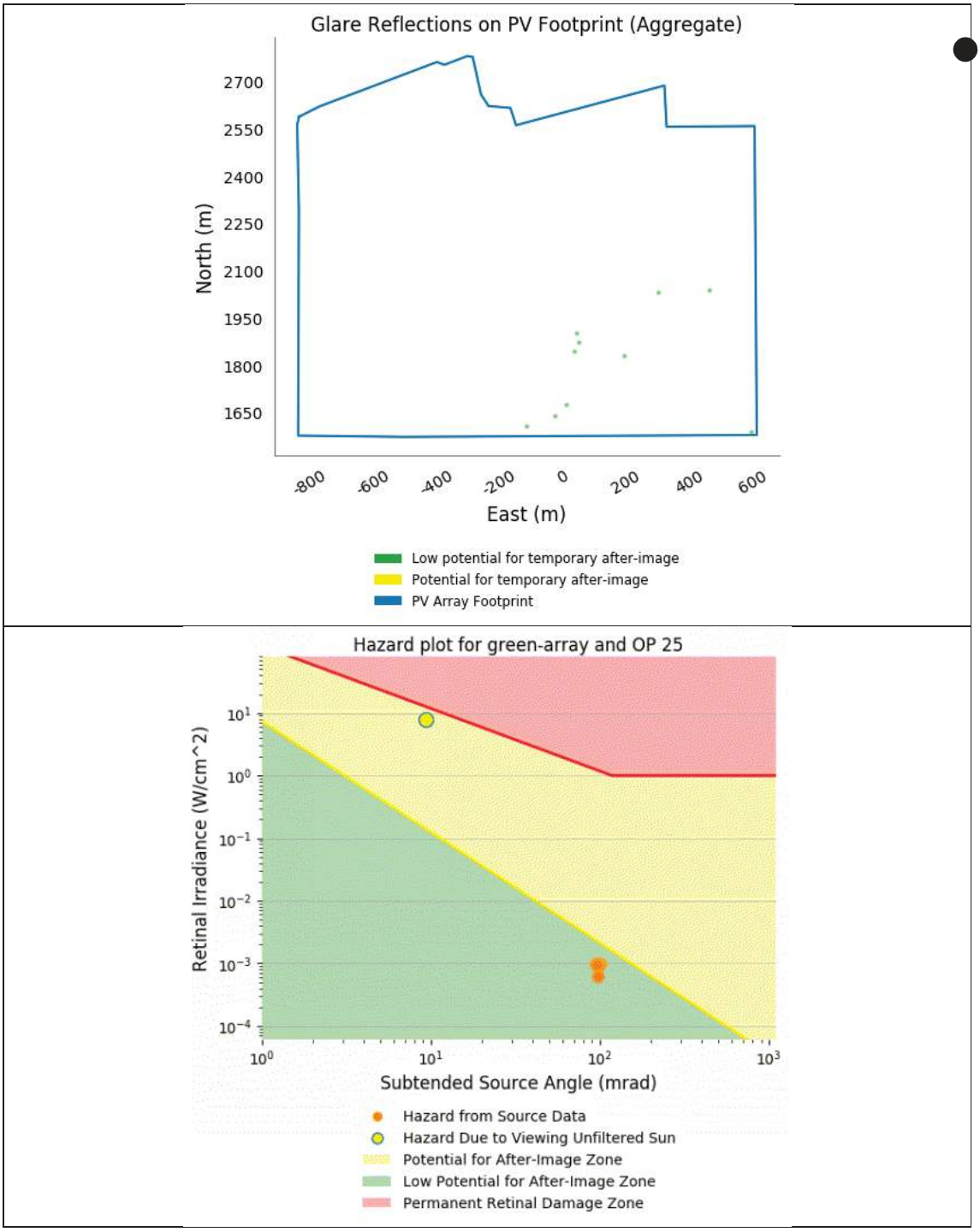
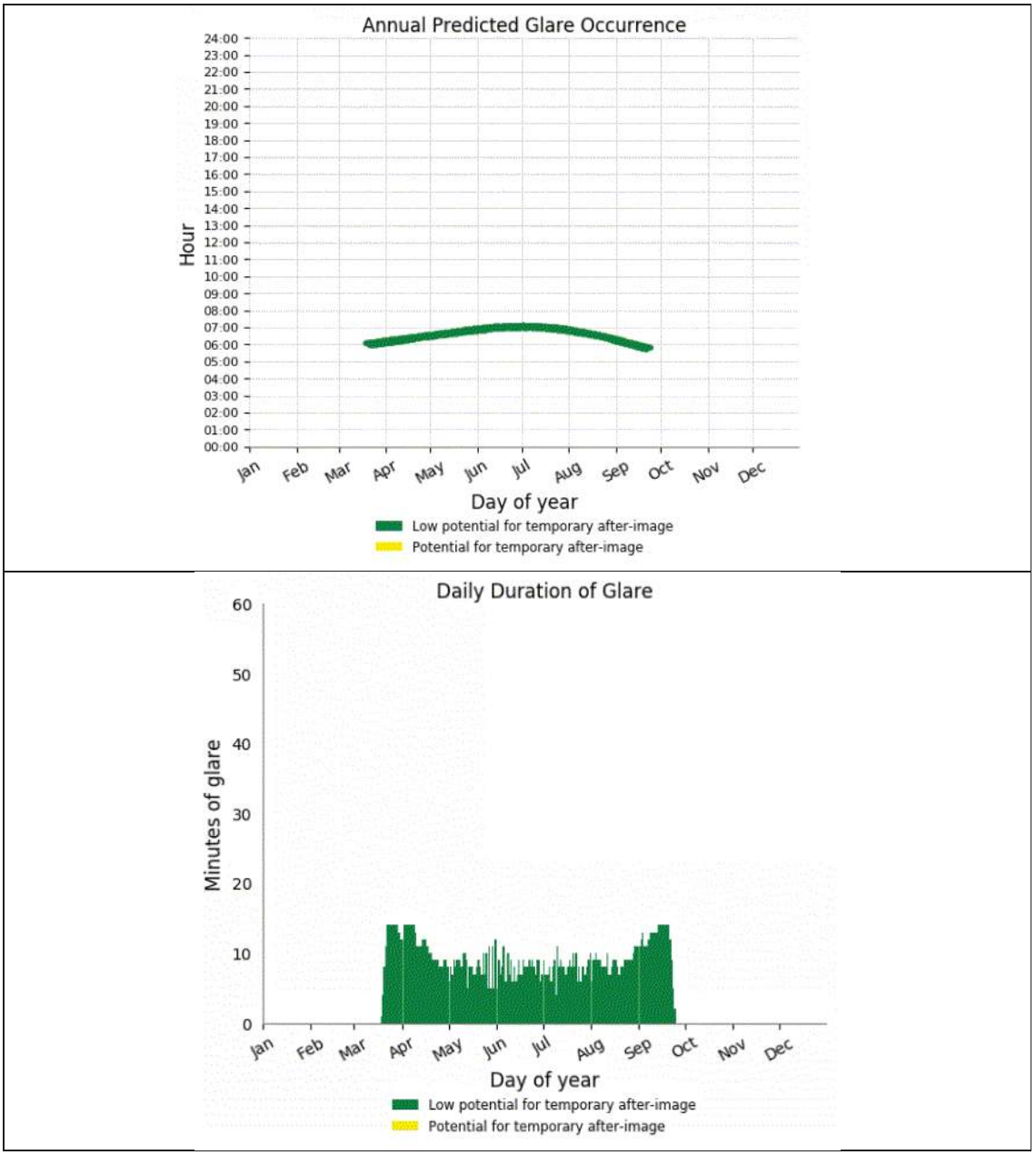


Figure 30: SGHAT Results OP43[21]

[21] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.15 OP44 – Gulf View Road

This property may experience some limited GREEN GLARE during the early morning hours of each day for up to 15 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP44. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.



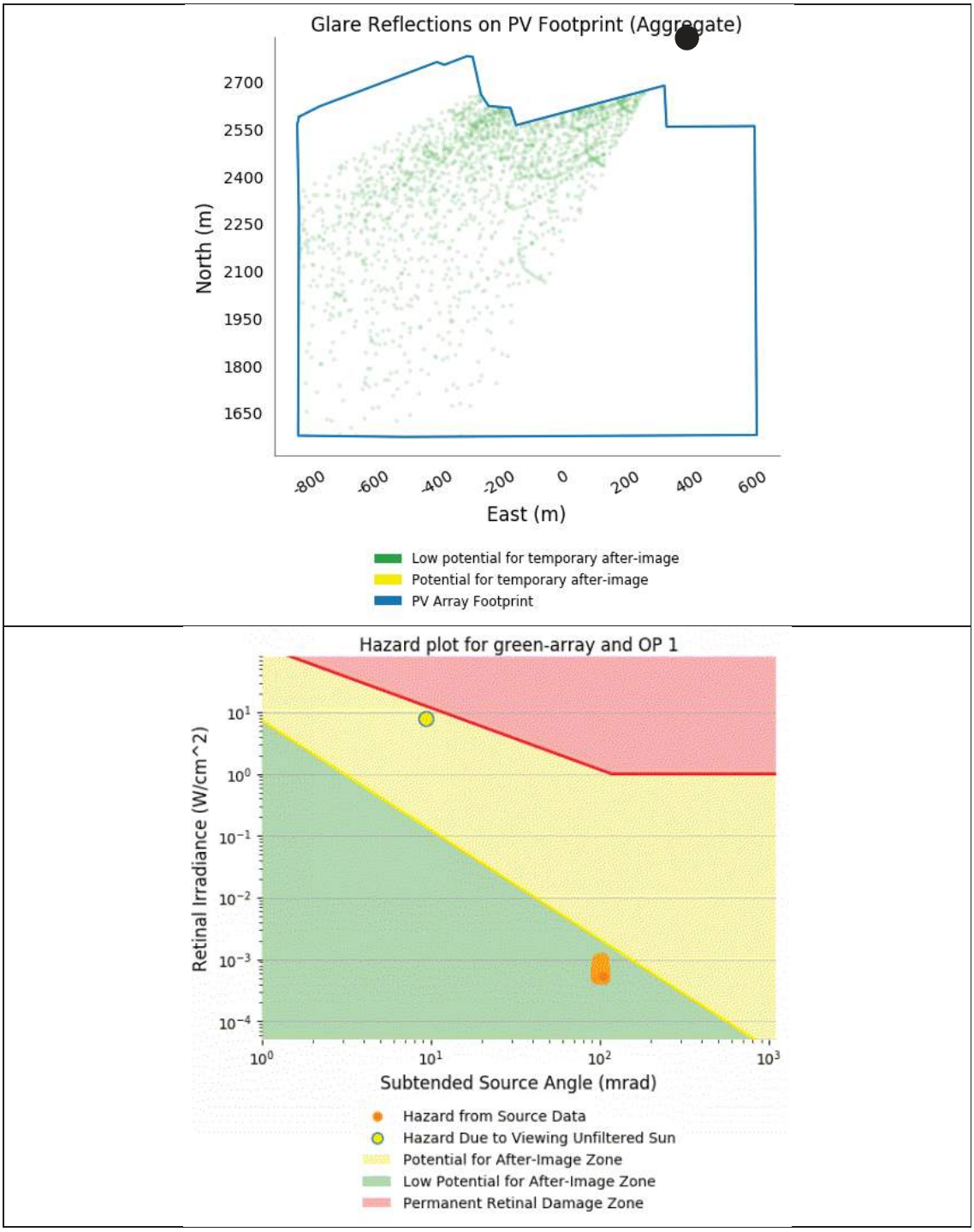
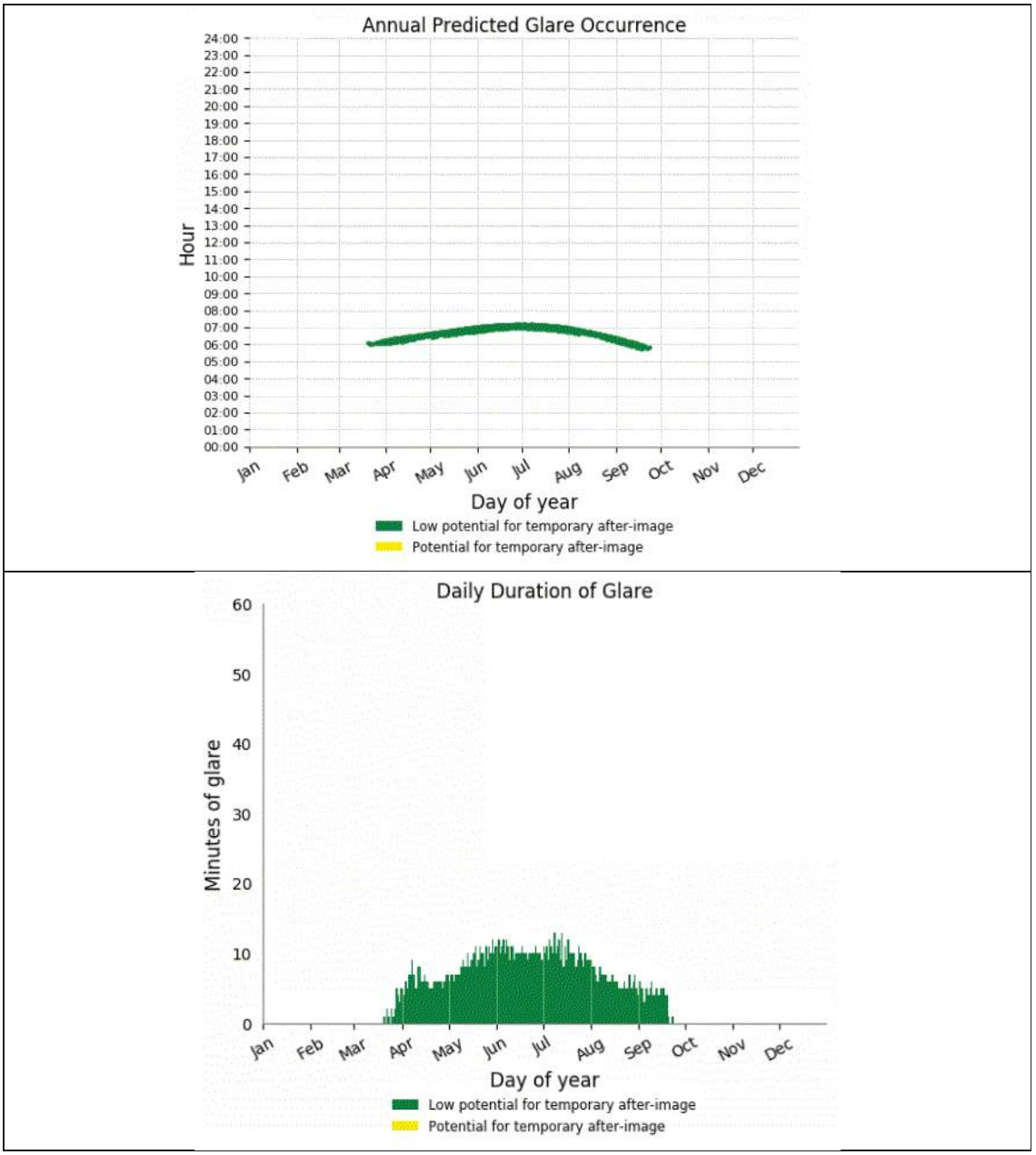


