<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td rowspan="2"></td><td><u>Assessment against the principles</u>
Seriously at Variance – All VA's</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC.</u>
Impact Significance
Given the largest patch of suitable habitat in the Project Area for the White-winged Chough is going to be avoided, clearance may be considered to be not significant, given that it is unlikely to:

lead to a long-term decrease in the size of a population;
reduce the area of occupancy of a species;
fragment an existing population into two or more populations;
decrease availability of habitat such that the extent of a species is likely to decline;
result in invasive species becoming established in the threatened species habitat;
interfere with the recovery of a species.

Additionally, given the patches of mallee that are planned on being impacted are small, these patches may not be considered preferred habitat for the threatened species like the White-winged Chough. It is unlikely such small patches are critical habitat.
However, a significant impact self-assessment is required to determine the level of impact this Project may have on several MNES, as it may be considered habitat critical to the survival of some species. A significant impact self-assessment is planned for this Project.

Common species
For common species occurring within the Project Area, higher quality areas of vegetation, including those areas where structural diversity is higher, are being avoided for clearance. The habitat under application is unlikely to be essential habitat for local populations of common species.</td></tr>
<tr><td rowspan="3">Principle 1(c) – plants of a rare, vulnerable or endangered species</td><td><u>Relevant information</u>
No listed threatened plant species were recorded at the site. Only Phlegmatospermum eremaeum (Spreading Cress) which is a State threatened rare species was identified as possibly occurring in the Project Area.
Threatened Flora Score(s) – 0 (all sites)</td></tr>
<tr><td><u>Assessment against the principles</u>
The clearance is not at variance or seriously at variance with Principle 1(c).</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC.</u>
Not applicable.</td></tr>
<tr><td rowspan="2">Principle 1(d) – the vegetation comprises the whole or part of a plant community that is Rare, Vulnerable or endangered</td><td><u>Relevant information</u>
The PMBW TEC (listed under the EPBC Act) was identified within the Project Area. Half of the TEC in the Project Area is planned on being impacted (VA6).
<table>
<tr><th>Threatened Ecological Community</th><th>Conservation Status</th><th>Vegetation Association</th><th>TEC Score</th></tr>
<tr><td>Plains mallee box woodlands (PMBW) of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plain Bioregions</td><td>Critically Endangered</td><td>A6 – Eucalyptus porosa Open Mallee over Maireana brevifolia and Enchylaena tomentosa.</td><td>1.4</td></tr>
<tr><td>Mallee Bird Community of the Murray Darling Depression Bioregion</td><td>Endangered</td><td>A1 – Eucalyptus oleosa ssp. oleosa +/- Eucalyptus gracilis Mallee over Chenopod and Sclerophyll Shrubs.</td><td>1.4</td></tr>
</table></td></tr>
<tr><td><u>Assessment against the principles</u>

Seriously at Variance: VA1, VA6</td></tr>
</table>

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td></td><td><u>Moderating factors that may be considered by the NVC.</u>

<u>Impact Significance</u>
If the NVC considers that the impact is not significant, the clearance may be reduced to At Variance.

<u>Area of Impact</u>
If less than 1% of the area of that vegetation community within the immediate vicinity (within a 1 km radius) of proposed clearance is to be affect, the proposed clearance may be tempered to ‘At variance’.

<u>Condition of the vegetation</u>
If the vegetation is in a highly degraded state and is unlikely to return to a functional state without significant human intervention, the proposed clearance may be tempered to ‘At variance’.</td></tr>
<tr><td rowspan="3">Principle 1(e) – it is significant as a remnant of vegetation in an area which has been extensively cleared</td><td><u>Relevant information</u>
The Project Area contains one IBRA Subregion (and association): Murray Mallee (Sutherlands). The Murray Mallee subregion (Sutherlands land system name) is largely cleared as it is often utilised for agriculture, with the remanent vegetation mostly consisting of mallee, woodlands, and grasslands.
The clearance of the Project Area may be considered insignificant as majority of the Project Area has previously been cleared for agriculture and the largest patch of remnant vegetation planned in being avoided.

<table><tr><th>Subregion</th><th>Remnancy</th><th>Association</th><th>Remnancy</th></tr><tr><td>Murray Mallee</td><td>21%</td><td>Sutherlands</td><td>47%</td></tr></table>
Total Biodiversity Score – 4,089.18</td></tr>
<tr><td><u>Assessment against the principles</u>

Seriously at Variance</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC.</u>

Most of the Project Area that will be impacted by construction has historically been utilized for agriculture. Native vegetation has regenerated in these areas but is limited to grasses and shrubs. It is in poor or degraded condition. These vegetation associations include:
A3 (94.39 ha) – Historically cleared for cropping and livestock.
A5 (8.47 ha) – Historically cleared and used as a Atriplex nummularia plantation.
A8 (2.21 ha) – Historically cleared for cropping and livestock.
The remaining area consists of small patches of remnant vegetation and clearance of these patches may be considered as minimal impact upon the remnant vegetation of the Subregion.</td></tr>
<tr><td rowspan="3">Principle 1(f) – it is growing in, or in association with, a wetland environment</td><td><u>Relevant information</u>
There are multiple streamlines that branch across the Project Area with both the northern and southern edge of the Project Area may be subject to flooding, however no evidence of flooding or water was noticed. These areas seem could be considered not important.</td></tr>
<tr><td><u>Assessment against the principles</u>

The clearance is not at variance or seriously at variance with Principle 1(f).</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC.</u>

Not applicable.</td></tr>
<tr><td></td><td><u>Relevant information</u></td></tr>
</table>

Principle of clearance	Considerations
Principle 1(g) – it contributes significantly to the amenity of the area in which it is growing or is situated	The Project Area is situated away along Bower Road, with the old plantation being alongside the road. Both the eastern and western fence line has a line of trees which may be utilised as habitat and a passageway for fauna
	Assessment against the principles The clearance is not at variance or seriously at variance with Principle 1(g).
	Moderating factors that may be considered by the NVC. Not applicable.

Principles of Clearance (h-m) will be considered by comments provided by the local NRM Board or relevant Minister. The Data Report should contain information on these principles where relevant and where sufficient information or expertise is available.

4.6. Risk assessment

The risk level of this clearance application is presented in Table 19. The table indicates that this is a Level 4 clearance, due to escalating matters.

Table 19. Summary of the level of risk associated with the application.

Total clearance	No. of trees	N/A
	Area (ha)	111.50
	Total biodiversity Score	4089.18
Seriously at variance with principle 1(b), 1(c) or 1 (d)		1(a), 1(b), 1(d)
Risk assessment outcome		Level 4

5. CLEARENCE SUMMARY

Clearance summary tables for the clearance application are shown in Table 20 on page 43. The summary tables indicate the SEB points and SEB payment obligations of the clearances.

The total SEB obligations of the clearance are summarised in Table 21 on page 44.

Table 20. Clearance summary and total Significant Environmental Benefit (SEB) obligations for vegetation associations impacted by the Project.

Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	Total Biodiversity score	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
A	A1a	10	1.4	0	0.1	63.91	3.65	233.28	1	-	-	244.94	$80,864.69	$4,447.56
A	A1b	10	1.4	0	0.1	62.18	3.65	226.94	1	-	-	238.29	$79,166.37	$4,354.37
A	A1c	14	1.4	0	0.1	67.29	3.65	245.59	1	-	-	257.87	$85,673.19	$4,712.03
A	A1d	18	1.4	0	0.1	69.19	3.65	252.54	1	-	-	265.17	$86,987.97	$4,784.34
A	A1e	25	1.4	0	0.1	99.62	3.65	363.61	1	-	-	381.79	$124,448.66	$6,844.68
A	**A1 Mean**	**15.4**				**72.44**	**3.65**	**264.39**	**1**	**-**	**-**	**277.612**	**$91,428.18**	**$5,028.60**
A	**A2**	**12**	**1**	**0**	**0.1**	**31.77**	**1.01**	**32.09**	**1**	**-**	**-**	**33.69**	**$11,334.79**	**$623.41**
A	A3a	20	1	0	0.1	26.74	94.39	2523.89	1	-	-	2650.08	$880,438.31	$48,424.11
A	A3b	24	1	0	0.1	25.33	94.39	2391.05	1	-	-	2510.6	$847,214.22	$46,596.78
A	A3c	14	1	0	0.1	26.88	94.39	2537.32	1	-	-	2664.19	$882,340.85	$48,528.75
A	A3d	18	1	0	0.1	29.04	94.39	2741.43	1	-	-	2878.5	$959,332.01	$52,763.26
A	A3e	24	1	0	0.1	33.52	94.39	3164.19	1	-	-	3322.4	$1,110,744.17	$61,090.93
A	A3f	24	1	0	0.1	46.31	94.39	4371.66	1	-	-	4590.24	$1,505,834.89	$82,820.89
A	A3g	24	1	0	0.1	42.19	94.39	3982.1	1	-	-	4181.21	$1,367,282.85	$75,200.56
A	**A3 Mean**	**21.14**				**32.86**	**94.39**	**3101.66**	**1**	**-**	**-**	**3256.75**	**$1,079,026.76**	**$59,346.47**
A	A4a	26	1	0	0.1	59.64	1.21	72.17	1	-	-	75.77	$25,411.81	$1,397.65
A	A4b	26	1	0	0.1	62.97	1.21	76.2	1	-	-	80.01	$26,664.54	$1,466.55
A	**A4 Mean**	**26**				**61.31**	**1.21**	**74.19**	**1**	**-**	**-**	**77.89**	**$26,038.18**	**$1,432.10**
A	**A5**	**20**	**1**	**0**	**0.1**	**57.11**	**8.47**	**483.76**	**1**	**-**	**-**	**507.95**	**$168,225.81**	**$9,252.42**
A	**A6**	**26**	**1.4**	**0**	**0.1**	**75.47**	**0.45**	**33.96**	**1**	**-**	**-**	**35.66**	**$11,884.26**	**$653.63**
A	**A7**	**12**	**1**	**0**	**0.1**	**47.07**	**0.11**	**5.18**	**1**	**-**	**-**	**5.44**	**$1,806.15**	**$99.34**
A	A8a	20	1	0	0.1	21.51	2.21	47.53	1	-	-	49.9	$16,422.68	$903.25
A	A8b	14	1	0	0.1	42.22	2.21	93.32	1	-	-	97.98	$32,245.20	$1,773.49
A	A8c	24	1	0	0.1	63.81	2.21	141.01	1	-	-	148.06	$48,571.40	$2,671.43
A	**A8 Mean**	**19.3**				**42.51**	**2.21**	**93.95**	**1**	**-**	**-**	**98.65**	**$32,413.09**	**$1,782.72**
						Total	**111.50**	**4089.18**				**4293.63**	**$1,422,157.21**	**$78,218.69**

Table 21. Summary of the total SEB obligations of the clearance.

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	4089.18	4293.63	$1,422,157.21	$78,218.69	$1,500,375.90

Economies of Scale Factor	0.35
Rainfall (mm)	318

6. SIGNIFICANT ENVIRONMENTAL BENEFIT

A Significant Environmental Benefit (SEB) is required for approval to clear under Division 5 of the *Native Vegetation Regulations 2017*. The NVC must be satisfied that as a result of the loss of vegetation from the clearance that an SEB will result in a positive impact on the environment that is over and above the negative impact of the clearance.

ACHIEVING AN SEB

Indicate how the SEB will be achieved by ticking the appropriate box and providing the associated information:

☐ Establish a new SEB Area on land owned by the proponent.

☐ Use SEB Credit that the proponent has established.

☐ Apply to have SEB Credit assigned from another person or body.

☐ Apply to have an SEB to be delivered by a Third Party.

☒ Pay into the Native Vegetation Fund.

PAYMENT SEB

If a proponent proposes to achieve the SEB by paying into the Native Vegetation Fund, summary information must be provided on the amount required to be paid and the manner of payment:

The total SEB payment for the clearance of 111.50 ha of native vegetation with a Total Biodiversity Score of 4,089.18 is $1,500,375.90, which includes an administration fee of $78,218.69.

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8. APPENDICES

Appendix 1 - Flora species recorded by the field survey.

Introduced	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
	Acacia myrtifolia	Myrtle Wattle	-	-
	Acacia nyssophylla	Spine Bush	-	-
	Acacia oswaldii	Umbrella Wattle	-	-
*	*Alectryon oleifolius ssp. canescens*	Bullock Bush	-	-
*	*Asphodelus fistulosus*	Onion Weed	-	-
	Atriplex acutibractea ssp.	Pointed Saltbush	-	-
	Atriplex lindleyi ssp.	Baldoo	-	-
	Atriplex nummularia ssp.	Old-man Saltbush	-	-
	Atriplex semibaccata	Berry Saltbush	-	-
	Atriplex stipitate	Bitter Saltbush	-	-
	Atriplex vesicaria	Bladder Saltbush	-	-
	Austrostipa acrociliata	Graceful Spear-grass	-	-
	Austrostipa elegantissima	Feather Spear-grass	-	-
	Austrostipa nitida	Balcarra Spear-grass	-	-
	Austrostipa sp.	Spear-grass	-	-
	Callitris gracilis	Southern Cypress Pine	-	-
*	*Carrichtera annua*	Ward's Weed	-	-
*	*Carthamus lanatus*	Saffron Thistle	-	-
	Convolvulus sp.	Bindweed	-	-
	Einadia nutans ssp.	Climbing Saltbush	-	-
	Enchylaena tomentosa var.	Ruby Saltbush	-	-
	Eremophila longifolia	Weeping Emubush	-	-
	Eriochiton sclerolaenoides	Woolly-fruit Bluebush	-	-
	Eucalyptus gracilis	Yorrell	-	-
	Eucalyptus oleosa ssp.		-	-
	Eucalyptus porosa	Mallee Box	-	-
*	*Geijera linearifolia*	Sheep Bush	-	-
*	*Hordeum sp.*		-	-
	Kippistia suaedifolia	Fleshy Kippistia	-	-
	Lycium austral	Australian Boxthorn	-	-

Introduced	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
*	*Lycium ferocissimum*	African Boxthorn	-	-
	Maireana brevifolia	Short-leaf Bluebush	-	-
	Maireana georgei	Satiny Bluebush	-	-
	Maireana scleroptera	Hard-wing Bluebush	-	-
	Maireana tomentosa ssp. urceolata		-	-
	Maireana trichoptera	Hairy-fruit Bluebush	-	-
*	*Marrubium vulgare*	Horehound	-	-
*	*Medicago minima*	Little Medic	-	-
*	*Mesembryanthemum crystallinum*	Common Iceplant	-	-
*	*Mesembryanthemum sp.*	Iceplant	-	-
*	*Onopordum acaulon*	Horse Thistle	-	-
	Oxalis pes-caprae	Soursob	-	-
	Rhagodia parabolica	Mealy Saltbush	-	-
	Roepera apiculata	Pointed Twinleaf	-	-
	Roepera aurantiaca ssp.	Shrubby Twinleaf	-	-
	Rytidosperma sp.	Wallaby-grass	-	-
	Salsola australis	Buckbush	-	-
*	*Salvia sp.*	Sage	-	-
	Scaevola spinescens	Spiny Fanflower	-	-
	Sclerolaena diacantha	Grey Bindyi	-	-
	Sclerolaena obliquicuspis	Oblique-spined Bindyi	-	-
	Senna artemisioides ssp. filifolia	Fine-leaf Desert Senna	-	-
	Sida corrugata var.	Corrugated Sida	-	-
*	*Sisymbrium sp.*	Wild Mustard	-	-
	Tetragonia sp.	False Spinach	-	-
	Teucrium racemosum	Grey Germander	-	-
	Vittadinia cuneata var.	Fuzzy New Holland Daisy	-	-
	Vittadinia sp.	New Holland Daisy	-	-
	Wahlenbergia sp.	Native Bluebell	-	-
	Westringia rigida	Stiff Westringia	-	-

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

Appendix 2 - Fauna species recorded by the field survey.