Figure 31: SGHAT Results OP44[22]

[22] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.16 OP49 – Off Gulf View Road

This property may experience some limited GREEN GLARE during the early morning hours of each day for up to 12 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP49. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.



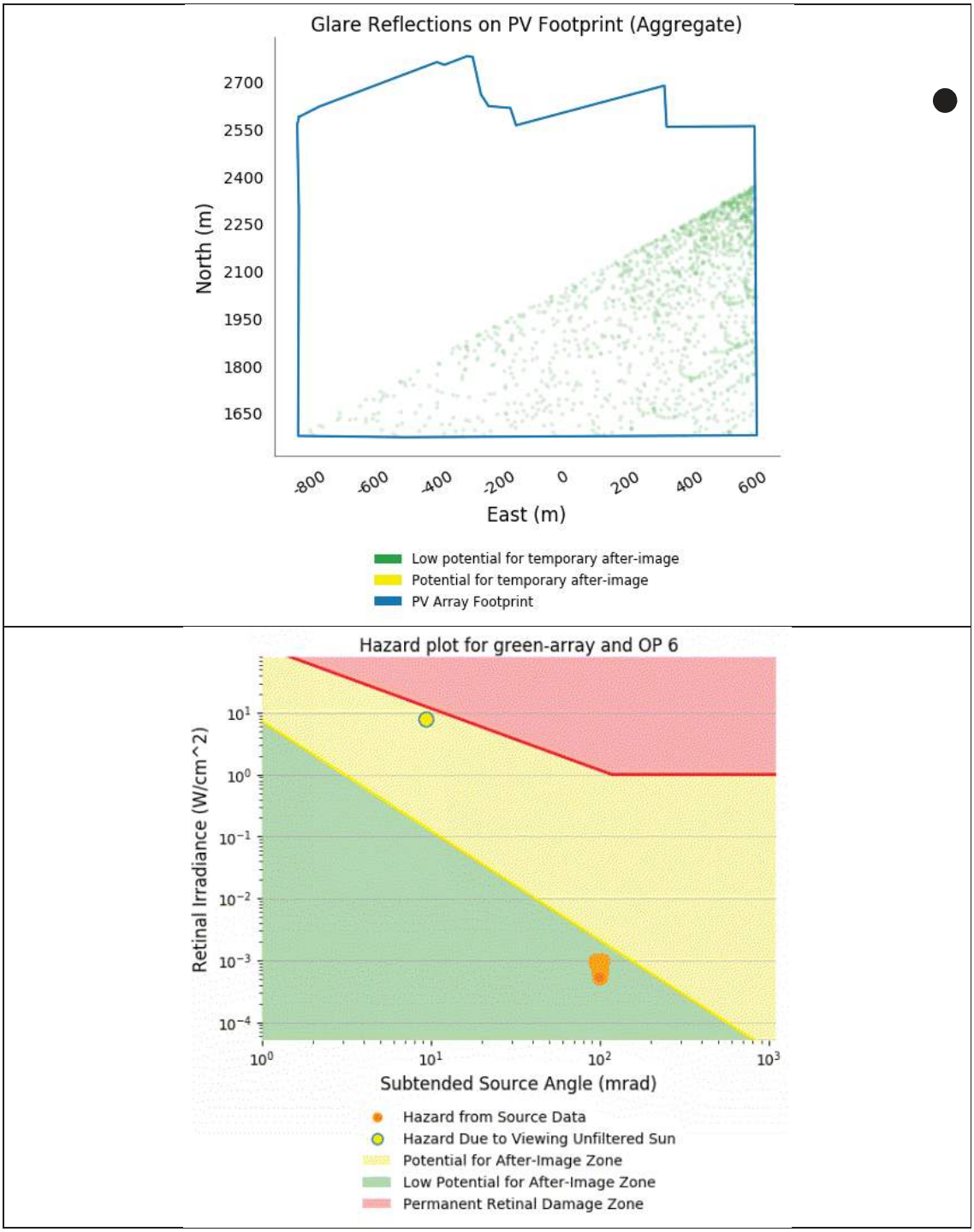
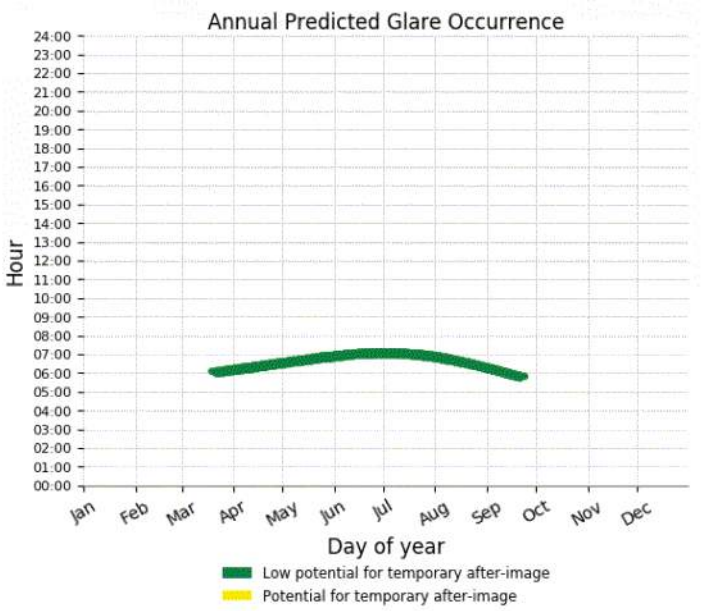


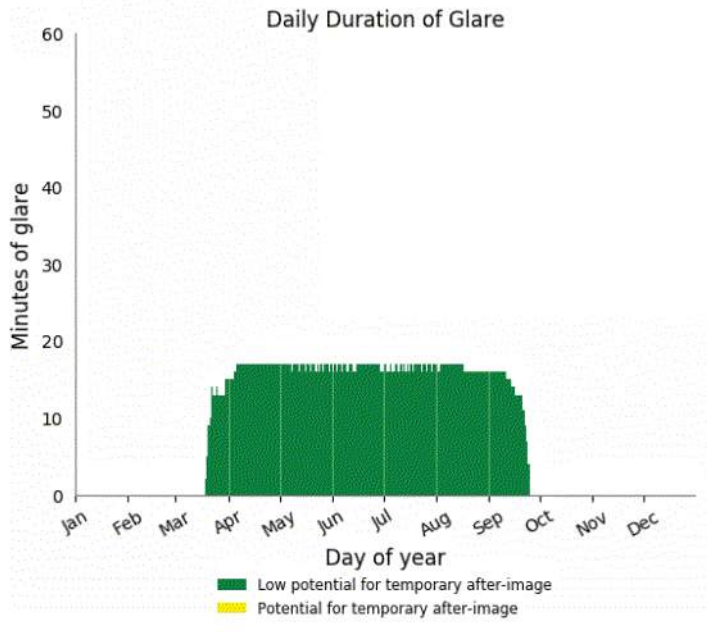
Figure 32: SGHAT Results OP49[23]

[23] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.17 OP50 – Off Gulf View Road

This property may experience some limited GREEN GLARE during the early morning hours of each day for up to 18 min. This is however not considered to be an issue and is easily screened by the existing vegetation on this property. However, in addition to the existing vegetation the Client proposes to incorporate a 50 m wide visual buffer including a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to OP50. This visual buffer and landscape screen in combination with the existing vegetation surrounding many parts of the project area and adjacent residences will substantially ameliorate any GREEN GLARE.





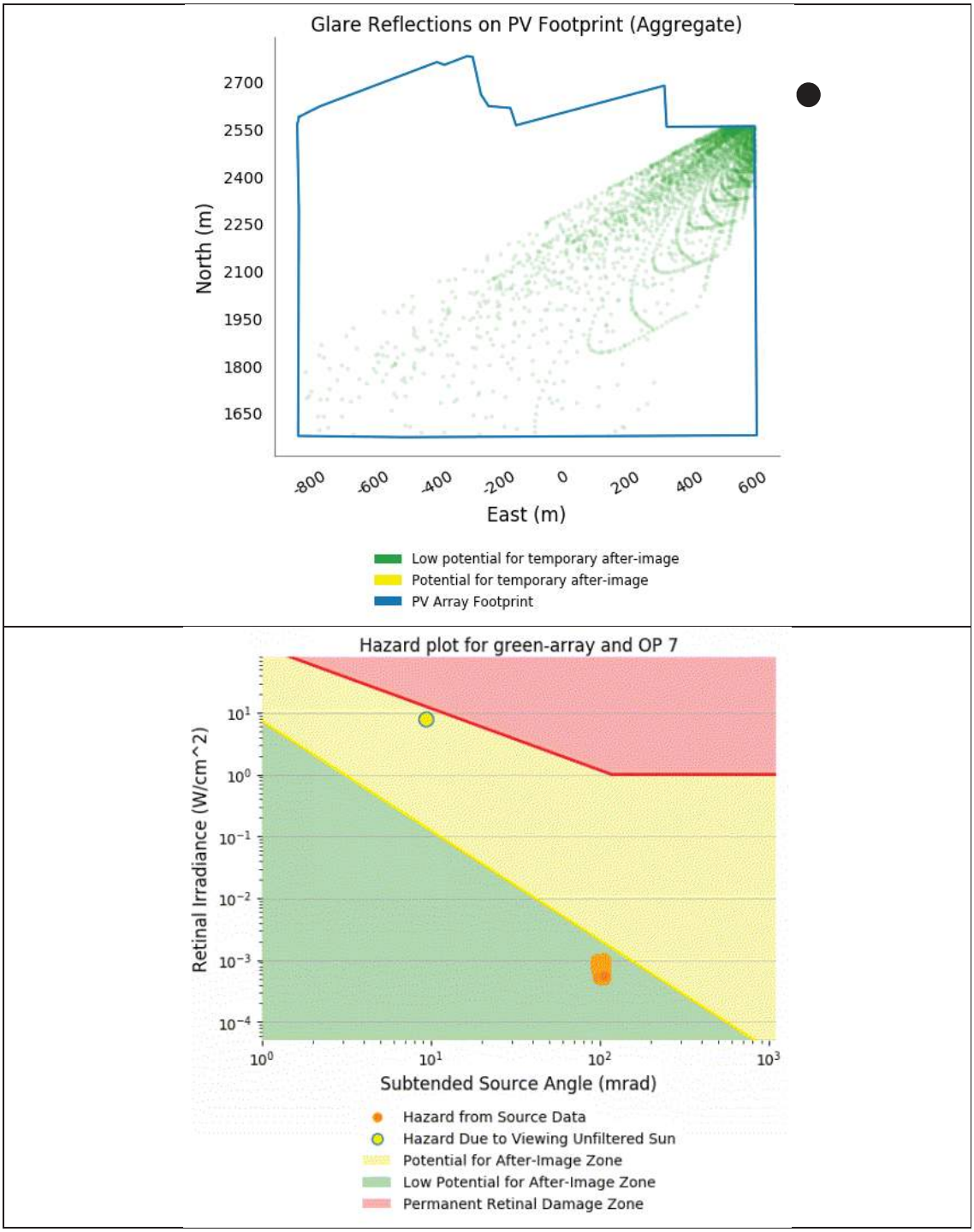
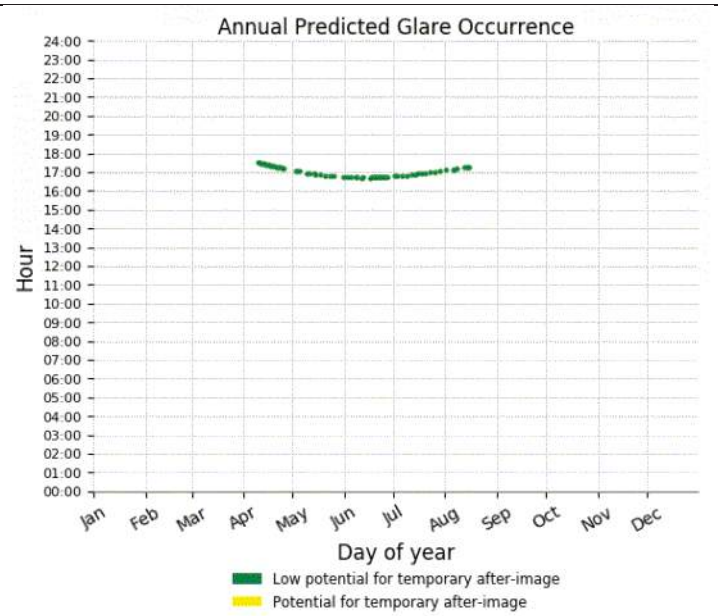


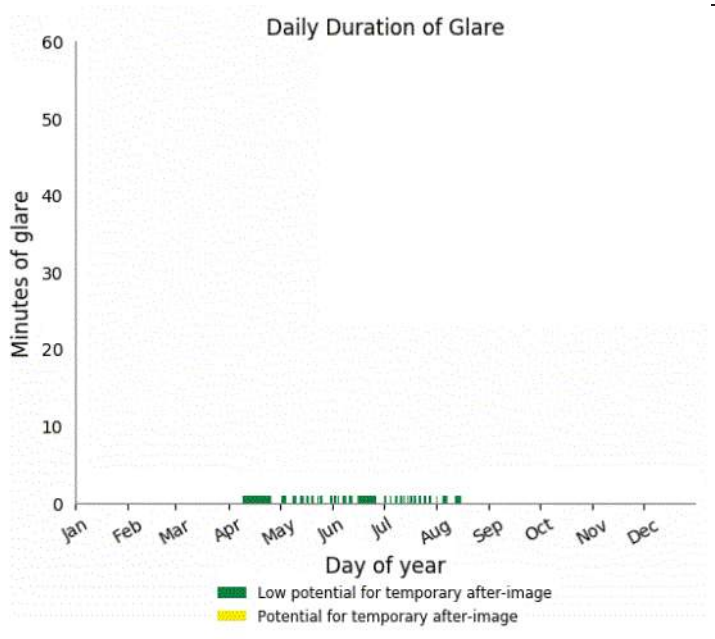
Figure 33: SGHAT Results OP50[24]

[24] OP number shown in Hazard Plot is incorrect due to calculation requirement to split into blocks

8.18 Warnertown Road

On Warnertown Road only very short duration of some GREEN GLARE during the late afternoon hours can be expected. As sun is very low during that period and therefore already represents some glare issues for drivers heading west and through their rear-view mirror driving east the additional glare from the PVS solar panels is considered negligible. Intermittent screening by trees or scrubs alongside the road further reduces any potential glare issues. However, in addition to the existing vegetation within the road corridor the Client proposes to incorporate a 10 m wide and 4 m high landscape screen around the boundary of the Project Area adjacent to Warnertown Road. This visual buffer and landscape screen in combination with the existing vegetation will substantially ameliorate any GREEN GLARE.





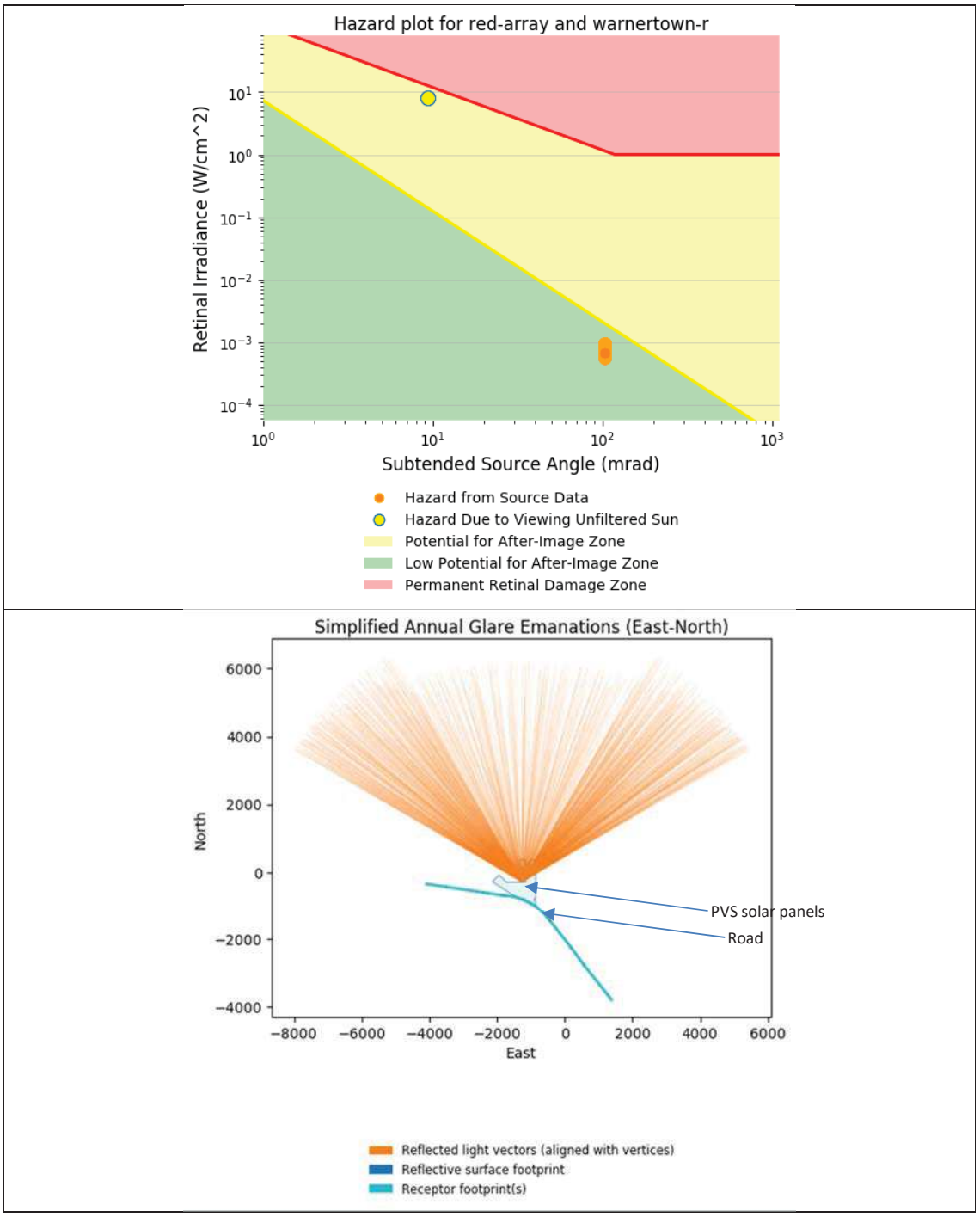
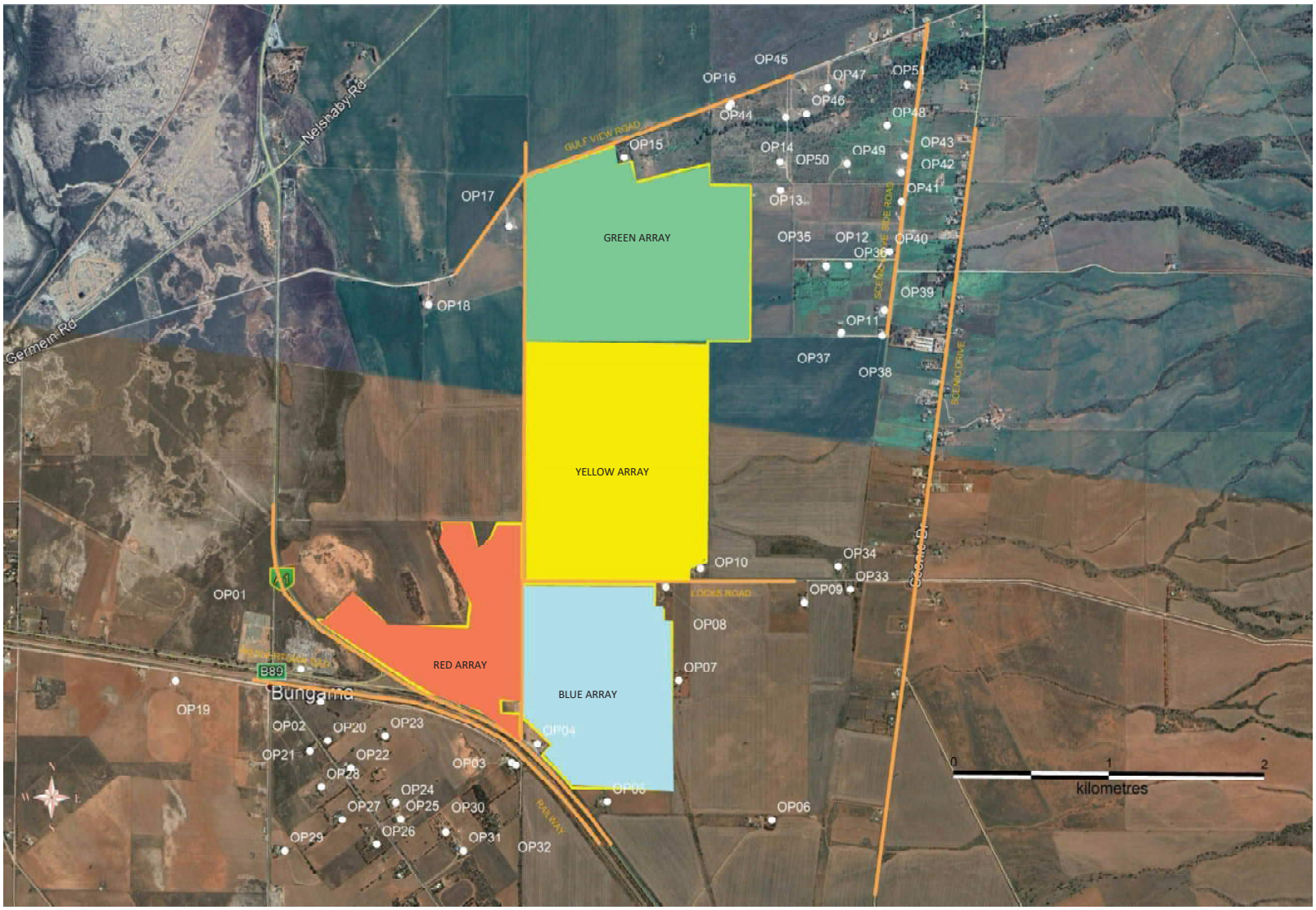