Year Recorded	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
2023	*Acanthiza chrysorrhoa leighi*	Yellow-rumped Thornbill (eastern SA)	-	-
2023, 2021	*Anthus australis australis*	Australian Pipit (most of SA)	-	-
2023	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow (eastern SA)	-	-
2023, 2021	*Barnardius zonarius barnardi*	Mallee Ringneck	-	-
2023	*Cincloramphus cruralis*	Brown Songlark	-	-
2023	*Climacteris picumnus picumnus*	Brown Treecreeper	-	-
2023	*Corcorax melanorhamphos melanorhamphos*	White-winged Chough (MM, SE)	-	R
2023	*Corvus coronoides coronoides*	Australian Raven (YP, eastern SA, KI)	-	-
2021	*Corvus mellori*	Little Raven	-	-
2021	*Cracticus torquatus*	Grey Butcherbird	-	-
2023, 2021	*Eolophus roseicapilla*	Galah	-	-
2021	*Falco cenchroides*	Nankeen Kestrel	-	-
2023	*Falco berigora berigora*	Brown Falcon	-	-
2023	*Gavicalis virescens*	Singing Honeyeater	-	-
2023	*Gavicalis virescens sonorous*	Singing Honeyeater (EP, YP, FR, MN, AP, MM, coastal SE)	-	-
2023	*Grallina cyanoleuca cyanoleuca*	Magpielark	-	-
2023, 2021	*Gymnorhina tibicen*	Australian Magpie	-	-
2021	*Hirundo neoxena*	Welcome Swallow	-	-
2023	*Lalage tricolor*	White-winged Triller	-	-
2021	*Macropus fuliginosus*	Western grey kangaroo	-	-
2023	*Macropus (Osphranter) rufus*	Red Kangaroo	-	-
2023	*Malurus leucopterus leuconotus*	White-winged Fairywren	-	-
2023, 2021	*Manorina flavigula flavigula*	Yellow-throated Miner (central eastern, mid-North, YP, FR)	-	-
2023	*Melithreptus brevirostris brevirostris*	Brown-headed Honeyeater (lower SE)	-	-
2023	*Ocyphaps lophotes lophotes*	Crested Pigeon	-	-
2021	*Oryctolagus cuniculus**	European Rabbit*		
2023	*Pachycephala rufiventris rufiventris*	Rufous Whistler	-	-
2023, 2021	*Pardalotus striatus*	Striated Pardalote	-	-

Year Recorded	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
2021	*Phaps chalcoptera*	Common Bronzewing	-	-
2023	*Psephotus haematonotus haematonotus*	Red-rumped Parrot (eastern SA except NE)	-	-
2023	*Ptilotula ornate*	Yellow-plumed Honeyeater	-	-
2023, 2021	*Smicrornis brevirostris brevirostris*	Weebill	-	-
2023, 2021	*Tachyglossus aculeatus*	Short-beaked Echidna	-	-
2023	*Todiramphus pyrrhopygius*	Red-backed Kingfisher	-	-
2021	*Vulpes vulpes**	Red Fox*		

Conservation Status: EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act**: South Australia (*National Parks and Wildlife Act 1972*). **Conservation codes: R**: Rare.

*Introduced species.

Appendix 3 – Likelihood of Occurrence Assessment

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
FLORA							
Acacia glandulicarpa	Hairy-pod Wattle	VU	E	1	May	Discontinuous, occurring in the Burra Gorge, Hanson and Bordertown areas, SA, and the Little Desert–Dimboola area, Vic. Grows in alkaline soil on rocky hills in open scrub (Burra), or in eucalypt open forest (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in the Project Area. No historical records in the search Area.
Acacia menzelii	Menzel's Wattle	VU	V	1	May	Endemic to SA, where it occurs discontinuously from Mt Hack (Northern Flinders Ranges) to Brachia, in the north, near Burra and to the Murray Bridge area in the south. Grows in calcareous loamy earths in open Eucalyptus scrub (DCCEEW 2023b).	**Unlikely –** There are no historical records in the Search Area, the species was not detected during the field survey and is only listed as 'May Occur' by the PMST.
Caladenia tensa	Greencomb Spider-orchid, Rigid Spider-orchid	EN		1	Likely	Found in the upper South-east in SA, growing in dry woodland and mallee on sandy loams (DCCEEW 2023b).	**Unlikely -** There are no historical records in the Search Area, the species was not detected during the field survey and is only listed as 'Likely Occur' by the PMST.
Codonocarpus pyramidalis	Slender Bell-fruit, Camel Poison	VU	E	1	May	Grows along the crests of hills and ridges, slopes and along creeks, where the soil is either a loamy sand or sandy clay loam. Throughout its range it is never common and only scattered trees are to be found (DCCEEW 2023b).	**Unlikely** – There are no historical records in the Search Area, the species was not detected during the field survey and is only listed as 'May Occur' by the PMST.
Dodonaea subglandulifera	Peep Hill Hop-bush	EN	E	1,2	Known, 2000	Endemic to SA and found on the east side of the Mount Lofty Ranges and on Yorke Peninsula, growing on low hills on loamy soils associated with rocky outcrops in open woodland, open shrubland and mallee (DCCEEW 2023b).	**Unlikely –** Although there are nearby historical records, suitable habitat in the impact area was surveyed and the species was not detected.
Olearia pannosa ssp. *pannosa*	Silver Daisy-bush, Silver-leaved Daisy, Velvet Daisy-bush	VU	V	1	Likely	The silver daisy-bush is endemic to SA where it is scattered throughout agricultural areas. The silver daisy-bush occurs in sandy, flat areas and in hilly, rocky areas in woodland or mallee. Hilly area soil types	**Unlikely -** There are no historical records in the Search Area, the species was not detected during the field survey

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
						include hard pedal mottled-yellow duplex and hard pedal red duplex (DCCEEW 2023b).	and is only listed as 'Likely Occur' by the PMST.
Phlegmatospermum eremaeum	Spreading Cress		R	2	2010	Scattered distributions on the Nullarbor and in the north-eastern and central parts of SA, growing in open mallee on calcareous clay or loam (Seeds of SA 2018).	**Possible -** Suitable habitat and recent (<20 years old) records. However the species was not detected during field surveys.
Pterostylis xerophila	Desert Greenhood	VU	V	1	May	Occurs in dry woodland on fertile red loamy soils, on or around granite or quartzite rock outcrops. Species commonly found in Broombush, Ridge-fruited Mallee, Beaked Red Mallee and/or Narrow-leaf Red Mallee (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in the Project Area.
Senecio macrocarpus	Large-fruit Fireweed, Large-fruit Groundsel	VU	V	1	May	Occurs most commonly in depressions in low lying closed sedgeland but may occur in sedgeland, herb land, low shrubland to low open woodland where competition from understorey plants is low. The soils range from clay to loamy sand (DCCEEW 2023b).	**Unlikely** – There are no historical records in the Search Area, the species was not detected during the field survey and is only listed as 'May Occur' by the PMST.
Swainsona pyrophila	Yellow Swainson-pea	VU	R	1	May	Grows in mallee scrub on sandy or loamy soil and is usually found to germinate only after fire and subsequent rain, although scraping of seed via soil disturbances such as grading can also stimulate germination (DCCEEW 2023b).	**Unlikely –** There are no historical records in the Search Area, the species was not detected during the field survey and is only listed as 'May Occur' by the PMST.
AMPHIBIANS							
Litoria raniformis	Southern Bell Frog	VU	V	1	May	This species is found mostly amongst emergent vegetation, including Typha sp., Phragmites sp. and Eleocharis sp., in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area.
AVES							
Actitis hypoleucos	Common Sandpiper	Mi(W)	R	1	May	Inhabit in Salt-water and fresh-water ecosystems along all coastlines of Aus and in many areas inland (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area.

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
Amytornis striatus howei	Murray Mallee Striated Grasswren, Striated Grasswren (sandplain)	EN	R	1	May	Occur in open mallee over a sparse layer of shrubs and a ground layer dominated by spinifex (*Triodia*), though they are sometimes found in other vegetation types (DCCEEW 2023).	**Unlikely –** There is no suitable habitat present in Project Area and no historical records in the Search Area.
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU		1	Known	Found in a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains (DCCEEW 2023c).	**Highly likely -** Despite no recent (<40 years) records, habitat is present within Project Area.
Apus pacificus	Fork-tailed Swift	Mi(M)		1	Likely	Widespread but almost exclusively aerial. Mostly occur over inland plains, over cliffs and beaches and sometimes well out to sea or in dry or open habitats (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area. Potential for fly-over only.
Calidris acuminata	Sharp-tailed Sandpiper	Mi(W)		1	May	Temporary or flooded wetlands and leaving them when they dry. On migration, they forage and roost on rocky and sandy beaches, freshwater habitats, and inland saltwater habitats (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area.
Calidris ferruginea	Curlew Sandpiper	CE, Mi(W)	E	1	May	Habitat mainly includes coastal waters but also recorded, though less often, inland in fresh and brackish waters (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area.
Calidris melanotos	Pectoral Sandpiper	Mi(W)	R	1	May	Prefers shallow fresh to saline wetlands ranging from coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains, and artificial wetlands (DCCEEW 2023b).	**Unlikely -** There is no suitable habitat present in Project Area and no historical records in the Search Area.
Corcorax melanorhamphos	White-winged Chough		R	2, 3	2020	Mostly a sedentary and colonial species that inhabits woodlands and taller mallee, where it feeds on the ground amongst the leaf-litter. Tend to prefer wetter areas with leaf-litter, for feeding, and available mud for nest building (Australian Museum, 2005).	**Known -** Species was observed during the field assessment.
Falco hypoleucos	Grey Falcon	VU	R	1	Likely	The species frequents timbered lowland plains, particularly acacia shrublands that	**Unlikely –** There is no suitable habitat present in Project Area

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
						are crossed by tree-lined water courses. Observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (DCCEEW 2023b).	and no historical records in the Search Area.
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Mi(W)	R	1	May	Usually inhabit open, freshwater wetlands with low, dense vegetation like swamps, flooded grasslands, or heathlands, around bogs and other water bodies (DCCEEW 2023b)	**Unlikely -** No suitable habitat occurs within the Project Area.
Grantiella picta	Painted Honeyeater	VU	R	1	May	Lives in dry, open forests and woodlands. The species usually occurs in areas with flowering and fruiting mistletoe and flowering eucalypts (DCCEEW 2023b).	**Unlikely –** No suitable habitat is present within the Project Area.
Leipoa ocellata	Malleefowl	VU	V	1	Likely	Found predominantly in mallee eucalypt shrublands, but also occur, or once occurred, in a range of other shrubland communities on sandy soils (DCCEEW 2023b).	**Unlikely –** No records in the Search Area and impacted vegetation is unsuitable habitat.
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo (eastern), Eastern Major Mitchell's Cockatoo	EN		1	May	Lives in arid and semi-arid woodlands dominated by mulga (Acacia aneura), mallee and box eucalypts, slender cypress pine (Callitris gracilis) or belah (Casuarina cristata) (DCCEEW 2023d).	**Unlikely –** No records in the Search Area and impacted vegetation is unsuitable habitat.
Melanodryas cucullata cucullata	South-eastern Hooded Robin, Hooded Robin (south-eastern)	EN	R	1 ,2	Known, 2010	Found in Eucalypt woodland and mallee and Acacia shrubland with a remnant size of >50 ha is required (DEH 2014a).	**Likely -** Habitat in the Project Area is suitable and recent (<20 years old) records.
Microeca fascinans fascinans	Jacky Winter		R	2	2010	Prefer open woodland (Eucalypt and mallee) with an open shrub layer and bare ground. Often seen in farmland and parks (DEH 2014b).	**Likely -** Habitat in the Project Area is suitable and recent (<20 years old) records.
Motacilla cinerea	Grey Wagtail	Mi(T)		1	May	European and Asian species that migrates south in winter, rarely reaches Australia, but when it does it favours habitat near freshwater streams, also mown grass, ploughed land or near sewage ponds (Morcombe eGuide 2022).	**Unlikely -** No suitable habitat is present in Project Area, and species is vagrant to Aus.
Motacilla flava	Yellow Wagtail	Mi(T)		1	May	Open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground. Occasionally on dier inland plans. Rare but regular visitor	**Unlikely -** No suitable habitat is present in Project Area, and species is vagrant to Aus.

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
						around Aus coast especially the NW coast Broome to Darwin (Morcombe eGuide 2022).	
Myiagra cyanoleuca	Satin Flycatcher	Mi(T)		1	May	Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in Project Area.
Neophema chrysostoma	Blue-winged Parrot	VU	V	1	Likely	Inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones. The species can also be seen in altered environments such as airfields, golf-courses, and paddocks (DCCEEW 2023e).	**Possible -** Suitable habitat is present in Project Area, however no recent records.
Pedionomus torquatus	Plains-wanderer	CE	E	1	May	Inhabit sparse, treeless, lowland native grasslands which usually occur on hard red-brown clay soils (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in Project Area.
Pezoporus occidentalis	Night Parrot	EN	E	1	May	Primarily found in arid and semi-arid regions of Aus, particularly in areas with spinifex grasslands, shrublands, and tussock grasslands. These habitats are often characterized by low vegetation, open woodlands, and sparse vegetation cover (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in Project Area.
Polytelis anthopeplus monarchoides	Regent Parrot (eastern)	VU	V	1	Likely	Primarily inhabits riparian or littoral River Red Gum forests or woodlands and adjacent Black Box woodlands. Nearby open mallee woodland or shrubland, usually with a ground cover of spinifex or other grasses, supporting various eucalypts, especially Christmas Mallee and Yellow Mallee, as well as Belah, Buloke or Slender Cypress Pine also provide important habitat for this subspecies. They often occur in farmland, especially if the farmland supports remnant patches of woodland along roadsides or in paddocks. The subspecies seldom occurs in more	**Unlikely -** No suitable habitat is present in Project Area.

Species	Common name	Conservation status		Data Source	Date of last record / PMST	Species known habitat preferences	Likelihood of occurrence within Project Area - comments
		EPBC Act	NPW Act				
						extensively cleared areas (DCCEEW 2023b).	
Rostratula australis	Australian Painted Snipe	EN	E	1	May	Prefers shallow freshwater wetlands, including swamps, marshes, and shallow lakes with dense vegetation, reeds, and mudflats. Found in suitable wetland habitats across SA. Specific locations may include wetlands along the Murray-Darling Basin and other river systems, coastal lagoons, and freshwater marshes (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in Project Area.
Stagonopleura guttata	Diamond Firetail	VU	V	1	Known	Reside in a wide range of Eucalypt dominated vegetation communities that have a grassy understorey, including woodland, forest, and mallee (DCCEEW 2023f).	**Unlikely –** No records in the Search Area and habitat is unsuitable.
MAMMALS							
Nyctophilus corbeni	Corben's Long-eared Bat, South-eastern Long-eared Bat	VU	V	1	May	In SA, the species distribution is patchy and distributed, with most of its range in the Murray Darling Basin but with some records outside of this area. It is more common in box, ironbark and cypress pine woodland on the western slopes and plains but also found in other inland woodland vegetation types including mallee (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in the Project Area. No historical records in the search Area.
REPTILES							
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1	Likely	The species burrows freely in loose sand and soil, under rocks and litter. The species occurs in open woodland, native tussock grassland, riparian habitats, and rocky isolates (DCCEEW 2023b).	**Unlikely -** Suitable habitat is limited in the Project Area. No historical records in the search Area.
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard, Adelaide Blue-tongue Lizard	EN	E	1	May	Found in a variety of habitats, ranging from highly degraded grasslands (dominated by exotic grasses) to grasslands with high native biodiversity (DCCEEW 2023b).	**Unlikely -** No suitable habitat is present in Project Area.

Source; 1- BDBSA, 2 – Protected matters search tool 3 – Observed/recorded in the field,
NPW Act; E= Endangered, V = Vulnerable, R= Rare
EPBC Act; Ex = Extinct, CR = Critically endangered, EN = Endangered; VU = Vulnerable, Mi = Migratory, T = Terrestrial, M = Marine, W = Wetland;
The BDBSA data has been sourced from the South Australian Department for Environment and Water Biological Database of SA, Record set number DEWNRBDBSA230911-1

EBS Ecology
112 Hayward Avenue
Torrensville, SA 5031
www.ebsecology.com.au
t. 08 7127 5607

VISUAL IMPACT ASSESSMENT

Project	Australia Plains Solar & Battery Storage
Location	Lot 315 Bower Road & 91 Mickan Road, Australia Plains
Ref No.	24.034
Client	Green Gold Energy
Date	09.09.2024
Issue	Final

OVERVIEW

This visual assessment relates to the proposed solar farm and battery storage facility located on two allotments, Lot 315 Bower Road and 91 Mickan Road, Australia Plains. The purpose of the report is to provide an assessment and opinion of the suitability of the proposal with consideration of the existing landscape context.

INSPECTION

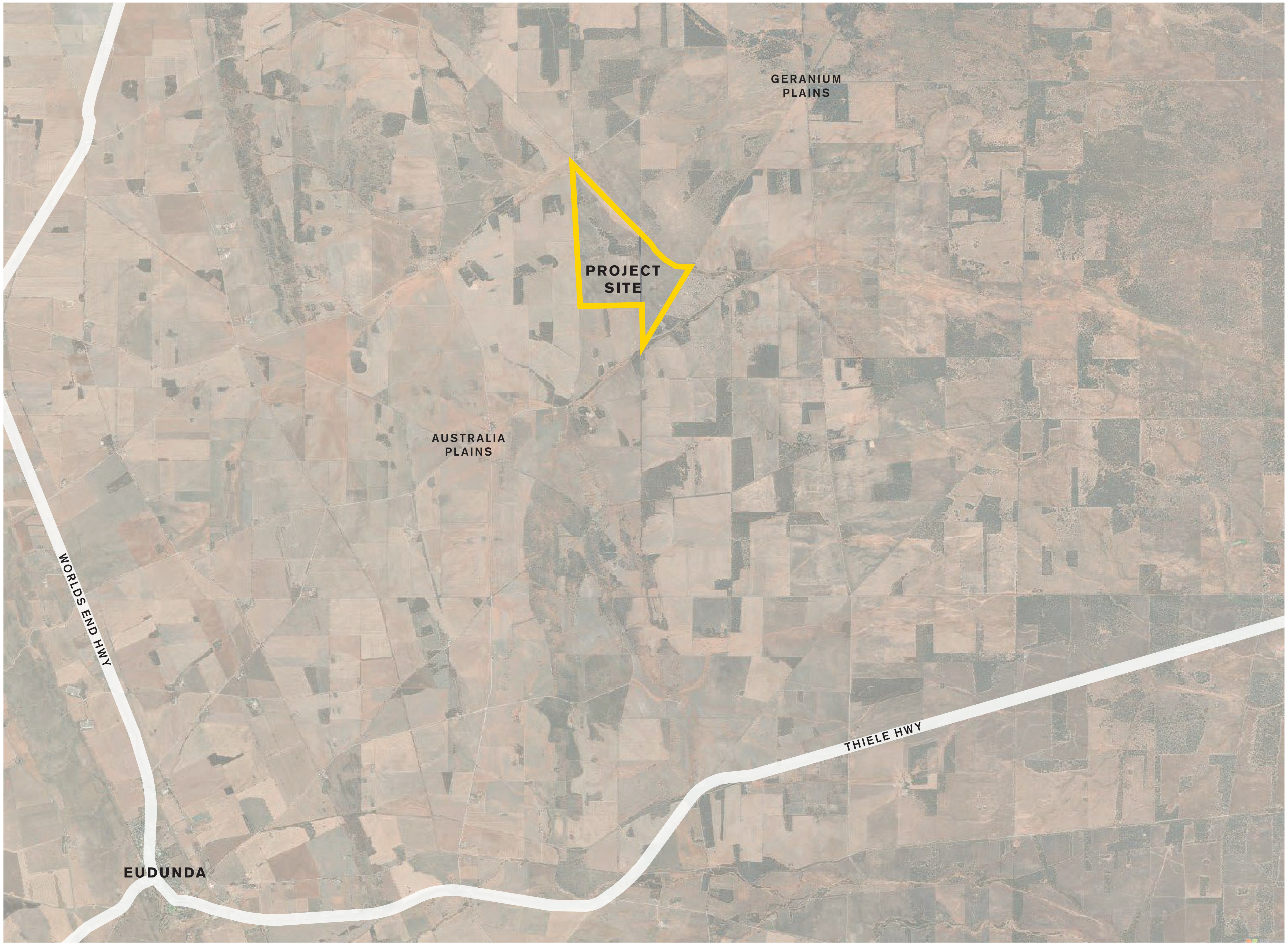
The project site and locality were inspected on Wednesday 3 July 2024 to take photographs, assess the character and amenity of the area and determine the possible visual impact of the proposal prior to preparation of this report.

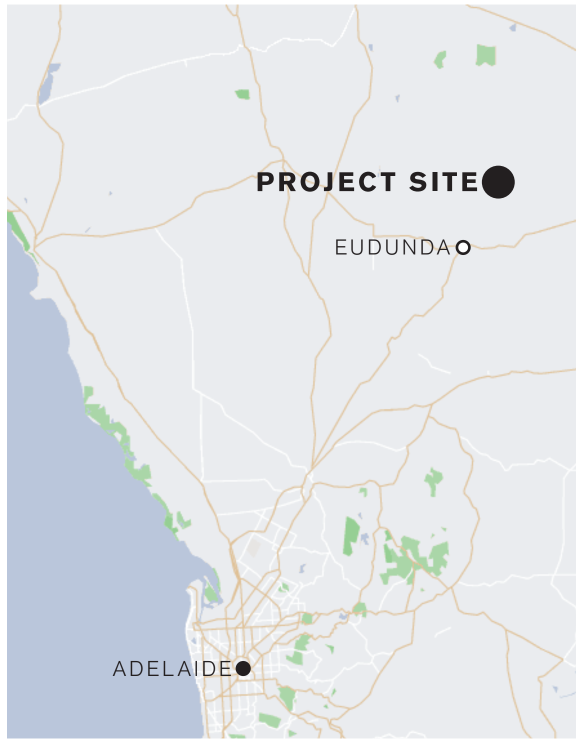
BACKGROUND DOCUMENTS

The following documents have been considered in this report:

— Development Application Report, prepared by Planning Aspects, dated 22 January 2024
— Traffic Impact Assessment, prepared by Cirqa, dated 19 December 2023
— Heritage Assessment, prepared by IHC, dated January 2024
— CFS Assessment, prepared by SA CFS Development Assessment Services, dated 09 May 2024
— Native Vegetation Clearance Assessment, prepared by EBS Ecology, dated 24 June 2024
— Proposal Plans, prepared by Green Gold Energy, dated 09 January 2024
— Stormwater Management Strategy, prepared by WGA, dated 26 March 2024

LOCATION





Project site property boundary

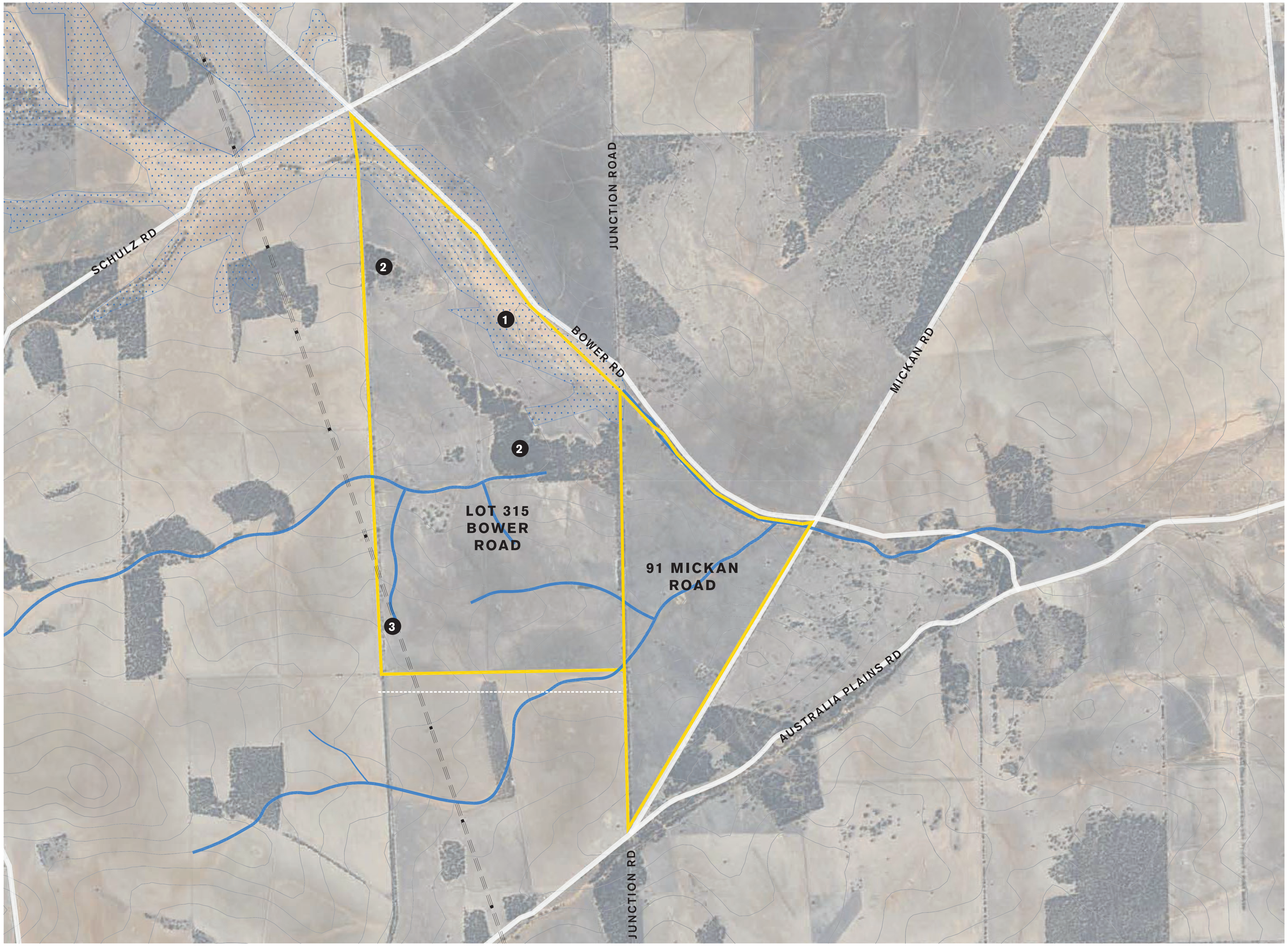
SITE LOCATION

- The site is located approximately 125km north-east of Adelaide within the Regional Council of Goyder.
- The nearest townships include:
  - Australia Plains, located 2km south-west of the site (41 people as of 2021 census).
  - Robertstown, located 11.5km north-west of the site (223 people as of 2021 census).
  - Eudunda, located 6km south-west of the site (815 people as of 2021 census).
- The site is accessible via unsealed roads the north-west, north-east, east, and south-west.

North

0 1000 2500

EXISTING SITE



▬	Project site property boundary
▬	Watercourse
1	Area subject to inundation
2	Patch of mallee vegetation
3	275KV electrical tower & powerlines
—	5m interval contours*

SITE DESCRIPTION

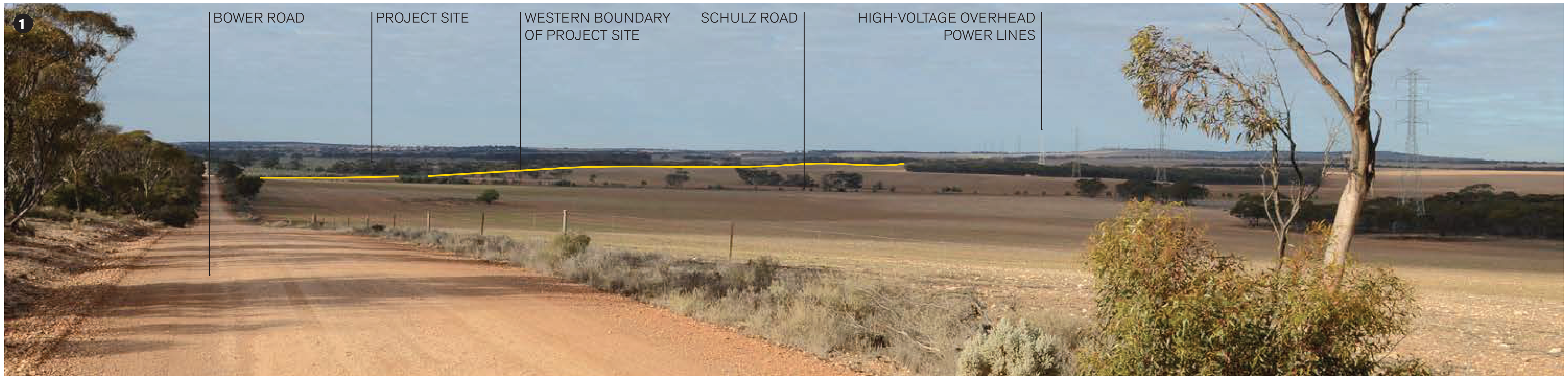
- The project site comprises Lot 315 Bower Road and 91 Mickan Road, Australia Plains. Junction Road separates the two allotments. The portion of Junction Road that passes through the site it is not accessible to the public
- The site is an irregular shape and is approximately 352 hectares in size. It is bound by Bower Road to the north, Mickan Road to the east, and provide allotments to the south and west.
- Based on available topographic information sourced from Elevation and Depth - Foundation Spatial Data (ELVIS) and Data SA, the site slopes from a high point to the south-west to a low point to the north-east .
- Seasonal watercourses are located within the site and along the northern boundary. An area of inundation is also observed.
- Existing vegetation is generally characterised by Chenepod shrubland.
- Stands of mallee eucalypts are located along the site boundary and a large patch of mallee is located at the centre of the site.
- 275 kilovolt (KV) transmission powerlines traverse the site in a north-west to south-east direction. A tower is located in the south-west corner of the site.

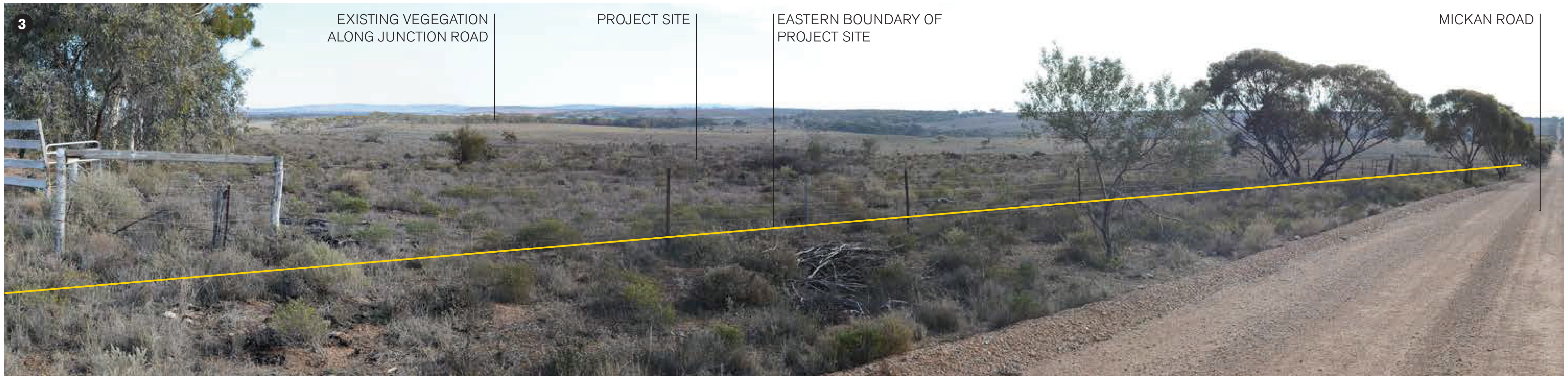
North

1:20,000 / A3

0 200 500 1000

EXISTING SITE





1	View looking south-east along Bower Road
2	View looking south from Bower Road
3	View looking west from Mickan Road

View 2 and 3 are panoramic. While it is recognised that panoramic views do not accurately represent the field of view of the human eye, they are an effective tool in demonstrating broader landscape context, including local topography.

North

EXISTING CHARACTER

OVERVIEW

Location	Lot 315 Bower Road, Australia Plains 91 Mickan Road, Australia Plains
P&D Zone	Rural
P&D Overlay	Hazards (Bushfire - Regional) Hazards (Flooding - Evidence Required) Murray-Darling Basin Native Vegetation Water Resources
Council Area	The Regional Council of Goyder

LANDSCAPE CHARACTER

The landscape character of the local area is reflective of the semi-arid climate and is defined by flat expanses of dryland agriculture and sparse vegetation. The landscape character of the local area is generally defined by the following:

- Flat to gently undulating topography. The terrain is generally low-lying.
- Large allotments generally comprising agricultural land uses, including cropping, and sheep and grazing.
- Native grasslands interspersed with low shrubs and occasional stands of mallee eucalypts.
- Occasional dry creek beds and small seasonal rivers that flow during periods of rainfall.
- Isolated dwellings and outbuilding, reflecting the vastness and remoteness of the landscape.
- Small rural townships, including Australia Plains.
- These views are only interrupted by subtle undulations in the landscape and stands of vegetation along roadways, watercourses and within private allotments.

TOPOGRAPHY & VIEWS

The topography of the local area is generally characterised by flat to gently undulating terrain that stretches across large areas. The local area topography and views are defined by the following:

- Generally flat terrain with gentle undulations forming subtle rises and dips.
- The eastern escarpment of the Mt Lofty Ranges forms a notable feature to the west of the project site.
- In low lying areas, including along the northern boundary of the site, dry creek beds and seasonal watercourses are evident. Soil erosion and vegetation copse are typical within these areas.
- Open and long-distance views of the surrounding landscape. These views are only interrupted by subtle undulations in the landscape and stands of vegetation along roadways, watercourses and within private allotments.