Figure 34: SGHAT Results Warnertown Road



Point

Subarrays Legend

Region

Region

Region

Region

Roads Legend

Line

BV

CONSULTING

BV CONSULTING

NORA-PLATIEL-STR. 4, 34253 LOHFELDEN
GERMANY

PV Plant Overview

BUNGAMA SOLAR

SIZE	Author	DWG NO	REV
A3	B. Voll	BPV-LAYOUT-BV20181111	0

SCALE	n/a	25-11-2018	SHEET	1 OF 1

APPENDIX 13

Noise Assessment

NOISE ASSESSMENT

Prepared for Bungama Solar

Prepared by Muller Acoustic Consulting

BUNGAMA SOLAR

www.bungamasolar.com.au

EPS ENERGY

Reference No. 11297

November 18

Noise Assessment

Bungama Solar Project
Napperby, South Australia
November 2018

Prepared for: Bungama Solar 1 Pty Ltd
November 2018
MAC180707RP1

Muller Acoustic Consulting

Document Information

Noise Assessment

Bungama Solar Project

Napperby, South Australia

Prepared for: Bungama Solar 1 Pty Ltd
PO Box 195
Charlestown NSW 2290

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180707RP1	Final	26 November 2018	Rod Linnett		Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by EPS Energy Pty Ltd on behalf of Bungama Solar 1 Pty Ltd to prepare a Noise Assessment (NA) for the proposed Bungama Solar Project (the 'Project'). The Project is an integrated but separately operated grid connected Photo Voltaic Energy Generation System (PVS) of approximately 280MW (AC) generation capacity and a 140MW capacity Battery Energy Storage System (BESS) with 560MWh of storage that will feed into the National Electricity Market via ElectraNet's Bungama Substation. This report presents the methodology and findings of the assessment for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the Planning Report for the project. The purpose of the NA is to quantify potential environmental noise levels associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receptors situated within the area of influence to the project;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receptors;
- provide a comparison of predicted noise levels against relevant construction and operational criteria to determine the potential noise impacts associated with the project; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where construction or operational criteria may be exceeded.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**

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2 Project Description

2.1 Background

The Project land comprises the Project area on which the PVS, BESS Project's substation, Operations and Maintenance buildings and associated infrastructure will be built and operated together with the land required to connect the Project's elements to ElectraNet's Bungama Substation.

The Project area is approximately 530ha located in the suburbs of Bungama, Napperby and Warnertown in South Australia, and is situated approximately 6km east of Port Pirie, and 218km north of the State's capital, Adelaide. The Project is within the Local Government Area (LGA) of Port Pirie Regional Council.

Land within the immediate surrounding area of the Project area is used for agriculture, rural residential living and public services including electricity infrastructure.

2.2 Description of Proposed Construction Works

The Project includes the installation of groups of Photo Voltaic (PV) panels arranged in rows mounted on single axis trackers with a maximum height most likely not exceeding 4m above the natural ground level. The PV panels will be installed on a mounting structure comprising steel posts driven approximately 2.5m below ground using a small pile driver. Additional support structures would be attached to the piles, which would then support the PV panels.

Earthworks will primarily involve trenching which is required for cabling of each PV array/module to inverters and a substation. Construction of internal access tracks and other minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

2.3 Description of Proposed Operation

The PVS element of the Project will have a maximum output capacity of up to approximately 280MW (AC). The BESS element of the Project includes up to 140MW capacity battery with up to 560MWh of storage. The Project may also include one or more synchronous condensers to assist in providing inertia for managing power system strength. The PVS element, the BESS element and associated infrastructure, collectively from herein are referred to as "the Project".

The Project will include, but not be limited to, the following components:

- Solar Photo Voltaic modules and ground mounted tracking racks;
- DC/AC containerised or skid mounted inverter stations;
- Battery storage area;
- Synchronous condensers (subject to requirement);
- Transformers;
- Switching yard and electrical substation;
- Associated underground cables connecting groups of solar panels to inverter stations and inverter stations via overhead and/or underground transmission lines to a transformer in the substation;
- Ancillary infrastructure and buildings associated with the development including a site office, maintenance sheds, laydown area/compound access tracks and perimeter fencing; and
- Connection to Bungama Substation via overhead and/or underground transmission lines.

The project will be contained solely within the site, including areas required for stockpiling and materials laydown during construction as shown in **Figure 1**.

The project would operate 24 hours a day, 7 days a week, which would involve the presence of staff on-site and would typically see minimal plant and equipment operating on site. During operation, the PVS would generate electricity which would be transferred into the power grid via the substation. Key noise emissions from the operation of the project are associated with the inverter and transformer components of the substation. It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receptors.

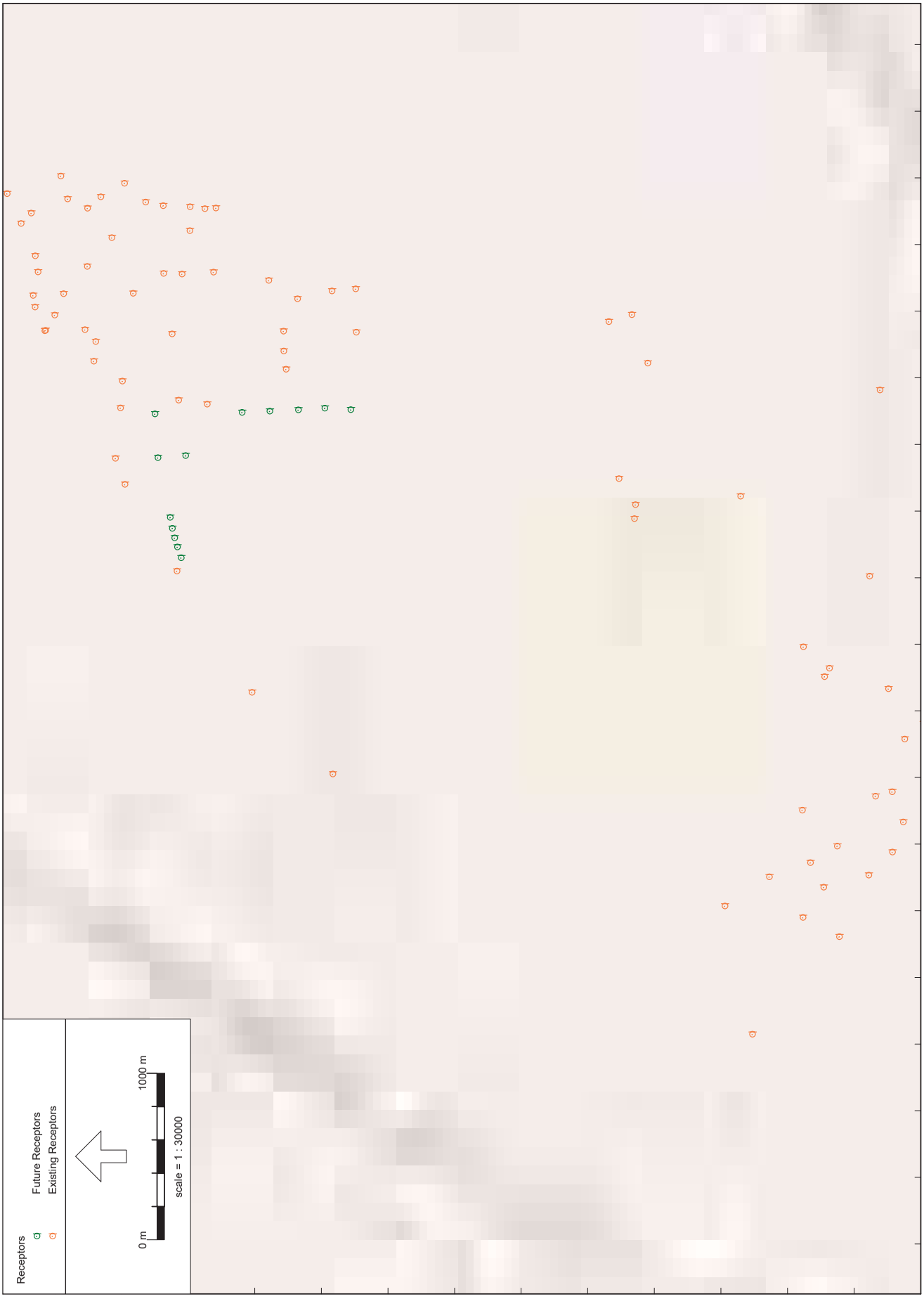
When required, maintenance activities will be undertaken during standard working hours (except for emergencies) and are expected to include:

- panel cleaning;
- repairs or replacement of infrastructure, as required; and
- land management including mowing to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicles movements on site and maintenance equipment.

2.4 Potentially Sensitive Receptors

From review of aerial imagery and associated project information, MAC has identified the following potentially sensitive receptors that may be affected by noise from operations, construction activities and related road traffic and are presented in **Figure 1**.