BUILT FORM

Generally, there is minimal built form within the site and local area. Within the project site, existing built form comprises:

- A stone outbuilding and galvanised steel shed located in the northern portion of the site, accessible from Bower Road.
- A galvanised steel shed and plastic water tank located in the eastern portion of the site, adjacent to Mickan Road.

The local area generally comprises large allotments with scattered dwellings and outbuildings. Due to the low density pattern of development within the local area, there are few dwellings adjacent to the project site.

VISUAL INTERFERENCE & INFRASTRUCTURE

275KV transmission powerlines form the most noticeable visual interference within the local area. They pass through the site from the north-west to south -east. The towers are approximately 50m tall.

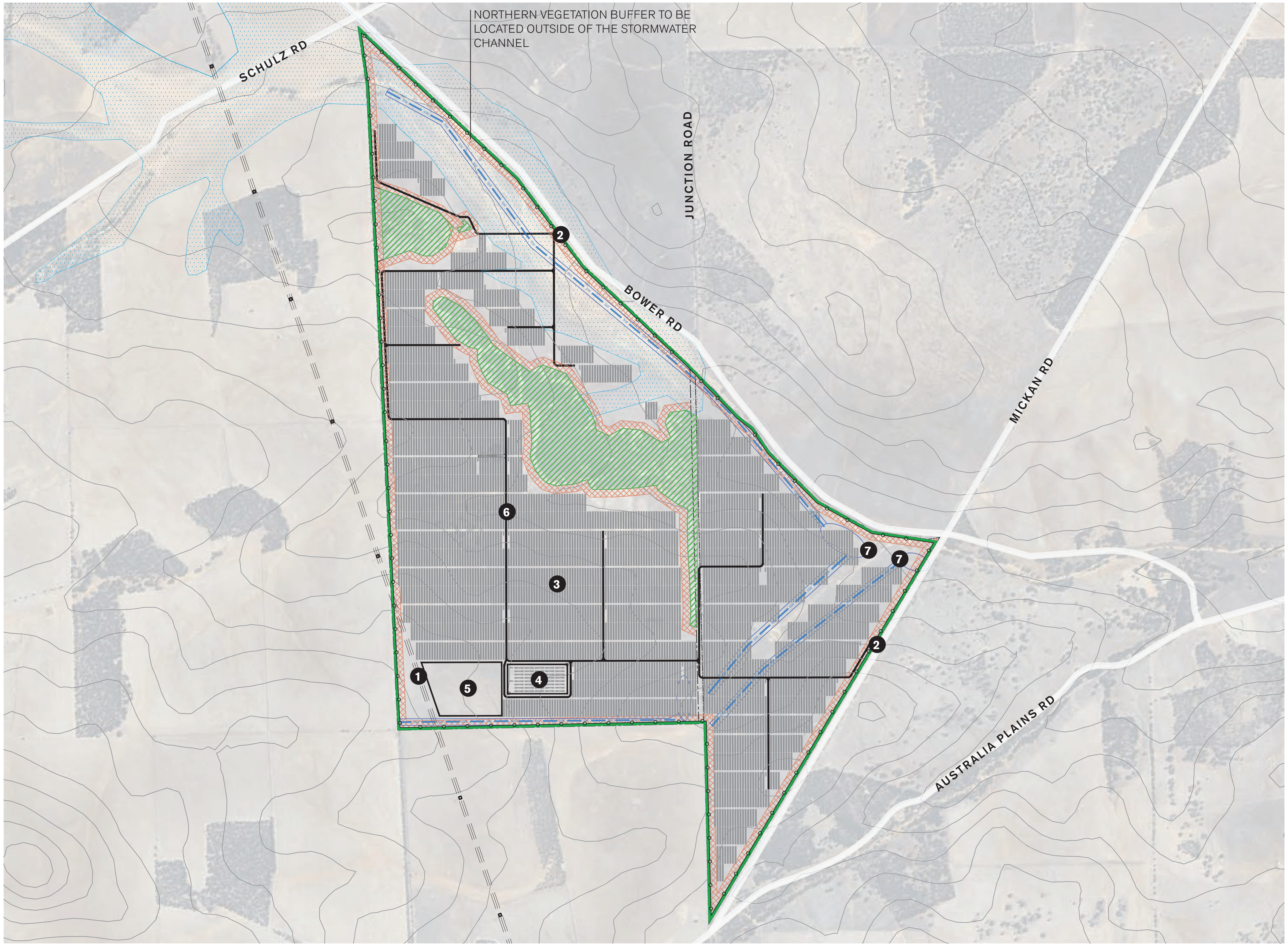
Generally, the flat to gently undulating topography allows long distant views to the horizon while restricting localised views.

PROPOSED DEVELOPMENT

We understand the proposal comprises the following:

- Installation of approximately 435, 450 solar photovoltaic (PV) panels.
- Development of an on-site substation and battery storage.
- Installation of an overhead transmission line connecting the on-site substation to the existing network.
- Development of buildings and structures to support the operation of the solar farm, including:
  - Site offices (containerised buildings)
  - Storage containers housing equipment, general items and staff amenities.
  - Installation of water tanks for fire-fighting purposes.
- Development of two site access points:
  - Northern point of the Bower Road allotment close to the intersection of Schulz and Bower Roads
  - Bower Road along the northern boundary of the Mickan Road allotment.
- Development of internal access roads / tracks within the project site.
- Development of cyclone mesh security fencing around the perimeter of the site.
- Landscape buffer of 5 metres around entire perimeter of site.

PROPOSED PLAN



	Project site property boundary
1	275KV electrical tower & powerlines
2	Proposed access gate
3	Proposed solar panels
4	Proposed battery storage (BESS)
5	Proposed substation
6	Proposed internal road
7	Proposed vegetated basin
	Proposed vegetated swale
	Proposed boundary fence, chainmesh and barbed wire
	Proposed landscape buffer vegetation, 5m wide
	Asset Protection Zone*
	Area subject to inundation
	Existing vegetation to be retained

Note, refer to Green Gold Energy for detailed site plan.

* The Asset Protection Zone comprises a 30m width buffer between the fence and project infrastructure, including substation, solar panels and BESS. Within the APZ, the following vegetation management will be undertaken:

— Understorey plants within the APZ will be maintained such that when considered overall a maximum coverage of 30% is attained, and so that the leaf area of shrubs is not continuous.

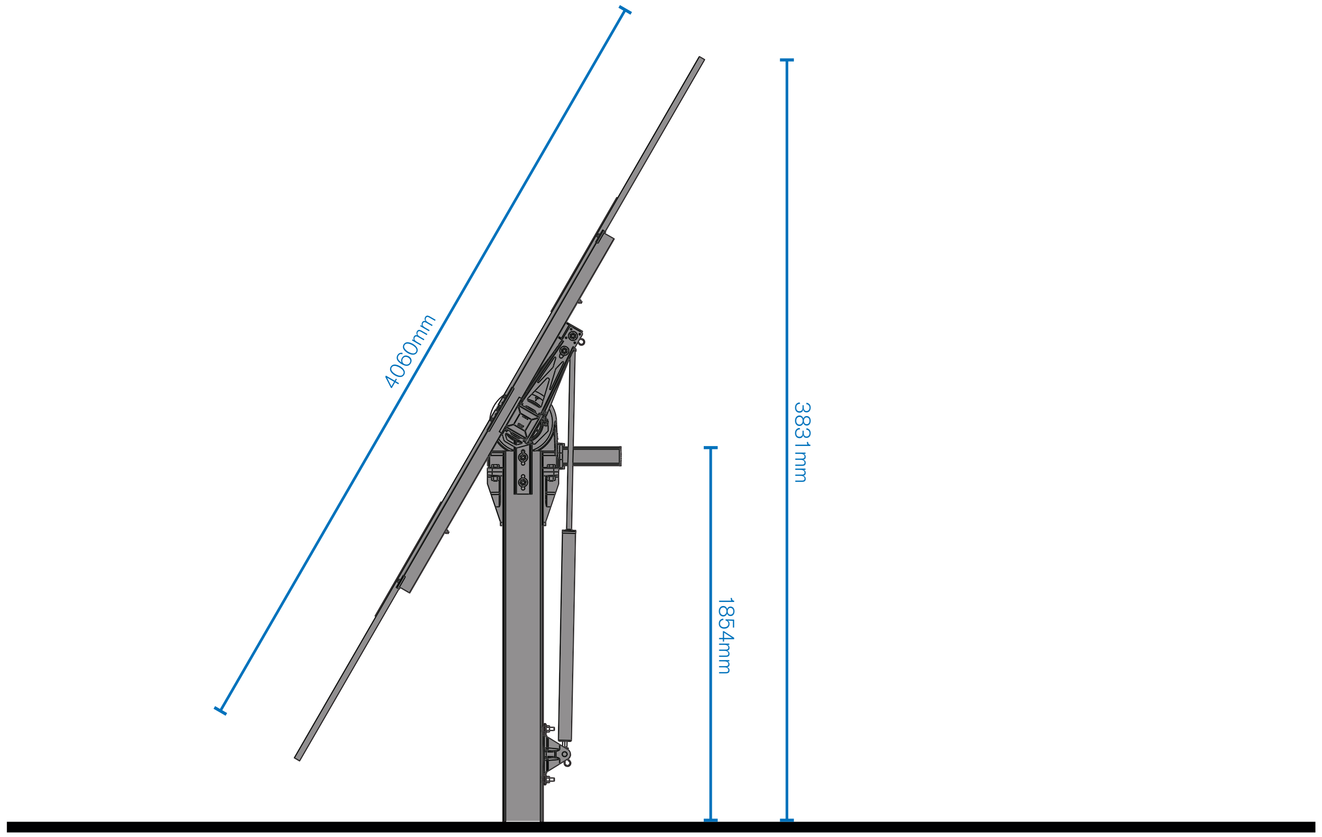
— No understorey vegetation shall be established within 10m of the substation site (Understorey is defined as plants and bushes up to 2m in height).

— Grasses within the APZ shall be reduced to a maximum height of 10cm during the fire danger season (e.g. by grazing, slashing or chemical treatment).

— The APZ shall be maintained to prevent the accumulation of dead vegetation during the fire danger season.

**Contour information is sourced from Elevation and Depth - Foundation Spatial Data (ELVIS) and cross-referenced with Nature Maps, Data SA

EXAMPLE SOLAR ARRAY

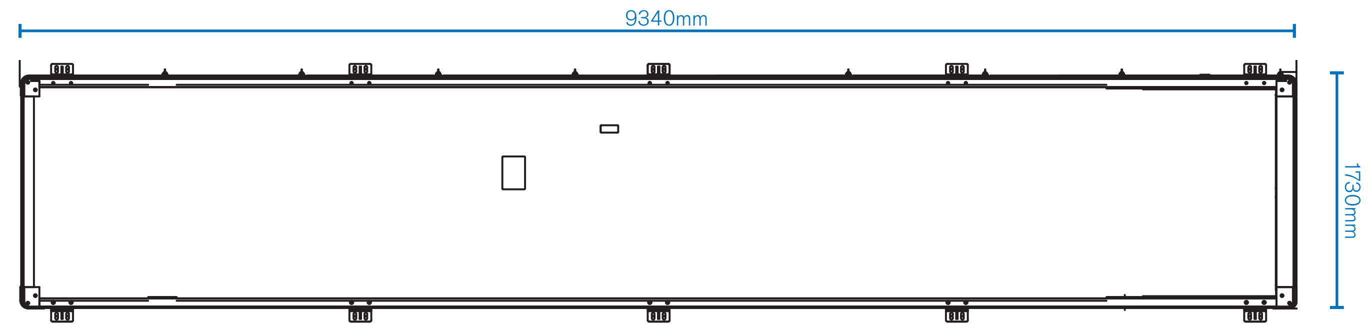


ELEVATION

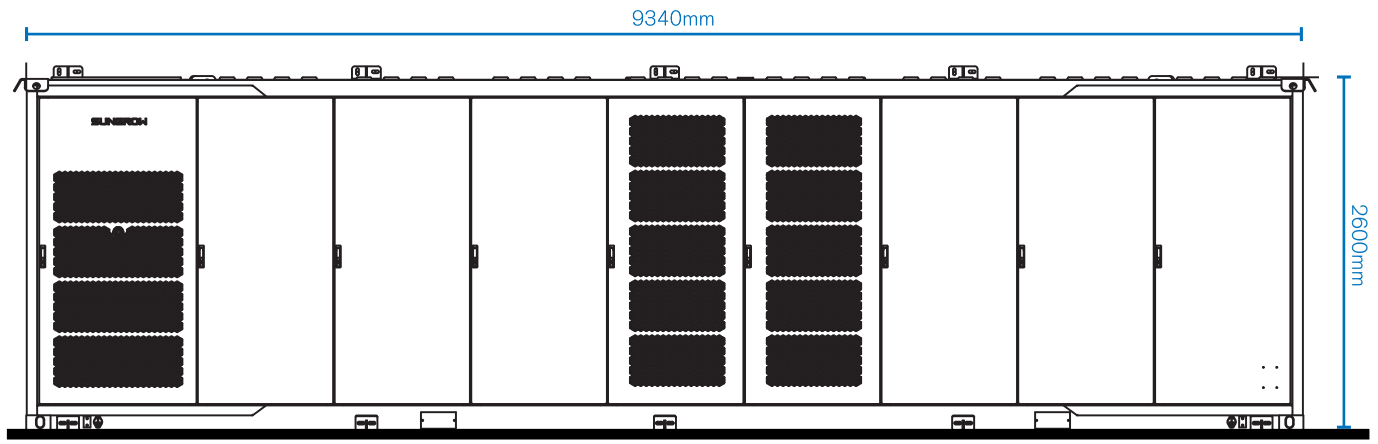
EXAMPLE GROUND-MOUNTED SOLAR ARRAY PROVIDED BY GREEN GOLD ENERGY

EXAMPLE GROUND-MOUNTED SOLAR ARRAY PROVIDED BY GREEN GOLD ENERGY

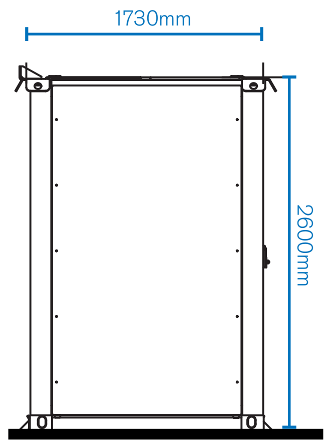
EXAMPLE BATTERY



PLAN 01



ELEVATION 01

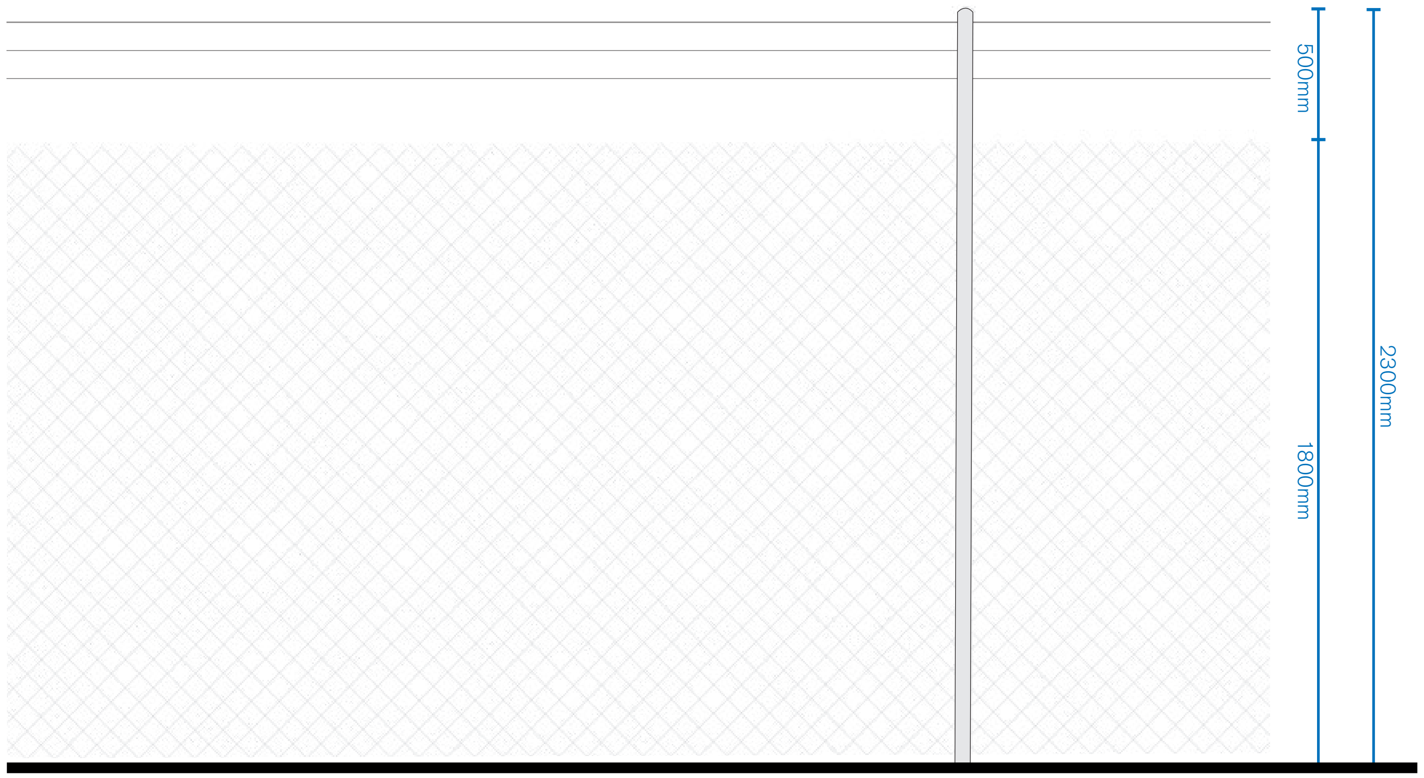


ELEVATION 02

EXAMPLE BATTERY DRAWINGS PROVIDED BY GREEN GOLD ENERGY

EXAMPLE BATTERY, HORNSDALE POWER RESERVE, SA

EXAMPLE SECURITY FENCING

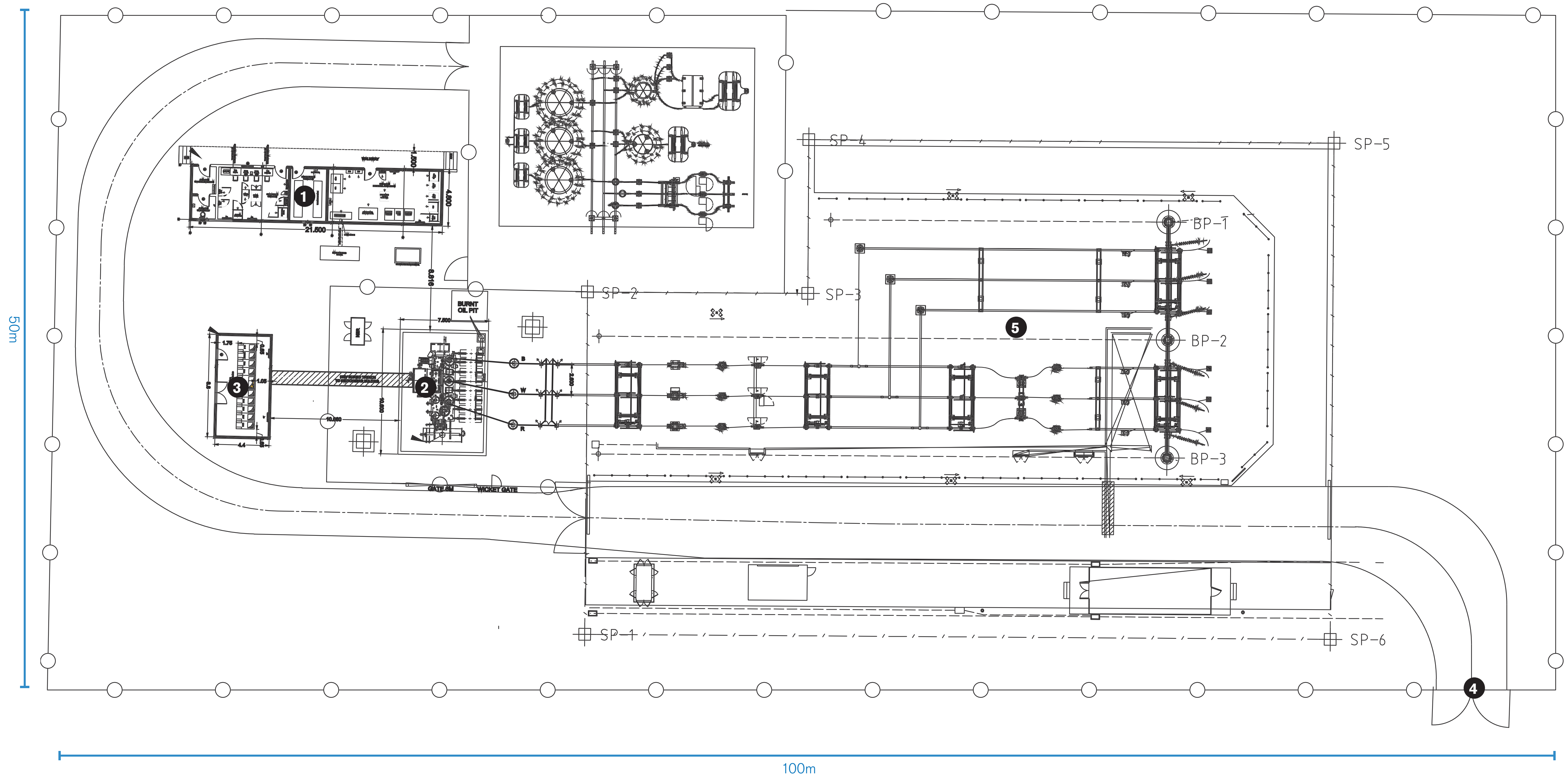


ELEVATION

EXAMPLE SECURITY FENCE AS PER SPECIFICATION PROVIDED BY PLANNING ASPECTS

2.3 METRE HIGH SECURITY FENCE

EXAMPLE SUBSTATION



PLAN

EXAMPLE SUBSTATION PLAN PROVIDED BY GREEN GOLD ENERGY

1	Control room
2	HV E-house
3	Step-up transformer
4	Access
5	Bus pipes

EXAMPLE BUS PIPES, 6-10m IN HEIGHT

LANDSCAPE STRATEGY

LANDSCAPE APPROACH & STRATEGIES

LANDSCAPE APPROACH

The landscape approach aims to:

- Minimise the visual impact of the proposal on the existing location.
- Maximise opportunities for local native revegetation and biodiversity habitat.
- Promote establishment and long-term planting success.

LANDSCAPE STRATEGIES

The landscape approach is reinforced with the following key strategies:

- Retention of existing vegetation that is well-established.
- Hydroseeding with local native species to the entire perimeter of the site.
- Overplanting with new trees and shrubs comprising semi-advanced trees and tubestock.
- Planting within the stormwater swales and retention basin batters.
- Automatic irrigation through the establishment period. This will provide planting stock with the best possible chance of establishment and long term success.
- A minimum two year maintenance and establishment period where all failed stock are replaced.

SEMI-ADVANCED

Source: Contract grown

Use: Planted at a rate of 1 plant per 5sqm

Protection: Stakes and ties

Watering: Establishment only

TUBESTOCK

Source: Contract grown

Use: Planted at a rate of 1 plant per 0.5sqm

Protection: Coreflutes

Watering: Establishment only

HYDROSEED

Supplier: Locally sourced or Native Seeds custom mix

Use: Applied to proposed landscape areas

Watering: Establishment only

PROPOSED PLANTING SPECIES

PLANTING NOTES

- Proposed planting species have been selected with consideration of local growing conditions, including soil and watering requirements.
- Soil mapping and vegetation mapping sourced from Data SA had been used to inform species selections.
- Proposed planting species have been designed to provide appropriate greening, landscape amenity and visual screening for the proposal.
- Species selected are available from retail and/or State Flora nurseries.
- A mix of direct seeding and tubestock planting is recommended for the chosen species and locations. This combination will perform better over-time and is more suited to mass screening / revegetation projects.
- Tubestock planting is not recommended during peak summer. Direct seeding must be undertaken during June/ July.

EXPECTED GROWTH

- A range of shrubs and trees have been selected to provide adequate screening and vegetation buffer to the surrounding roads.
- Species are proposed to be mixed together and it is anticipated that their varied heights and forms will provide a dense and multi-layered buffer.
- Expected growth rates shown in the 'Photomontages' are approximate only and based on previous experience with revegetation programs.
- The inclusion and guarantee of irrigation provides the stock with the best possible chance of healthy growth.

ATRIPLEX NUMMULARIA

Old Man Saltbush

AUSTROSTIPA SPECIES

Spear Grass

THEMEDA TRIANDRA

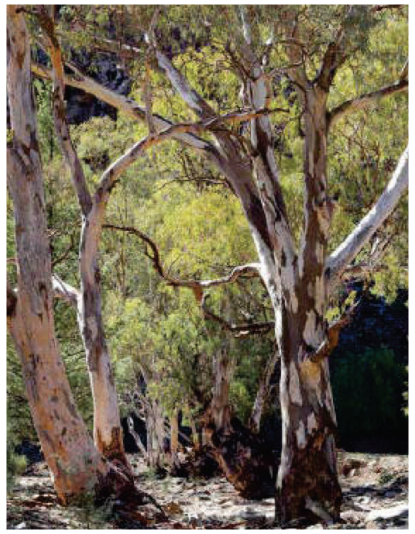
Kangaroo Grass

ALLOCASUARINA VERTICILLATA

Drooping Sheoak

EUCALYPTUS GRACILIS

Yorrell



EUCALYPTUS CAMALDULENSIS

River Red Gum

EUCALYPTUS OLEOSA

Red Mallee

ACACIA ANEURA

Mulga Wattle

PROPOSED PLANTING, IRRIGATION & MAINTENANCE

PREPARATION

SITE PREPARATION

- Spray existing area with a non-residual herbicide in any registered formulae, at the recommended maximum rate.
- Provide a minimum 2 weeks after application of herbicide to remove vegetative spoil from site. Do not burn.
- Remove any debris and level and shape the dry soil surface.

RIPPING

- Rip the existing soil to 200mm depth and remove stones exceeding 25 mm, clods of earth exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during preparation.
- Do not rip within the dripline of trees and shrubs to be retained.
- Do not disturb services or tree roots and if necessary cultivate these areas by hand.

PRE-HYDROSEEDING

- Provide flat and even topsoil surface free from lumps prior to application of hydroseed.

HYDROSEEDING

TYPE

- Local native seed mix.

RATE

- 3kg of seed per hectare.

APPLICATION

- Moisten the topsoil to full depth before applying the slurry.
- Apply seed mix using a dilute paper-based hydroseed solution with the aim of achieving good seed-soil contact.
- Apply a capping layer using a wood fibre hydromulch product (ie. Flexterra or equivalent) to achieve a 'light finish' (not so thick that would otherwise suppress seed germination and to allow light and water to penetrate).
- Prevent or exclude vehicle and foot traffic until fully established so as to preserve the hydromulch crust.
- Seeding to occur between June and July.

WATERING

- Before germination, water the seeded area with a fine spray until the topsoil is moistened to its full depth. Until germination, keep the surface damp and the topsoil moist but not waterlogged.
- Irrigate 2-3 times per week to keep seeds moist throughout establishment.

IRRIGATION

- The Contractor must provide a fit for purpose fully automatic irrigation system as a 'Design and Construct' item to all hydroseed areas, planting and trees.
- All irrigation equipment and installation must comply with australian standards as 2698.2-2000, AS/NZ 3500 and local relevant authority requirements.
- Set-up: The Contractor is responsible for the initial programming and seasonal adjustments of the irrigation system during the maintenance period and prior to handover.
- Controllers: The new systems must be run from one battery controllers equivalent to a Hunter Node housed in a flush in-ground pit.
- Valves: Hydroseed areas, trees and tube planting to be operated by separate stations.
- Shop drawings: The Contractor is to provide shop drawings and schedules showing the layout and details of the system for approval by the principal, including the following:
    - Connections to the water supply.
    - Connections to the new controller.
    - Fixed above ground rotary sprinklers to hydroseed areas (ensure even coverage).
    - Above ground drip lines (at min. 500mm ctrs) to trees and tube.
    - Contractor to verify all irrigation components with Principal prior to purchase and installation.
- Water supply: New SA Water meter required. Confirm location on-site prior to application. Ensure take-off and installation is complaint to all relevant Australian Standards and Office of Technical Regulator Guidelines.
- All operation manuals to be provided to Client prior to handover.

MAINTENANCE

- Two year defects liability period and maintenance period from Practical Completion. Scope to include:
    - Establishment of all trees, planting, and hydroseeded areas.
    - Replacement of dead or failed shrubs and trees.
    - Pruning, trimming and tree surgery.
    - Insect and disease control of shrubs and trees.
    - General cleaning and tidying of planting and hydroseeded areas.
    - Maintenance of irrigation systems.
    - Weeding of hydroseeded areas.
    - Removal of rubbish and debris.
    - Keeping of a log book.
    - Monthly reports.
- The contractor is responsible for all watering during the maintenance phase, no variations will be accepted for additional watering requirements.
- Monthly reports (including photographs) are to be submitted the principal throughout the maintenance period.
- Contractor to ensure the general appearance and presentation of the landscape and the quality of plant material at date of Practical Completion is maintained for the planting establishment period.
- Contractor is responsible for replacing failed, dead and/ or damaged plants at maximum 3 weekly intervals as necessary throughout the plant establishment period.

VISUAL ASSESSMENT

METHODOLOGY

METHODOLOGY

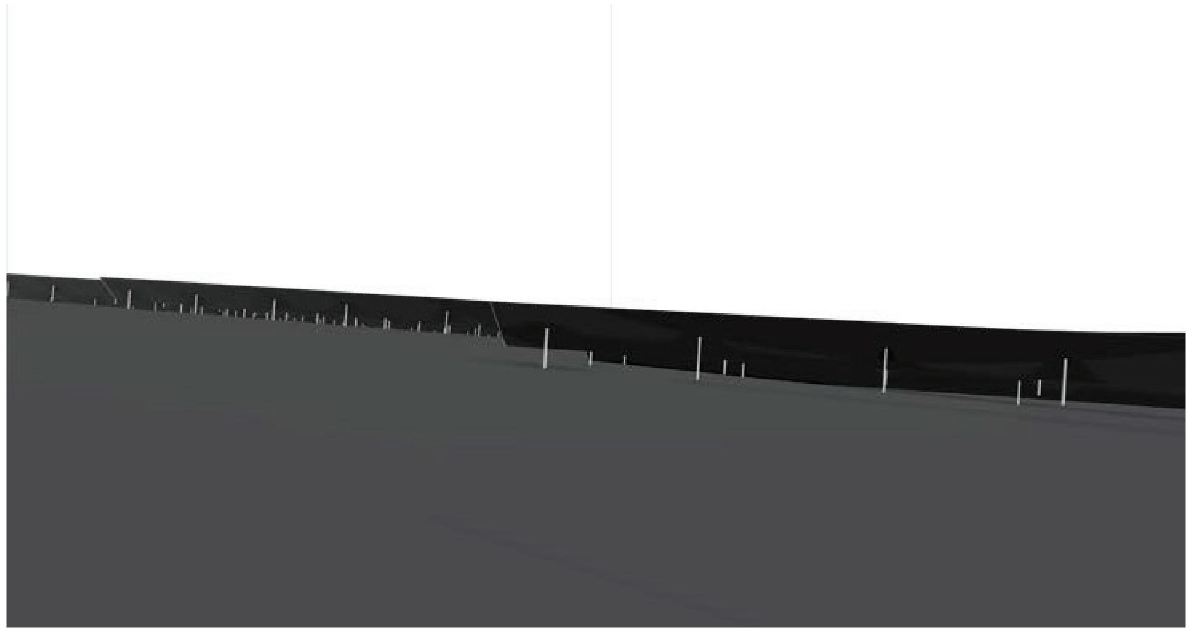
Photography was undertaken using the following methodology:

- All photos were taken at eye level, with no filter.
- Focal length was set at 22mm.
- Photos were taken from publicly accessible viewpoints within the local area. It is acknowledged that this assessment does not include views from every position where the proposal will be visible.
- A series of locations were selected to illustrate the visual impact of proposal. A photomontage technique was used to edit these photos to accurately demonstrate the possible future change. Refer to the description across.
- Any photos that have been altered, are labelled as 'Photomontage'.

3D MODEL & PHOTOMONTAGES

Photomontages were prepared using the following methodology:

1. Site contour information was obtained from ELVIS (https://elevation.fsdf.org.au) and imported into QGIS. Topographic Pointcloud data was generated.
2. A 3D model of the site was prepared in Rhino3D using the Pointcloud data.
3. A 3D model of the proposed development was prepared and superimposed onto the 3D site model using Rhino3D, based on information provided by GreenGold Energy.
4. 3D views and photographic views were aligned in the model. This included importing selected photographic viewpoints into the model and verifying the accuracy of views based on existing site features (transmission towers, fences and vegetation).
5. 3D views were exported from Rhino3D with modelled topography, solar panels and key site features.
6. 3D views were imported into Adobe Photoshop and superimposed on photographs taken during the site visit.
7. Proposed vegetation was superimposed at time of planting, 3 years, and 10 years.