Receptors
Future Receptors
Existing Receptors
0 m
1000 m
scale = 1 : 30000
6326000
6324000
226000
228000
230000
232000
Industrial noise - ISO 9613.1/2, [EIS Assessment - Figures] , iNoise V2018.2 Enterprise. Licensed to Muller Acoustic Consulting - Australia

3 Noise Policy and Guidelines

The NA has been conducted in accordance with the following key policy, guidelines and standards where relevant:

- South Australia Environment Protection Authority's (EPA), Environment Protection (Noise) Policy, (EPP) 2007 (Noise Policy);
- South Australia Environment Protection Authority's Information Sheet on Construction Noise, 2017;
- South Australia Environment Protection Authority's Information Sheet on General Environmental Noise, 2013;
- Department of Planning, Transport and Infrastructure (DPTI) Road Traffic Noise Guidelines V5 2016 (RTNG).
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017; and
- NSW Environment Protection Authority (EPA) – NSW Environmental Noise Management – Industrial Noise Policy (INP), January 2000 and relevant application notes (superseded).

3.1 South Australia Environment Protection (Noise) Policy 2007

An Environment Protection Policy (EPP) is a legislative tool provided under the Environment Protection Act 1993 (the EP Act). An EPP can be made for any purpose directed towards securing the objects of the Act.

The South Australia Environment Protection (Noise) Policy 2007 (Noise Policy) provides a legal framework for the assessment of a wide range of noise issues and incorporates a range of regulatory tools depending on the issue. In general, guidance is provided on the starting point (the indicative noise level) for action, and the factors to consider in determining what action to take. For more defined situations, such as the operation of an air conditioning unit at a dwelling, mandatory provisions are used. For more complex situations, descriptive and informative guidelines are called up by the Noise Policy.

The objectives of the Noise Policy are:

- to establish noise goals that, if achieved, secure compliance with the EP Act.
- where noise exceeds those noise goals, the Policy establishes what requirements the Authority will impose to address the noise issue.
- to establish a consistent approach to development applications under the Development Act. Noise issues are inherently more difficult to resolve once established, and therefore the Policy addresses noise at the development stage.

In addition, the Policy acknowledges there are special activities or sources that require specific management. These activities can be addressed through the application of special provisions or guidelines under the Policy.

3.1.1 Industrial Noise

The aim of the Noise Policy is to limit the level of noise exposure that for people living near industrial and other non-domestic premises.

The maximum permissible noise levels listed in **Table 1** are used as a guide in deciding whether the general environmental duty has been met and are adopted as the noise assessment criteria for this NA.

Table 1 Industrial Noise Assessment Criteria for Various Land Uses, dBA[1]

Land Use Category	Day (7am to 10pm)	Night (10pm to 7am)
Rural Living	47	40
Residential	52	45
Rural Industry	57	50
Light Industry	57	50
Commercial	62	55
General Industrial	65	55
Special Industry	70	60

Note 1: Measured according to the Noise Policy at any place, other than the premises from which the noise emanates, where a person lives or works.

3.2 Road Traffic Noise Guideline

Department of Planning, Transport and Infrastructure (DPTI) Road Traffic Noise Guidelines V5 2016 (RTNG) provide a framework for assessing and treating road traffic noise with regard to the construction of new roads or the upgrading of existing roads. The guideline is applicable for assessment of road traffic noise where traffic noise could possibly affect nearby noise- sensitive premises as a result of the construction of new roads, roadworks (e.g. re-alignment, road widening) or change in the function of roads.

In the absence of relevant policy, the RTNG criteria has been adopted for this NA. Where noise levels from the project construction related traffic are above the adopted RTNG criteria, noise levels may be deemed excessive and require noise mitigation measures to be implemented.

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4 Assessment Criteria

4.1 Construction Noise Criteria

The South Australia EPA Noise Policy and its associated guidance documents states that construction noise that causes an adverse impact on amenity is only permitted between 7am and 7pm, Monday to Saturday. Construction noise with an adverse impact on amenity is defined as an average noise level of 45dBA or a single noise event with a maximum noise level of 60dBA at a noise receptor (such as a residential dwelling). In practical terms this means that construction activities with the potential to cause adverse impacts are only permitted between the hours of 7am and 7pm Monday to Saturday where residential premises are potentially affected.

Construction activities that cause adverse impacts (exceed 45dB LA_{eq} or 60dB LA_{max}) are not permitted to occur outside of these hours or on a Sunday or Public Holiday without written permission from the EPA or another agency such as a council that administers the Environment Protection Act 1993.

4.2 Operational Noise Criteria

The noise goals for the project have been determined based on the maximum permissable levels minus 5dB in accordance with Clause 20(3) of the Noise Policy and are presented in **Table 2**.

Table 2 Project Noise Criteria

Receptor Type	Period[1]	Indicative Noise Level	Noise Criteria dB $LA_{eq(15min)}$
Rural Living	Day	47	42
	Night	40	35
Residential	Day	52	47
	Night	45	40
Rural Industry & Light Industry	Day	57	52
	Night	50	45
Commercial	Day	62	57
	Night	55	50
General Industrial	Day	65	60
	Night	55	50
Special Industry	Day	70	65
	Night	60	55

Note 1: ay 7am to 7pm; Night 7pm to 7am.

4.3 Road Traffic Noise Criteria

The adopted RTNG criteria for assessment of impacts from road traffic noise at potential residential receptors are presented in **Table 3**.

Table 3 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Road Name	Type of Project/Development	Assessment Criteria - dBA	
			Day (7am to 10pm)	Night (10pm to 7am)
Local Roads	Locks Road	Existing residences affected by additional traffic on existing local roads generated by land use developments	55dBA LAeq(15hr) external	50dBA LAeq(9hr) external
Freeway/arterial/sub-arterial road	National Highway (A1)	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60dBA LAeq(15hr) external	55dBA LAeq(9hr) external

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

The likely haulage route for equipment from Adelaide is the National Highway (A1) and via Locks Road to either of the three construction compounds/laydown areas.

The nearest potentially affected receptor to the National Highway (A1) is offset 130m. the access route via Locks Road does not pass any potentially sensitive noise receptors and hence, an assessment along the access route has not been completed.

5 Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receptors for typical construction activities and operations. DGMR's iNoise Version 2018.2 noise modelling software was used to assess potential noise impacts associated with the project. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. Additionally, the model uses relevant noise source data, ground type, shielding such as barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receptors. Plant and equipment were modelled at various locations and heights, representative of realistic construction and operational conditions for assessed scenarios.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

5.1 Construction Assessment Methodology

Construction activities are proposed to be progressive (trenching, piling and assembly) and will occur at several locations simultaneously. Noise emissions were modelled for the following three scenarios:

- earthworks involving trenching for cabling;
- piling of panel supports; and
- assembly of the panels.

It is envisaged that all three construction scenarios have the potential to occur simultaneously at up to 10 locations across the site. All significant noise generating construction activities will be limited to standard construction hours. Where low intensity construction activities are required to be undertaken outside standard construction hours (is cabling, minor assembly, use of hand tools etc) they will be managed such that they will not cause adverse impacts and comply with the construction noise criteria.

5.2 Operational Assessment Methodology

Noise predictions were modelled for a typical worst case operational scenario over a 15-minute assessment period based on the assumptions, quantities and sound power levels in **Table 4.** Plant noise emission data used in modelling for this assessment were obtained from manufacturers specifications. Where relevant, modifying factors in accordance with Section 3.3 and Fact Sheet D of the NSW Noise Policy for Industry (NPI) which has replaced the NSW Industrial Noise Policy which is referenced by the Noise Policy regarding modifying factors have been applied to source levels.

Final selection of equipment for the battery storage technology power conditioning (synchronous condensers) has not been finalised. In terms of noise emissions, the type of battery used may or may not require the use of HVAC units for temperature control. Similarly, the requirement for synchronous condensers and associated cooling towers are an additional noise source. As a conservative worst case, the assessment has included the use of HVAC units, synchronous condensers and cooling towers.

Table 4 Operational Equipment Sound Power Levels, Lw dBA re 10^{-12} W

Noise Source/Item	Activity	Approx Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor[1]	All tracking motors in operation 1 minute per 15-minute period	8760	60	83
4.9MVA Power Converter Unit [2,3] (Inverter, Transformer)	Constant	50	96	108
3.3MVA Power Converter Unit [2,3] (Inverter, Transformer)	Constant	12	94	100
HVAC unit[4]	Constant	140	87	97
Battery Storage[3]	Constant	140	85	91
Synchronous Condenser[4]	Constant	2	93	86
Cooling Tower	Constant	2	99	102
Substation[2,4]	Constant	1	90	90
Light Vehicle	2 vehicles arrive and depart from site (5 minutes duration)	2	76	79

Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel.

Note 2: Modifying factor penalty of +5dB added for low frequency and +5dB added for tonality.

Note 3: -15dB applied to account for enclosure

Note 4 -10dB applied for partially enclosed infrastructure

Noise emissions from industry can be significantly influenced by prevailing weather conditions. Wind has the potential to increase noise at a receptor when it is at low velocities and travels from the direction of the noise source.

Meteorological conditions that enhance received noise levels include source to receptor winds and the presence of temperature inversions. To account for the potential for enhancements, noise modelling has been conducted for source to receptor winds (CONCAWE Category 6) for the night time period.

5.3 Road Traffic Noise

The United States (US) Environmental Protection Agency's road traffic calculation method was used to predict the LA_{eq} noise levels from construction vehicles travelling past receptors along public roads. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered.

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6 Results

6.1 Construction Noise Results

A quantitative estimate of construction noise assessment has been undertaken which indicates that, in general, noise emissions during the construction phase are expected to be less than 45dBA at all receptors and comply with the Environment Protection (Noise) Policy 2007 criteria and not cause adverse impacts. Furthermore, the following measures will be implemented to minimise noise during the construction phase:

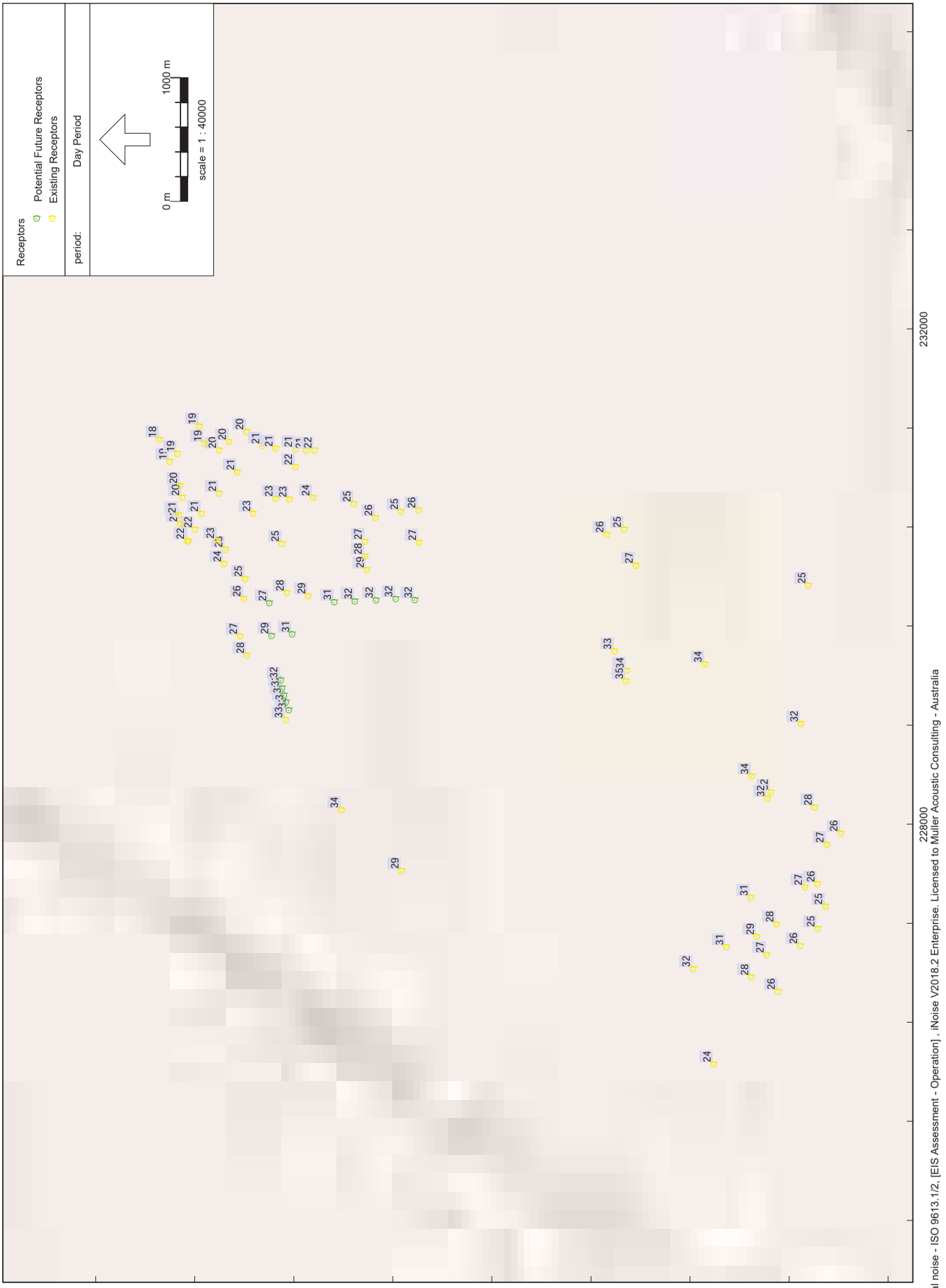
- Work on-site will occur within the standard work hours of 7am and 7pm Monday to Saturday;
- Deliveries and other operations may occur on Sundays, before 7am and after 7pm to avoid an unreasonable interruption of vehicle or pedestrian traffic movement;
- Particularly noisy activities will be commenced after 9am where the noise exceeds industry guidelines.

Subject to approval from the relevant authority, circumstances, such as extreme summer heat, may warrant construction activity to be permitted outside of the hours of 7am and 7pm Monday to Saturday or on a Sunday or Public Holiday.

6.2 Operational Noise Results

Noise levels were predicted at each assessed receptor assuming receptor heights of 1.5m above ground level. Predicted worst case operational noise levels are less than 35dBA during the daytime at all receptor locations; and are less than 38dBA during the night time at all receptor locations for noise enhancing conditions. Predicted noise levels for each assessed receptor are presented in **Figure 2** and **Figure 3**.

Bungama Solar - Operation Noise Assessment



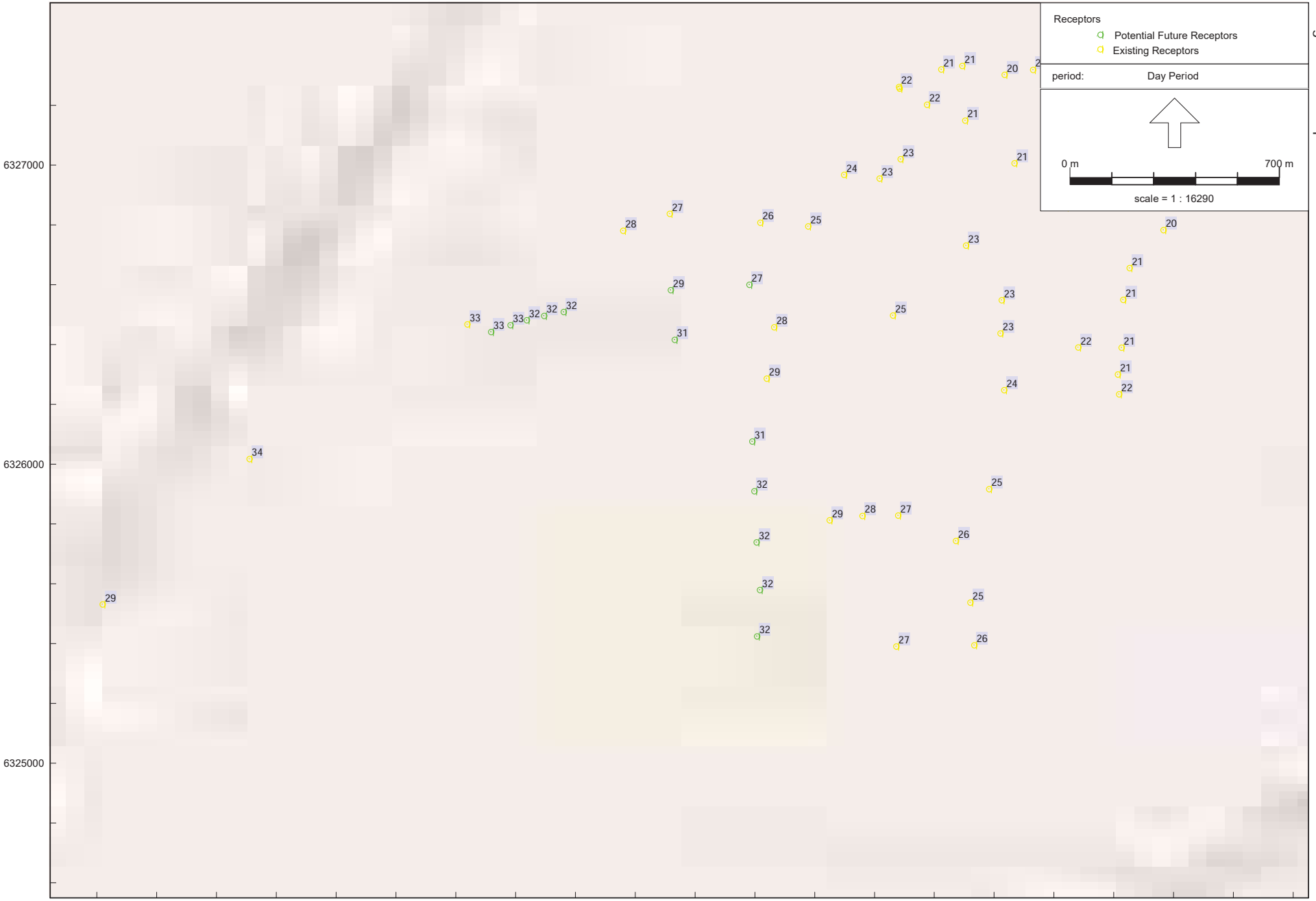
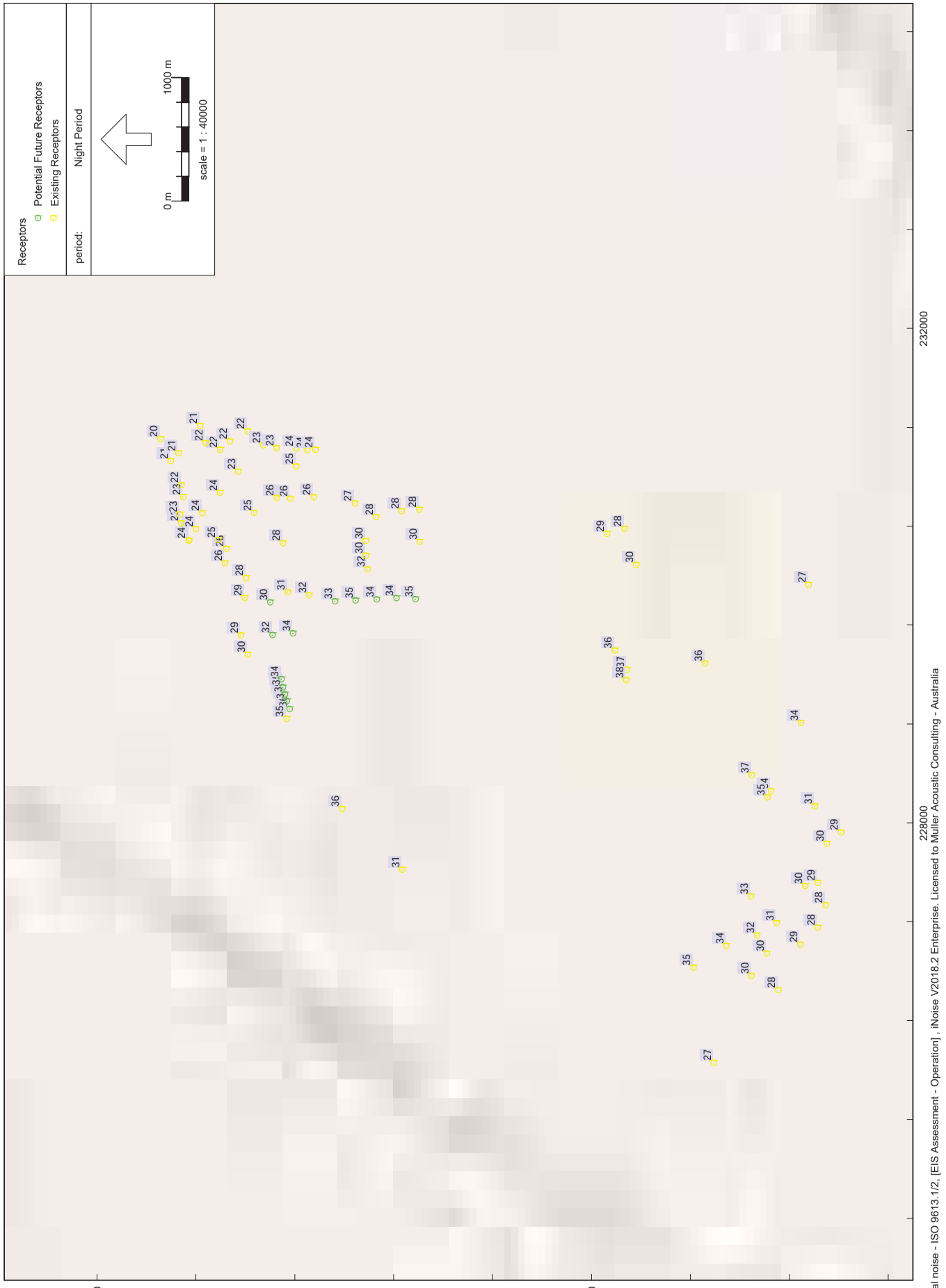