THE SCREENSHOT ABOVE IS FROM THE RHINO3D MODEL. IT REPRESENTS THE WORKING MODEL THAT WAS PREPARED TO ASSIST WITH PREPARATION OF THE PHOTOMONTAGE VIEWS.

The following rating scale has been used to determine the visual notability of the proposal at each viewpoint:

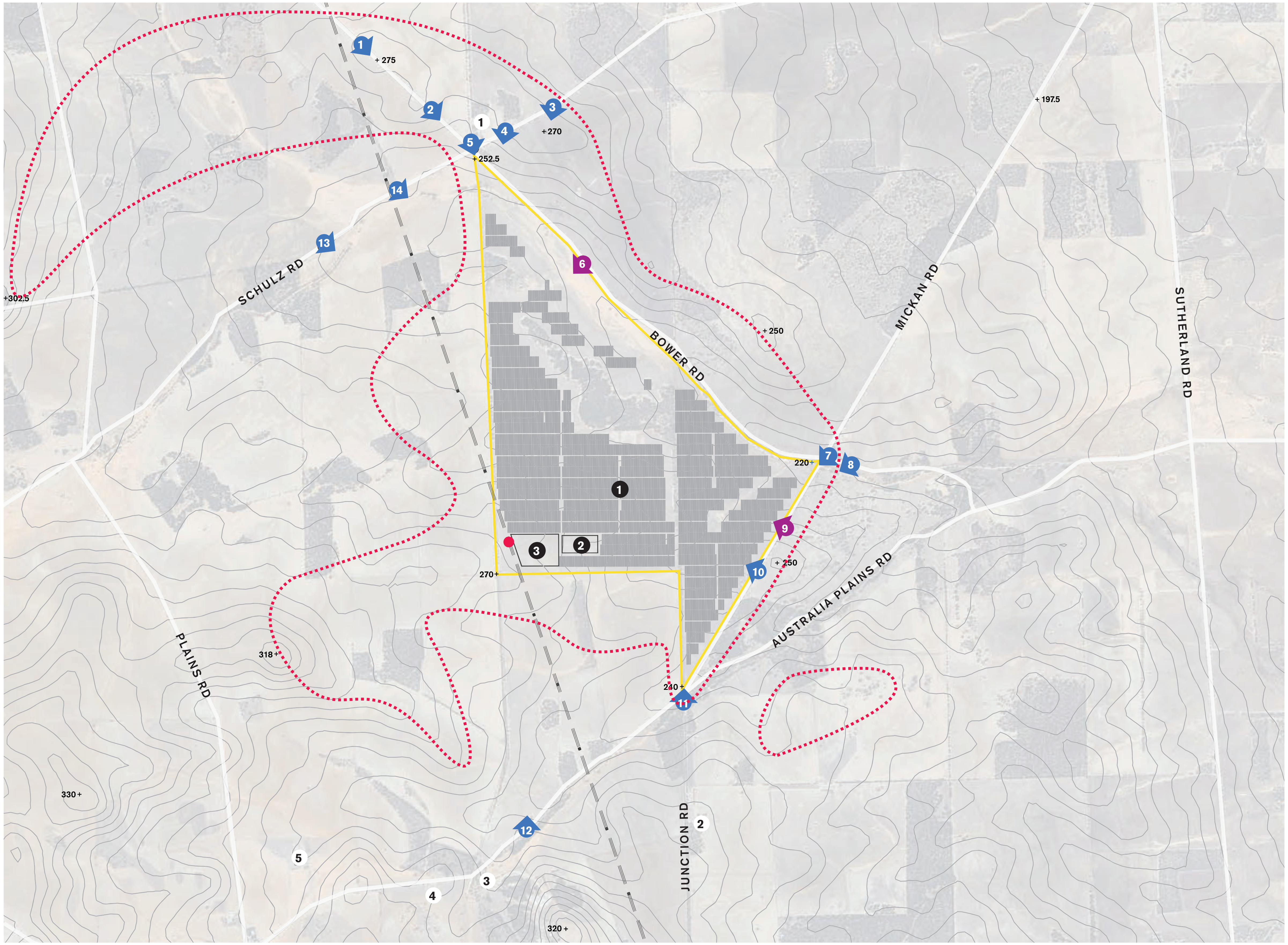
VISUAL NOTABILITY	DESCRIPTION
Negligible	Subject cannot be seen
Low	Subject can be seen
Moderate	Subject is reasonably visible
High	Subject is highly visible
Very High	Subject is highly visible and prominent

The following rating scale has been used to determine the visual impact of the proposal at each viewpoint. The visual impact takes into account how sensitive to change the existing landscape is.

IMPACT OF PROPOSAL	DESCRIPTION
Negligible	Will **not** be noticed and has a negligible to no impact on the visual amenity of the area
Low	Will just be noticed and has a low impact on the visual amenity of the area
Moderate	Will be noticed and has a moderate impact on the visual amenity of the area
High	Will be noticed and has a high impact on the visual amenity of the area
Very High	Will be noticed and has a very high impact on the visual amenity of the area

GLOSSARY OF TERMS	
Viewpoint	The specific location of a view, typically used for assessment purposes
Viewshed	The area that the proposal can be seen from
Visibility	The state or fact of being visible or seen
Visual impact	The impacts on the views from residences, workplaces and public places

VIEWPOINTS & VIEWSHED



1	Proposed solar panels
2	Proposed battery storage (BESS)
3	Proposed substation
	Project site property boundary
	Photographic viewpoint
	Viewpoint with photomontage
	Dwelling within the local area:
1	12 Back Road, Rocky Plain
2	1362 Australia Plains Road, Australia Plains
3	1170 Australia Plains Road, Australia Plains
4	1140 Australia Plains Road, Australia Plains
5	1041 Australia Plains Road, Australia Plains
	275KW transmission line located within south-west corner of project site
	5m interval contours*
+ XX	Australian Height Datum (AHD) level*
	Approximate extent of viewshed**

* Contour information is sourced from Elevation and Depth - Foundation Spatial Data (ELVIS) and cross-referenced with Nature Maps, Data SA

** The viewshed is approximate and has been generated from a compilation of information sourced from Google Earth. The viewshed assumes the solar panels are 3m above existing ground and sub-station 6m above existing ground. The viewshed is based on topographic information and does not take into account vegetation. It is noted that the whole site is not visible from any one location. Generally, views are heavily screened by topography and vegetation. Less than 50% of the site is typically visible from any one location.

North

0 200 500 1000

VIEWPOINTS

VIEWPOINT 01

Location	Bower Road, Rocky Plain
Distance from the site	1,050m
Distance from nearest solar panel	1,400m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	Moderate
Visual impact	Moderate

Notes

- The northern portion of the site will be partially visible from this elevated viewpoint.
- The majority of the proposed solar panels will be screened by the topography and existing roadside vegetation.

VIEWPOINT 02

Location	Bower Road, Rocky Plain
Distance from the site	450m
Distance from nearest solar panel	750m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	Low
Visual impact	Low

Notes

- The northern portion of the site will be partially visible from this viewpoint.
- The majority of the proposed solar panels will be screened by the topography and existing roadside vegetation.

VIEWPOINTS

VIEWPOINT 03

Location	Schulz Road, Rocky Plain
Distance from the site	600m
Distance from nearest solar panel	800m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	Low
Visual impact	Low

Notes

— The majority of the site will be screened from view by the topography in the foreground and existing vegetation.

— The southern portion of the site, including the substation and BESS, will be partially visible from this viewpoint.

VIEWPOINT 04

Location	Schulz Road, Rocky Plain
Distance from the site	250m
Distance from nearest solar panel	550m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	High
Visual impact	High

Notes

— The northern portion of the site, including solar panels, will be visible from this viewpoint.

— The southern portion of the site will be screened by existing mallee vegetation within the site.

VIEWPOINTS

VIEWPOINT 05

Location	Intersection of Bower Road & Schulz Road, Rocky Plain
Distance from the site	50m
Distance from nearest solar panel	450m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	Low
Visual impact	Low

Notes

— The majority of the site will be screened from view by existing vegetation.

VIEWPOINTS

VIEWPOINT 06 - EXISTING

Location	Bower Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	250m
Date & time	04.07.2024 - 10:00am
Image modifications	None
Visual notability	High
Visual impact	High

Notes

— The northern portion of the site, including solar panels, will be visible from this viewpoint.

— The southern portion of the site will be screened by existing mallee vegetation within the site.

VIEWPOINT 06 - COMPLETION OF SOLAR FARM & FENCE

Location	Bower Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	250m
Date & time	04.07.2024 - 10:00am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	High
Visual impact	High

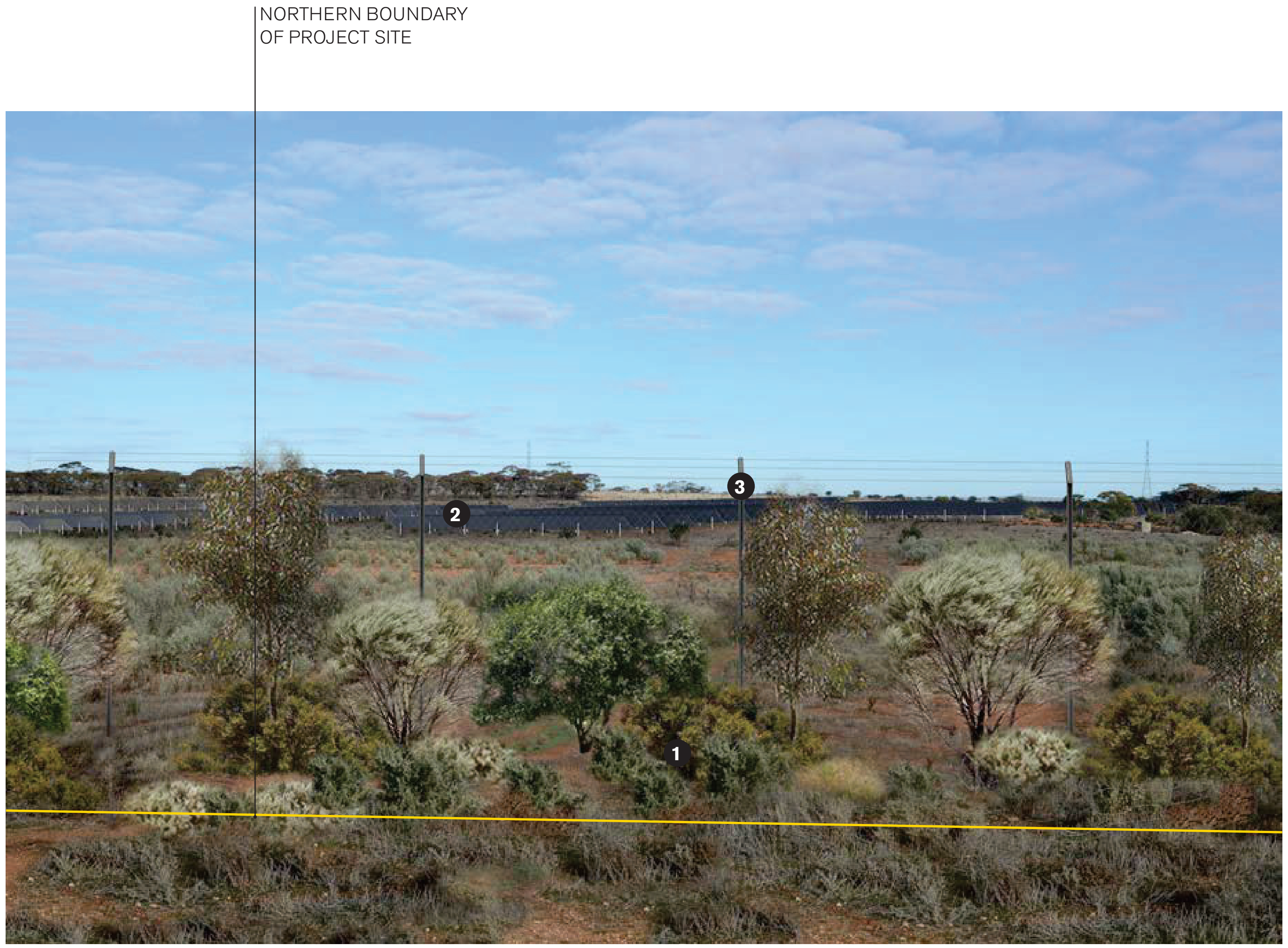
1. Proposed 5m vegetated buffer
2. Proposed solar panels
3. Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

— Vegetation growth shown is approximate only and based on previous experience and specific planting requirements provided.

VIEWPOINTS



VIEWPOINT 06 - 3 YEARS OF GROWTH*

Location	Bower Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	250m
Date & time	04.07.2024 - 10:00am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	Moderate
Visual impact	Moderate

1	Proposed 5m vegetated buffer
2	Proposed solar panels
3	Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

— Vegetation growth shown is approximate only and based on previous experience and specific planting requirements provided.

VIEWPOINT 06 - 10 YEARS OF GROWTH*

Location	Bower Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	250m
Date & time	04.07.2024 - 10:00am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	Low
Visual impact	Low

1	Proposed 5m vegetated buffer
2	Proposed solar panels
3	Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

— Vegetation growth shown is approximate only and based on previous experience and specific planting requirements provided.

VIEWPOINTS

VIEWPOINT 07

Location	Intersection of Mickan Road & Bower Road, Australia Plains
Distance from the site	50m
Distance from nearest solar panel	250m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	Moderate
Visual impact	Low

Notes

— Views to the solar panels will be significantly screened by existing vegetation.

VIEWPOINT 08

Location	Intersection of Mickan Road & Bower Road, Australia Plains
Distance from the site	200m
Distance from nearest solar panel	350m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	Negligible
Visual impact	Negligible

Notes

— The project site will not be visible from this viewpoint due to existing vegetation.

VIEWPOINTS

VIEWPOINT 09 - EXISTING

Location	Mickan Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	70m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	High
Visual impact	High

Notes

— Views to the solar panels will uninterrupted from this viewpoint.

— The sub-station and BESS will not be visible from this viewpoint due to topography and existing vegetation.

VIEWPOINT 09 - COMPLETION OF SOLAR FARM & FENCE

Location	Mickan Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	70m
Date & time	04.07.2024 - 10:10am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	High
Visual impact	High

1	Proposed 5m vegetated buffer
2	Proposed solar panels
3	Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

VIEWPOINTS

EASTERN BOUNDARY OF
PROJECT SITE SHOWN YELLOW

EASTERN BOUNDARY OF
PROJECT SITE SHOWN YELLOW

VIEWPOINT 09 - 3 YEARS OF GROWTH*

Location	Mickan Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	70m
Date & time	04.07.2024 - 10:10am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	Moderate
Visual impact	Moderate

1. Proposed 5m vegetated buffer
2. Proposed solar panels
3. Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

— Vegetation growth shown is approximate only and based on previous experience and specific planting requirements provided.