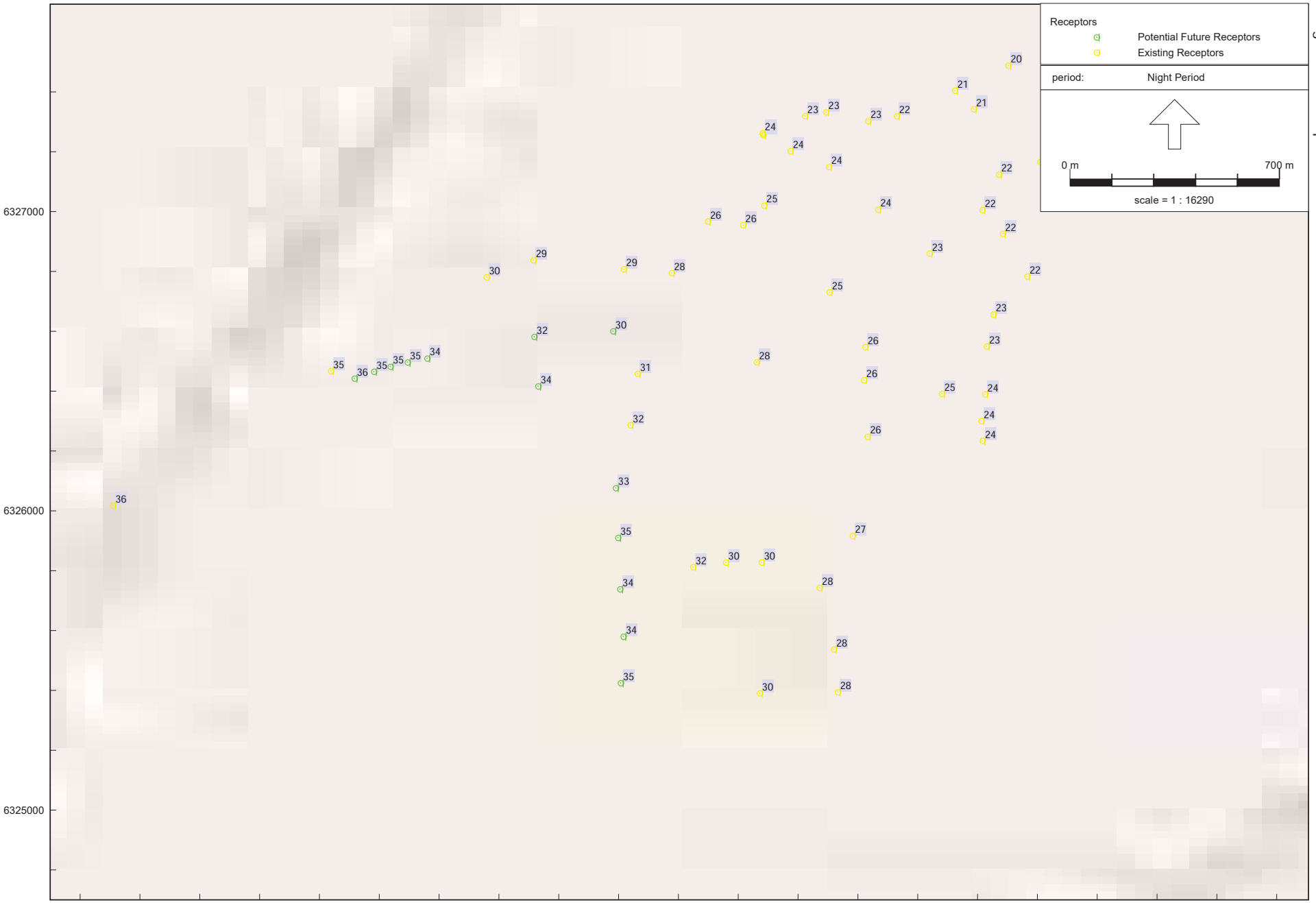
Figure 2A
Bungama Solar - Operation Noise Assessment

Industrial noise - ISO 9613.1/2, [EIS Assessment - Operation] , iNoise V2018.2 Enterprise. Licensed to Muller Acoustic Consulting - Australia

Muller Acoustic Consulting - Australia

Bungama Solar - Operation Noise Assessment





Industrial noise - ISO 9613.1/2, [EIS Assessment - Operation] , iNoise V2018.2 Enterprise. Licensed to Muller Acoustic Consulting - Australia

Figure 3A
Bungama Solar - Operation Noise Assessment
Muller Acoustic Consulting - Australia

6.3 Road Traffic Noise Assessment

The National Highway (A1) and Locks Road would be the major transport route for all project vehicles. During construction, traffic generated by the project include employee/subcontractor and delivery vehicles. During construction, the traffic volume over a typical day for standard construction hours is expected to be approximately 50 heavy vehicles (semi-trailers and/or b-doubles) and 50 light vehicles per day (including mini buses for employee transport). Road traffic noise calculations based on the parameters adopted for average and peak flows are presented in **Table 5**.

Table 5 Predicted Construction Road Traffic Flows

Vehicle Type	Vehicles per day[1]	Average per hour	Maximum per Hour[2]	Maximum Movements per hour3	Speed km/h
B-double or Semi-trailer	50	7	10	20	80
Mini bus	5	<1	5	10	80
Light Vehicle	45	4.1	20	40	100

Note 1: Standard construction hours 7am to 7pm.

Note 2: Assumes that all mini buses and 50% of light vehicles travel to and from site during AM peak and PM peak.

Note 3: Vehicle movements are doubles the vehicle quantity – one movement to site, one movement return from site.

Predicted $LA_{eq(1hr)}$ noise levels from project related construction traffic at the closest receptor on both roads on the route has been completed using the United States (US) Environment Protection Agency's road traffic calculation method and are presented in **Table 6**.

Table 6 Predicted Construction Road Traffic Noise Levels

Road Name	Nearest Offset Distance to Receptor	Predicted Noise Level	Criteria	Comply
National Highway	130m	40dB $LA_{eq(15hr)}$	60dB $LA_{eq(15hr)}$	Yes

Note 1: Assumes that all worker transportation enters and exits the site in one hour as a worst case assessment

Results demonstrate that project construction traffic noise levels would satisfy the relevant RTNG criteria.

7 Recommendations

7.1 Construction Noise Recommendations

It is noted that a quantitative construction noise assessment is not required, however the Project is committed to managing noise emissions within the community and will adopt the following procedures wherever feasible. Recommendations for consideration during construction activities to reduce emissions to the surrounding community for this project may include:

- scheduling of construction activities to minimise the number of work fronts and simultaneous activities occurring along the boundaries of the project area (within 200m) to minimise noise levels;
- a construction noise management protocol to minimise noise emissions, manage out of hours (minor) works to be inaudible, and to respond to potential concerns from the community;
- where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receptors, particularly where equipment is near the site boundary and/or a residential receptor including areas in constant or regular use (eg unloading and laydown areas);
- operating plant in a conservative manner (no over-revving), be shutdown when not in use, and be parked/started at farthest point from relevant assessment locations;
- selection of the quietest suitable machinery available for each activity;
- avoidance of noisy plant/machinery working simultaneously where practicable;
- minimise impact noise wherever possible;
- utilise a broadband reverse alarm in lieu of the traditional hi frequency type reverse alarm;
- provide toolbox meetings, training and education to drivers and contractors visiting the site during construction so they are aware of the location of noise sensitive receptors and to be cognisant of any noise generating activities;
- signage is to be placed at the front entrance advising truck drivers of their requirement to minimise noise both on and off-site; and
- utilise project related community consultation forums to notify residences within close proximity of the site with project progress, proposed/upcoming potentially noise generating works, its duration and nature and complaint procedure.

7.2 Operational Noise Recommendations

Operational noise predictions identify that relevant noise criteria would be satisfied at all receptors. Notwithstanding, it is recommended that the proponent actively minimise potential noise emissions from the project. To assist in noise management for the project the following is recommended:

- complete a one-off noise validation/ compliance check to quantify emissions from site and to confirm emissions meet relevant criteria; and
- prepare an operational noise management protocol to minimise noise emissions and to respond to potential concerns from the community regarding project noise emissions.

8 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by EPS Energy Pty Ltd to complete a Noise Assessment (NA) for the construction and operation of a Solar Farm at Bungama, near Napperby, South Australia. The assessment has quantified potential noise emissions associated with the construction (including road traffic) and operation of the project.

A quantitative construction noise assessment has been completed and identifies that adverse impacts should not occur. However, where construction activities are close to receptors (within 200m) mitigation measures have been recommended to minimise noise emissions (see **Section 7.1**).

The results of the NA demonstrate that operational noise levels satisfy relevant noise criteria at all assessed receptors. However, recommendations to ensure noise levels are minimised and verified have been provided in this report (see **Section 7.2**).

Additionally, the NA demonstrates that the road noise criteria as specified in the RTNG will be satisfied at all receptors on the proposed transport route.

Based on the NA results, there are no noise related issues which would prevent the approval of the project. The results of the assessment shows compliance with the relevant construction, operational and road noise criteria.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Terms

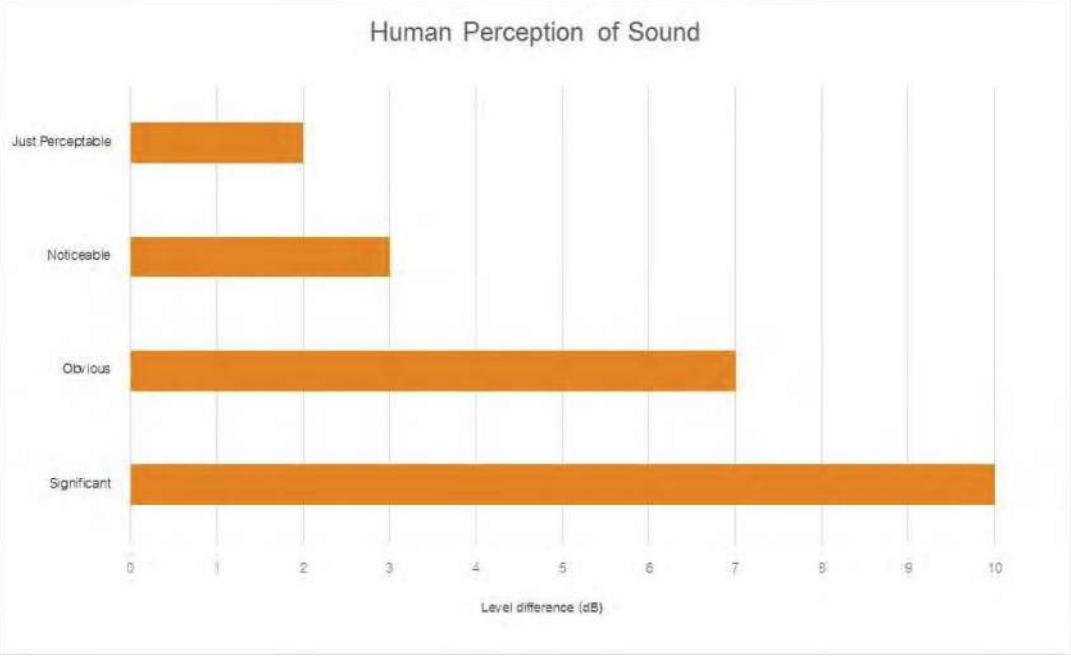
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting

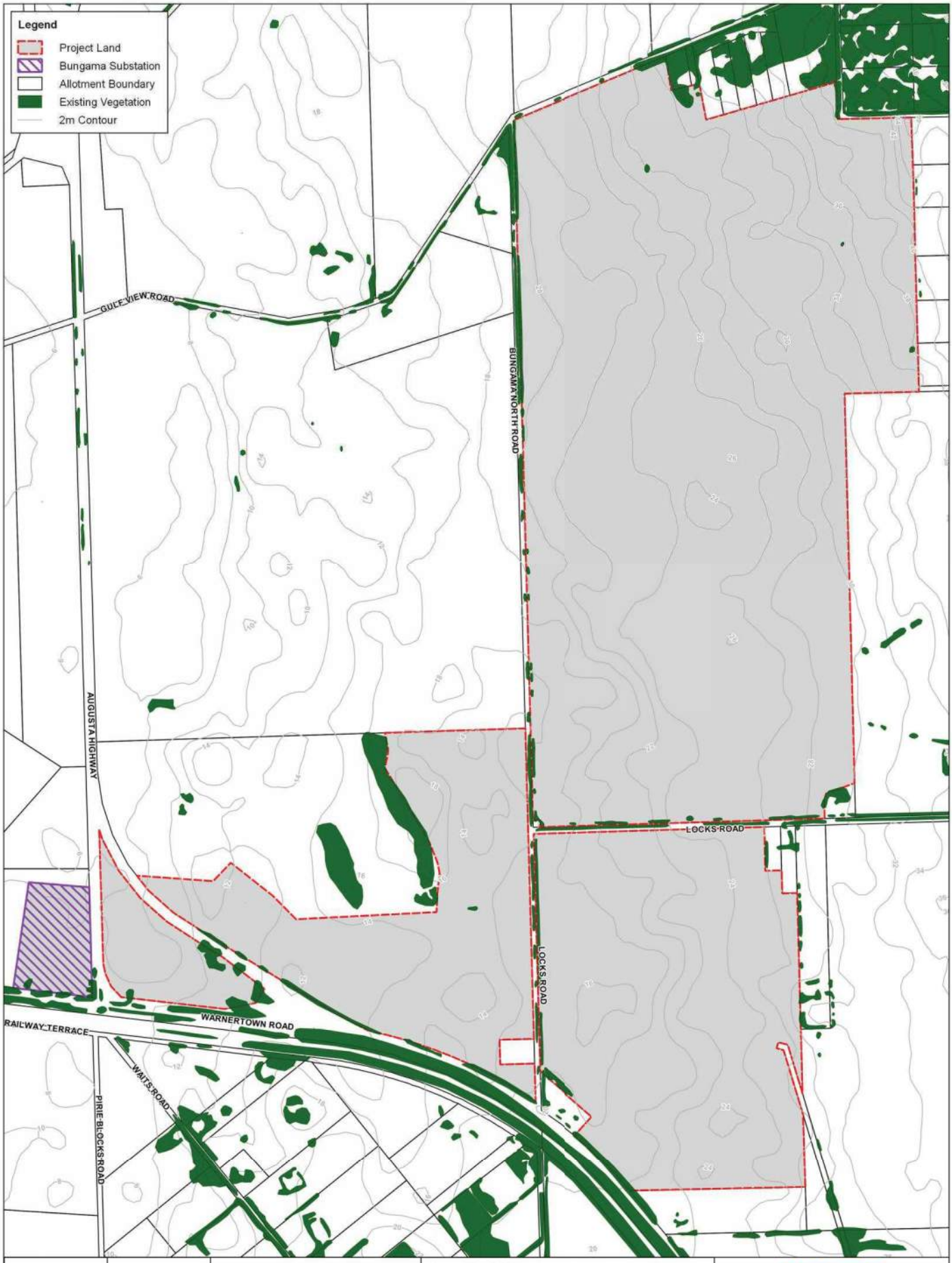
APPENDIX 14

Landscaping Plan

LANDSCAPE PLAN
BUNGAMA SOLAR
BUNGAMA, SA, AUSTRALIA

Author:	SW		Page 1 of 6	BUNGAMA SOLAR
Reviewer:	SMC/ JB		Landscape Plan	
A3 Scale:	N/A		Bungama Solar | Bungama SA Australia	
Job Ref/Version:	11297/ V03		22/11/2018	

11297_PR_Landscape_CoverSheet_pg1.qgs



Author:	SW
Reviewer:	SMC/ JB
A3 Scale:	1:12,500
Job Ref/Version:	11297/ V02

0 200 400 600 m

Map Projection: GDA 1994 MGA Zone 54

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Contours and Existing Vegetation Onsite or on Adjoining Roads

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11297_PR_Landscape_ExistingVeg_pg2.qgs

Author:	SW
Reviewer:	SMC/ JB
A3 Scale:	1:12,500
Job Ref/Version:	11297/ V03

0 200 400 600 m

Map Projection: GDA 1994 MGA Zone 54

Landscape Masterplan

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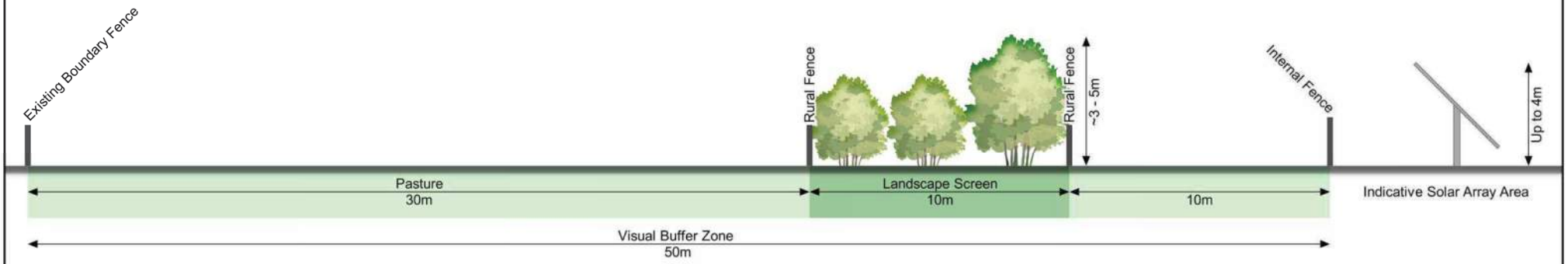
11297_PR_Landscape_Masterplan_pg3.qgs



Author:	SW
Reviewer:	SMC/ JB
A3 Scale:	1:150
Job Ref/Version:	11297/ V03

0 2.5 5 7.5 10 m

Elevations

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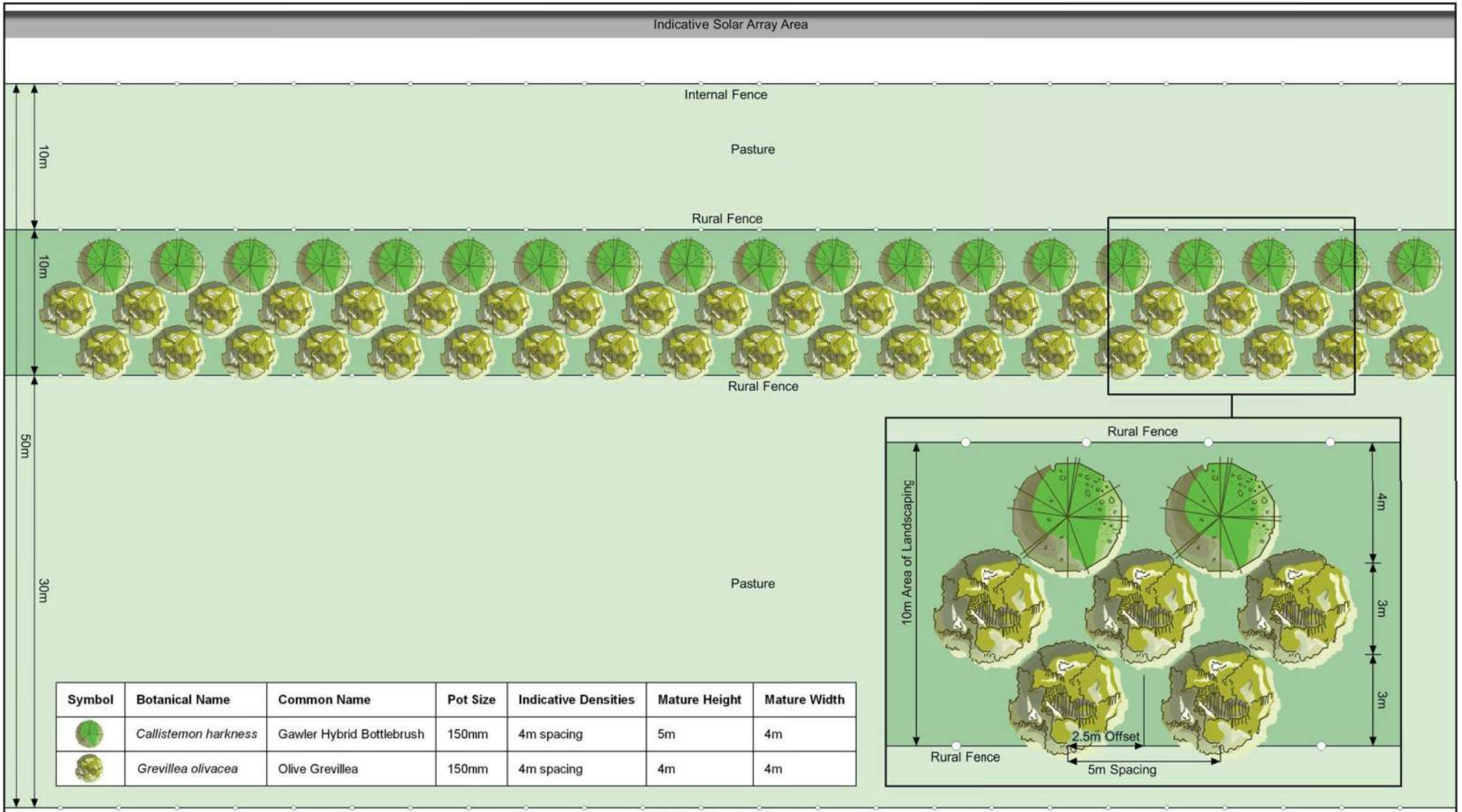
11297_PR_Landscape_Elevations_pg4.qgs



Symbol	Botanical Name	Common Name	Pot Size	Indicative Densities	Mature Height	Mature Width
	Callistemon harkness	Gawler Hybrid Bottlebrush	150mm	4m spacing	5m	4m
	Grevillea olivacea	Olive Grevillea	150mm	4m spacing	4m	4m

Author:	SW
Reviewer:	SMC/ JB
A3 Scale:	1:250
Job Ref/Version:	11297/ V03

0 5 10 15 m

Detail Sheet

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11297_PR_Landscape_DetailSheet_pg5.qgs

GENERAL

All landscaping is to be supervised by a landscape contractor or suitably qualified person. Any sub-contractors are to be co-ordinated by the lead contractor.

DEEP RIPPING

To be undertaken where tree stock is to be planted with (i) a bulldozer, or (ii) rippers on a tractor in dry conditions only.
Rip in a grid pattern where possible.
Avoid bringing clay soils to the surface.

FENCING & RABBIT PROOF NETTING

Place tree guards around seedlings upon planting.
Rabbit proof netting may be placed around the landscape area to protect it from invasion following works.
Stock proof fencing placed around landscaping until trees are at mature height.

WEED CONTROL

A Weed Management Plan will be developed in accordance with the Environmental Management Strategy.

PLANT MATERIAL

Plants shall be of the species and size detailed within the landscaping drawings. Plants shall be vigorous, well established, hardened off and free from pests and diseases. Plants shall not be soft, forced or root bound. Potted plants should be bushy or well furnished.

PLANTING

Ensure planting hole is bigger than pot size. When planting do not damage root system. Hold plant within the planting hole, replace soil around plant and firm down.

WATERING

To eliminated transplanting shock, water with one litre of water per seedling upon planting.
Over drier periods (December, January, February, March) water plant once a month at most until established.

MULCHING

Mulch to be of organic material, laid up to 75mm thick, 1m around each plant.
Keep mulch away from plant stems.

GROUNDCOVER

Use pasture species that will be seeded under solar panels as groundcover.

MAINTENANCE

For the first 52 weeks check plants for stress or failure and soil moisture.
Water as required.
Replace dead plants.

Olive Grevillea | *Grevillea olivacea*
Source: GardensOnLine

Gawler Hybrid Bottlebrush | *Callistemon harkness*
Source: davesgarden.com

Author:	SW		**Page 6 of 6**	BUNGAMA SOLAR
Reviewer:	SMC/ JB		**Specfic Details**	
A3 Scale:	N/A		**Bungama Solar | Bungama SA Australia**	
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BUNGAMA SOLAR

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