VIEWPOINT 09 - 10 YEARS OF GROWTH*

Location	Mickan Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	70m
Date & time	04.07.2024 - 10:10am
Image modifications	Yes, fence, vegetation and solar panels included
Visual notability	Low
Visual impact	Low

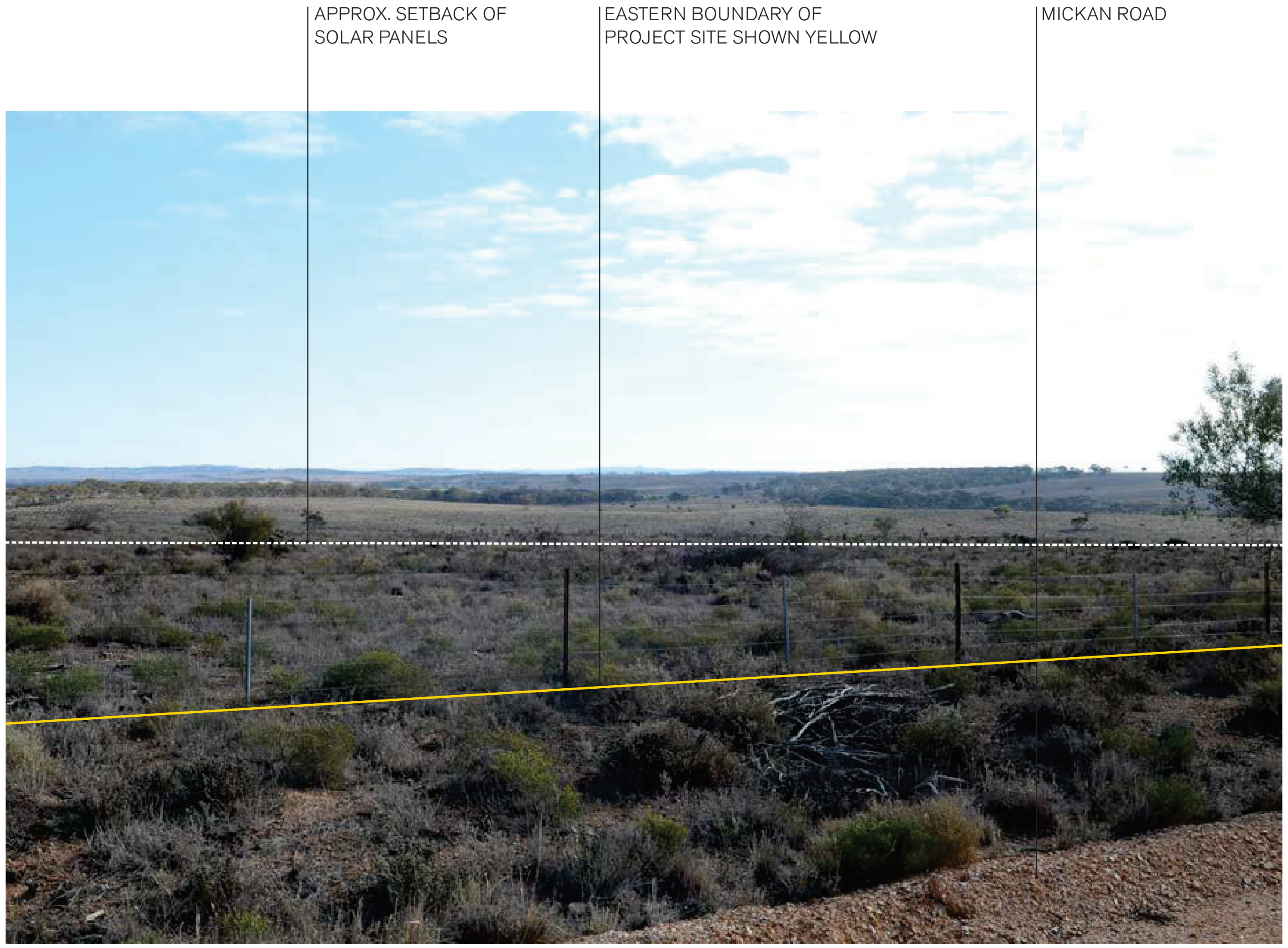
1. Proposed 5m vegetated buffer
2. Proposed solar panels
3. Proposed fence

Notes

— The solar panels are represented at their maximum height. The panels tilt to maximise their exposure to the sun and it is anticipated that the panels will generally be positioned lower than represented in the photomontage views.

— Vegetation growth shown is approximate only and based on previous experience and specific planting requirements provided.

VIEWPOINTS



VIEWPOINT 10

Location	Mickan Road, Australia Plains
Distance from the site	10m
Distance from nearest solar panel	70m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	High
Visual impact	High

Notes

— Views to the solar panels will uninterrupted from this viewpoint.

VIEWPOINT 11

Location	Intersection of Australia Plains Road & Mickan Road, Australia Plains
Distance from the site	40m
Distance from nearest solar panel	220m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	High
Visual impact	High

Notes

— Views to the solar panels will uninterrupted from this viewpoint.

— The sub-station and BESS will not be visible from this viewpoint due to topography and existing vegetation.

VIEWPOINTS

SOUTHERN BOUNDARY OF PROJECT SITE NOT VISIBLE DUE TO TOPOGRAPHY

VIEWPOINT 12

Location	Australia Plains Road, Australia Plains
Distance from the site	1,600m
Distance from substation	1,700m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	Negligible
Visual impact	Negligible

EASTERN BOUNDARY OF PROJECT SITE NOT VISIBLE DUE TO TOPOGRAPHY

VIEWPOINT 12

Location	Schulz Road, Rocky Plain
Distance from the site	1,030m
Distance from nearest solar panel	1,080m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	Negligible
Visual impact	Negligible

VIEWPOINTS

VIEWPOINT 13

Location	Schulz Road, Rocky Plain
Distance from the site	540m
Distance from nearest solar panel	600m
Date & time	04.07.2024 - 10:10am
Image modifications	None
Visual notability	Negligible
Visual impact	Negligible

CONCLUSION

The existing landscape character of the local area is highly modified and is currently defined by dryland agriculture comprising cropping and grazing with areas of mallee along fence lines and within allotments. High-voltage overhead power lines and outbuildings associated with agriculture provide visual interference. In summary, it is our opinion that the local area is of relatively low scenic quality.

Following assessment of the visual impact of the proposal, we have formed the opinion that the proposal will have a low visual impact on the local area due to the following:

1. Publicly accessible views of the proposal are extremely limited and generally include:
   - The roads immediately bordering the site, including Bower Road, Mickan Road and a short section of Australia Plains Road.
   - Longer distance views are limited to short sections of Bower Road, west of the site, and Schulz Road, north of the site.
2. The local area has a good capacity to absorb infrastructure of the proposed nature, with flat to gently undulating topography and scattered stands of mallee eucalypts that restrict views.
3. Retention of existing areas of mallee eucalypts within the site and along the site boundary restrict views.
4. Proposed landscaping around the entire perimeter of the facility ensures that the facility will be screened from adjacent roads and private allotments. The proposed landscaping will add to the landscape amenity of the area and improve local biodiversity.
5. The local area is currently populated with high-voltage overhead power lines, approximately 50m high.
6. The proposed sub-station and BESS units are consolidated and well located to minimise their visual impact. They are located in the south-west corner of the project site, away from publicly accessible vantage points. The topography of the local area will limit their visibility from the south and west.

The local area generally comprises large allotments with scattered dwellings and outbuildings. Due to the low density pattern of development within the local area, there are few dwellings adjacent to the project site. While a full photographic survey was not undertaken from private properties, a desktop review is summarised below:

- 12 Back Road, Rocky Plain, located approximately 150m from the northern project site boundary is the closest dwelling. Based on photographic survey undertaken from Schulz Road, adjacent to the dwelling, the following are noted:
  - The northern portion of the proposal will be partially visible from the dwelling. Views will be significantly obstructed by existing vegetation adjacent the dwelling and along Bower Road, as well as proposed vegetation along the project site boundary.
  - Views to the southern portion of the proposal, including substation and BESS will be obstructed by existing topography and mallee stands within the project site.
- 1362 Australia Plains Road, Australia Plains, located 700m south of the southern boundary. Based on photographic survey undertaken from Junction Road, adjacent the dwelling, it is anticipated that the proposal will not be visible due to local topography and vegetation.
- 1170 Australia Plains Road, Australia Plains, located 2,000m south of the southern project site boundary. Based on photographic survey undertaken from Australia Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.
- 1140 Australia Plains Road, Australia Plains, located 2,150m south of the southern project site boundary. Based on photographic survey undertaken from Australia Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.
- 1041 Australia Plains Road, Australia Plains, located 2,250m south-west of the southern project site boundary. Based on photographic survey undertaken from Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.

Due to the local topography, it is noted that some long distance views of the proposed development may be possible from private allotments to the east and north. It is anticipated that these views will be significantly limited by the local topography, existing vegetation and proposed landscaping.

Generally, local topography, existing vegetation, and proposed landscaping to the perimeter of the proposed development are envisaged to significantly limit the visual impact to an acceptable level.

The visual assessment carried out as part of this report has demonstrated that the visual impact of the proposal will be low and will lessen over time. It is our opinion, that it will not result in an unacceptable visibility that compromises the landscape character of the locality.

The successful establishment of proposed landscaping will provide visual and landscape benefit to the local area.

Urban Design, Landscape
Architecture & Gardens

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LANDSKĀP

AUSTRALIA PLAINS SOLAR FARM

GLINT AND GLARE ASSESSMENT REPORT
FINAL ISSUE

Prepared For
GREEN GOLD ENERGY

September 2024

Prepared By Environmental Ethos
for Green Gold Energy

REF NO. 24010

FINAL ISSUE: 03/09/2024

Cover Image: John Carnemolla

CONTENTS

EXECUTIVE SUMMARY

The proposed Australia Plains Solar Farm comprises of the installation and operation of a 150MW solar farm and 400MWh Battery Energy Storage System (BESS), located at Australia Plains approximately 11km south east of Robertstown, South Australia.

The structure of the solar farm will be a single axis horizontal tracking system with PV arrays running north/south. The PV arrays will be approximately 4.06 metres wide and 2.0 metres high, to centroid.

This glint and glare impact assessment utilised the Solar Glare Hazard Analysis Tool (SGHAT 2024A) in conjunction with a viewshed analysis, to undertake the glare modelling which is the basis for the impact assessment methodology.

The results of the viewshed analysis and the glint and glare modelling, together with the consideration of existing and proposed mitigating factors, identified the following:

- The assessment identified no aviation facilities within 5km of the Project, and no railway infrastructure within 1km of the Project.
- Within 3km of the Project, nine residential receivers were identified in the viewshed model as having potential line of sight to the Project (based on the terrain model).
- The viewshed modelling also identified the five (5) local roads as having potential line of sight to the Project, and an unformed road corridor.
- Glare (SGHAT) modelling identified that under normal operation of the solar farm with a tracking/backtracking operation and a minimum limit of 5 degree resting angle (being the fixed angle at which the backtracking process starts and finishes during daylight hours), no potential glare hazard impacts were identified as affecting residential receivers within 3km of the Project site.
- Glare (SGHAT) modelling also identified no potential glare hazard affecting Bower Road, Back Road, and Australia Plains / Emmaus Roads.
- PV Array 5, which is located to the east of the Project site, was identified as generating a small amount of glare affecting Mickan Road and a very small amount of glare affecting Schulz Road, when the resting angle was set at 5 degrees. Adjustment to a 6 degrees resting angle eliminated potential glare in the modelling, therefore the mitigation measures for PV Array 5 includes the requirement to limit the resting angle of the tracking system to a minimum 6 degrees.
- Glare (SGHAT) modelling also identified potential glare affecting the unformed road corridor (Junction Road) generated by PV Arrays 3 and 5. As the Project will curtail access along the road corridor during the life of the Project, the potential glare identified in the modelling is not considered likely to affect drivers of vehicles.
- Screen planting and the retention of areas of existing vegetation is proposed as part of the Project development. When the screen planting has become established to a height and density sufficient to block line of site to the Project from Mickan Road and Schulz Road, the requirement to limit the resting angle of the tracking system for PV Array 5 to 6 degrees (minimum) would no longer apply.
- The Project EMP should detail glare management measures required to avoid impacts to sensitive receptors, including the limits recommended in this report regarding resting angles. In addition,

monitoring of glare hazard potential is required and a process for managing complaints, including rectification, should be included in the Project EMP.

1. INTRODUCTION

This report has been prepared by Environmental Ethos on behalf of Green Gold Energy to assess the potential solar glint and glare impact of the proposed Australia Plains Solar Farm (the Project), located at Australia Plains, South Australia. The Project comprises of the installation and operation of a 150MW solar farm and 400MWh Battery Energy Storage System (BESS).

The Project site comprises of two parcels of land identified as; Lot 315 Bower Road and Lot 91 Mickan Road, Australia Plains.

The structure of the solar farm will be a single axis horizontal tracking system with PV arrays running north/south. The PV arrays will be two panels in portrait (4.06m wide), with an approximately height of 2.0 metres to centroid.

This glint and glare assessment has been undertaken with reference to large-scale solar energy design guidelines in Australia (NSW Government, 2022[1] and Victorian Government, 2019[2] Guidelines), including assessment of the following:

- All residential receivers with 3km of the proposed solar arrays with line of sight to the Project;
- All roads and rail lines within 1km of the proposed solar array; and
- All air traffic control towers and take off/landing approaches to any runway or landing strip within 5km of the proposed solar array.

1.1. Location

The Project site is located at Australia Plains, approximately 11 kilometres (km) south east of Robertstown, within the Goyder Regional Local Government Area, *refer Figure 1.*

The site adjoins Bower Road on north eastern boundary and Mickan Road on the south eastern boundary. An unformed road, Junction Road, runs north-south through the site.

The site is zoned Rural and is currently used for grazing. Patches of native vegetation are located within the site and along adjoining roads. Agriculture is the predominant land use in the surrounding area.

[1] Large-Scale Solar Energy Guideline, 2022, NSW Government
[2] Solar Energy Facilities Design and Development Guidelines, 2019, Victoria State Government

Figure 1. Location Plan

The site adjoins Bower Road on north eastern boundary and Mickan Road on the south eastern boundary. An unformed road, Junction Road, runs north-south through the site.

The site is zoned Rural and is currently used for grazing. Patches of native vegetation are located within the site and along adjoining roads. Agriculture is the predominant land use in the surrounding area.

2. SCOPE OF THE ASSESSMENT

The scope of this Glint and Glare Impact Assessment includes the following:

- Description of the methodology used to undertake the study;
- Assessment of the baseline conditions;
- Description of the elements of the Project with the potential to influence glare including size, height, angle and rotation of PV modules, and tracking system operation;
- Identification of the viewshed and potential visibility of the Project;
- Desktop mapping of potential glare at the location of sensitive receptors within the viewshed, based on Solar Glare Hazard Analysis and viewshed analysis;
- Assessment of the potential glare hazard affecting sensitive receptors during operation of the Project; and
- Assessment of potential mitigations measures to avoid, mitigate, or manage potential impacts.

3. METHODOLOGY

3.1. Glint and Glare Definitions

Glint and glare refers to the human experience of reflected light.

This study utilises the Solar Glare Hazard Analysis Tool (SGHAT) software developed in the USA to address policy adherence required for the 2013 U.S. Federal Aviation Administration (FAA) Interim Policy 78 FR 63276. The FAA definitions of glint and glare are as follows:

"Reflectivity refers to light that is reflected off surfaces. The potential effects of reflectivity are glint (a momentary flash of bright light) and glare (a continuous source of bright light). These two effects are referred to hereinafter as "glare," which can cause a brief loss of vision, also known as flash blindness."[3]

This definition of glint and glare is consistent with the NSW Guidelines definition:

"Glint (a momentary flash of light) and glare (a continuous, excessive brightness)".

For the purpose of this study the term 'glare' is used in reference to both glint and glare resulting from direct solar reflectivity from PV modules, measurable in duration over minutes (1 minute intervals throughout the year).

3.2. Solar glare Assessment Parameters

Solar glare assessment modelling for solar farms is based on the following factors:

- the tilt, orientation, and optical properties of the PV modules in the solar array;
- sun position over time, taking into account geographic location;
- the location of sensitive receivers (dwellings, roads, rail, and aviation facilities); and
- Screening potential of surrounding topography, vegetation and buildings.

3.3. Glare Intensity Categories

The potential hazard from solar glare is a function of retinal irradiance (power of electromagnetic radiation per unit area produced by the sun) and the subtended angle (size, distance, and geometry) of the glare source.[4]

Glare can be broadly classified into three categories: low potential for after-image (referred to as "Green Glare" in SGHAT), potential for after-image (referred to as "Yellow Glare" in SGHAT), and potential for permanent eye damage (referred to as "Red Glare" in SGHAT), *Figure 2* illustrates the glare intensity categories used in this study.

[3] Federal Aviation Administration, Version 1.1 April 2018, Technical Guidance for Evaluating Selected Solar Technologies on Airports
[4] HO, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare hazards from Concentrated Solar Power Plants

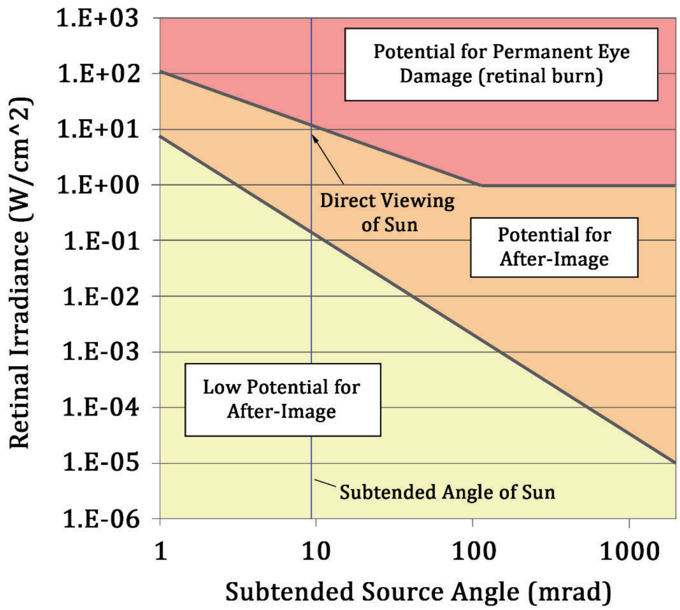


Figure 2. Ocular impacts and Hazard Ranges[5]

The amount of light reflected from a PV module depends on the amount of sunlight hitting the surface, as well as the surface reflectivity. The amount of sunlight interacting with the PV module will vary based on geographic location, time of year, cloud cover, and PV module orientation. 1000W/m^2 is generally used in most counties as an estimate of the solar energy interacting with a PV module when no other information is available. This study modelled scenarios using 2000 W/m^2 (Direct Normal Irradiance (DNI) peak) in order to cover potentially higher solar energy levels in Australia as compared to other parts of the world[6]. Flash blindness for a period of 4-12 seconds (i.e. time to recovery of vision) occurs when 7-11 W/m^2 (or 650-1,100 lumens/m^2) reaches the eye[7].

3.4. Reflection and Angle of Incidence

PV modules are designed to maximise the absorption of solar energy and therefore minimise the extent of solar energy reflected. PV modules have low levels of reflectivity between 0.03 and 0.20 depending on the specific materials, anti-reflective coatings, and angle of incidence.[8]

The higher reflectivity values of 0.20, that is 20% of incident light being reflected, can occur when the angle of incidence is greater than 50°. *Figure 3 and 4* show the relationship between increased angles of incidence and increased levels of reflected light. Where the angle of incidence remains below 50° the amount of reflected light remains below 10%. The angle of incidence is particularly relevant to specular reflection (light reflection from a smooth surface). Diffuse reflection (light reflection from a rough surface) may also occur in PV modules, however this is typically a result of dust or similar materials building up on the PV module surface, which would potentially reduce the reflection.

[5] Source: Solar Glare Hazard Analysis Tool (SGHAT) Presentation (2013) https://share.sandia.gov/phlux/static/references/glint-glare/SGHAT_Ho.pdf
[6] Global Solar Atlas 2.0, Solar resource data: Solargis
[7] Sandia National Laboratory, SGHAT Technical Manual
[8] *Ho, C. 2013 Relieving a Glare Problem*

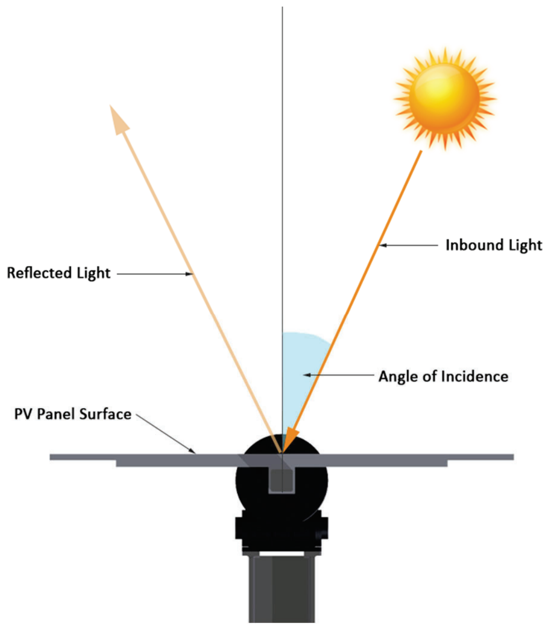


Figure 3. Angle of Incidence Relative to PV Panel Surface

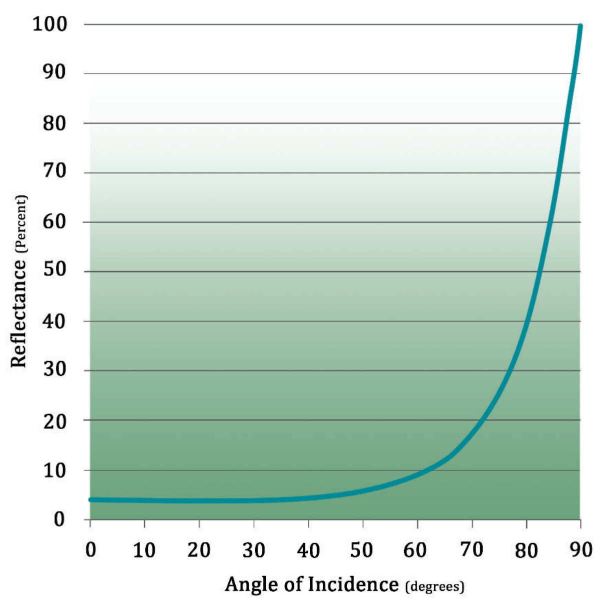


Figure 4. Angles of Incidence and Increased Levels of Reflected Light (Glass (n-1.5))

In a fixed PV solar array, the angle of incidence varies as the sun moves across the sky, that is the angle of incidence are at their lowest around noon where the sun is directly overhead, and increase in the early mornings and late evenings as the incidence angles increase. If the PV array is mounted on a tracking system, this variation is reduced because the panel is rotated to remain perpendicular to the sun. Therefore a PV modular array using a tracking system has less potential to cause glare whilst it tracks the sun. *Figure 5* illustrates a PV module mounted horizontal single axis tracking system following the east to west path of the sun.

A single axis tracking system has a fixed maximum angle of rotation, once the tracking mechanism reaches this maximum angle, the PV modules position relative to the sun becomes fixed and therefore the angle of incidence increases and the potential for glare increases. Some tracking systems utilise 'backtracking' to avoid PV modules over-shadowing each other. During the backtracking procedure (early morning and late afternoon) the tracking system begins to rotate away from the sun to reduce shadow casting to adjoining PV panels, *refer Figure 6*. During the backtracking phase, higher angles of incidence will occur in comparison to the tracking phase, and this may increase the potential for glare.

Tracking systems operate from a set resting angle, resting angles define the final angle at the beginning and end of the backtracking cycle. Generally resting angles range between 0 and 30 degrees, depending on the type of system used and the site requirements. A slight angle (5 degrees) is commonly used to allow rain and dew to sheet off the panels, some systems use higher angles in more extreme climatic conditions. Shallow resting angles increase the angle of incidence between the sun and PV model, therefore the shallower the angle the more likely glare may occur.

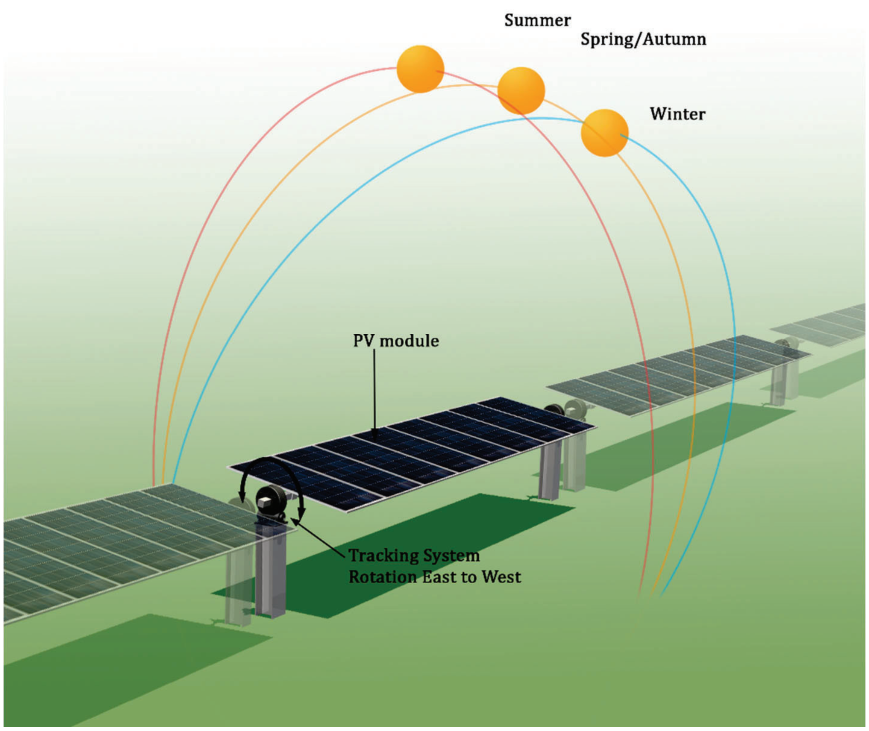


Figure 5. Diagrammatic illustration of sun position relative to PV module mounted on a horizontal single axis tracking system.

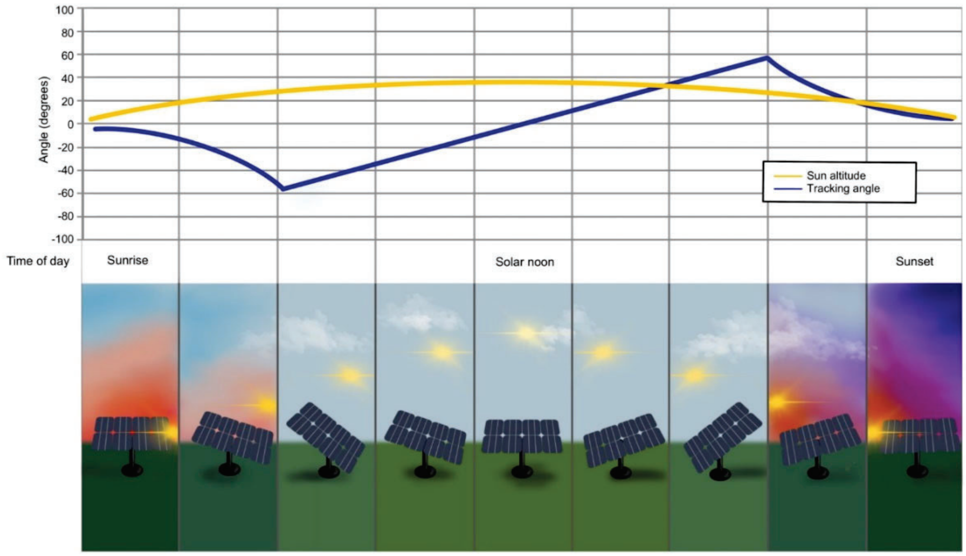


Figure 6. Diagrammatic illustration of a backtracking procedure for a horizontal single axis tracking system. (Source: ForgeSolar).

3.5. Viewshed Analysis

A desktop viewshed analysis was undertaken using ArcGIS 3D modelling. The extent of visibility of the proposed solar farm was assessed relative to the location of sensitive receptors (dwellings, roads, etc.) The desktop viewshed analysis is based on topography only and does not take into consideration existing vegetation.

3.6. Solar Glare Hazard Analysis

This assessment has utilised the Solar Glare Hazard Analysis Tool (SGHAT 2024A) co-developed by Sandi National Laboratory[9] and ForgeSolar (Sim Industries) (referred to as GlareGauge) to assess potential glare utilising latitude and longitudinal coordinates, elevation, sun position, and vector calculations. The PV module orientation, reflectance environment and ocular factors are also considered by the software. If potential glare is identified by the model, the tool calculates the retinal irradiance and subtended angle (size/distance) of the glare source to predict potential ocular hazards according to the glare intensity categories (refer *Section 3.3*).

The sun position algorithm used by SGHAT calculates the sun position in two forms: first as a unit vector extending from the Cartesian origin toward the sun, and second as azimuthal and altitudinal angles. The algorithm enables determination of the sun position at one (1) minute intervals throughout the year.

The SGHAT is a high level tool and does not take into consideration the following factors:

- Gaps between PV modules; and
- Atmospheric conditions.

[9] https://share.sandia.gov/phlux/static/references/glint-glare/SGHAT_Technical_Reference-v5.pdf

Updated SGHAT analysis now includes the ability to include ‘obstructions’ in the modelling (such as vegetation and buildings). This feature was not used as part of this assessment since detailed information on the screening height and density of existing vegetation was not available at the time of the assessment.

Backtracking

A single axis horizontal tracking system can be programed to operate a ‘backtracking’ procedure (*refer section 3.4*). Backtracking algorithms are becoming increasingly sophisticated with each system optimised dependent on individual project parameters including; distance between panels, width of each panel, incidence angle of the sun, field slope angle, and local weather (wind loading).

SGHAT software includes a backtracking feature which can be used to simulate various backtracking strategies, outputs of the model including tracking data detailing the range of rotation over time. The backtracking feature simulates a generic operation based on the models parameters, this may deviate from the project specific system design. The backtracking feature is used to model the glare implications of operating a backtracking procedure and provide guidance on the parameters required to operate the procedure without causing glare impacts to sensitive receptors.

Observation Point Receptor (OP)

In SGHAT modelling the Observation Point receptor ("OP") simulates an observer at a single, discrete location, defined by a latitude, longitude, elevation, and height above ground. OPs generally define the location of a residential receiver (dwelling) and are subscribed a unique number in the modelling. In addition, an OP can be marked to represent an Air Traffic Control Tower ("ATCT") for aviation purposes.

Route Parameters

The assessment of potential glare impacts to route receptors, people travelling along roads and rail, includes the parameters of direction of travel (single or both directions) and field-of-view (FOV). FOV defines the left and right field-of-view of observers traveling along a route. A view angle of 90° means the observer has a field-of-view of 90° to their left and right, i.e. a total FOV of 180°, refer *Figure 7.*

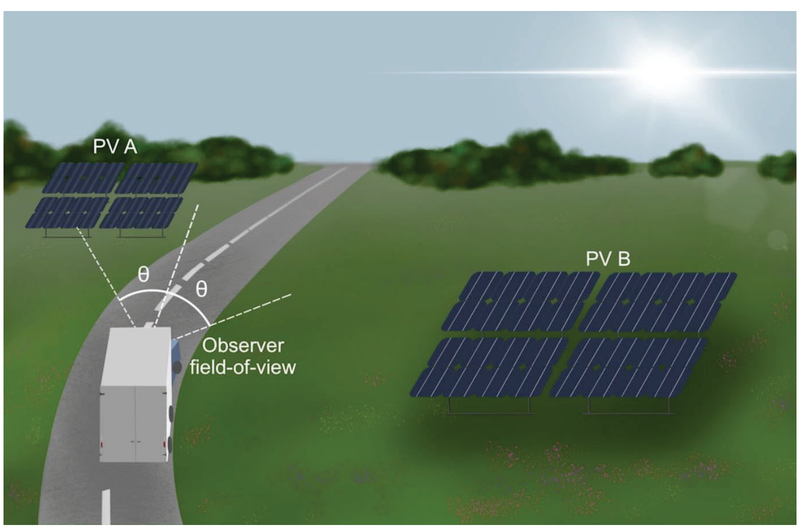


Figure 7. Diagrammatic illustration of Observer Field of View relative to PV array (source: ForgeSolar).

FAA research has identified ‘impairment ratings’ based on simulations of glare at various angles and duration, and the effect on a pilot’s ability to fly a plane[10]. The research identified impairment was highest

[10] https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/2010s/media/201512.pdf

when the glare source was within a FOV of 25° or less. The impact of glare fell below 'slight impairment' rating when the glare source was at an angle of 50° from the direction of travel. When the glare source was located at an angle of 90° the impairment rating reduced further.

SGHAT default parameter for FOV is 50°, this assessment used an FOV of 90°, representing a conservative assessment of potential glare hazard to drivers using the road network within the vicinity of the solar farm.

3.7. Hazard Assessment

Once the potential for solar glare has been identified through the viewshed analysis and SGHAT, which is based on topography only, an assessment of the likelihood of glare hazard occurring is undertaken, taking into consideration existing mitigating factors such as existing vegetation, buildings, and minor topographic variations outside the parameters of the modelling. Embedded mitigation measures, such as proposed vegetation screens to be undertaken as part of the Project, are also considered to identify residual glare potential.

Where required, additional mitigation measures, beyond those previously considered as part of the Project, are recommended to avoid, reduce or manage the identified risks.

3.8. Limitations to the assessment

This desktop assessment is based on a geometric analysis of potential glare using SGHAT software modelling. The parameters of the modelling are based on the default values within the software. Where these values have been altered (generally increased), this has been noted in the assessment.

The assessment considers potential impacts of solar glare under normal operational procedures, potential impacts during construction and non-operational events have not been assessed.

Field tests has not been undertaken as part of the assessment, therefore the modelling is reliant on the algorithms contained in the software.

SGHAT software is used under license to Sims Industries d/b/a ForgeSolar, refer to assumptions and limitations listed in the data output (Appendices) and for further information refer to www.forgesolar.com/help/.

Environmental Ethos does not verify the accuracy of the SGHAT software modelling. Responsibility and accountability for the accuracy of the SGHAT software (GlareGauge) resides with Sims Industries d/b/a ForgeSolar.

4. EXISTING CONDITIONS

The baseline is a statement of the characteristics which currently exist in the Project area. The baseline glare condition assessment takes into consideration the following:

- Characteristics of the environment that may affect the potential for glare;
- Land use and human modifications to the landscape such as roads, buildings and existing infrastructure which may influence glare and sensitivity to glare.

4.1. Baseline Conditions

The baseline conditions within the Project site are characteristic of the surrounding rural region, being gently undulating grazing land with patches of native vegetation.

The surrounding area is sparsely populated with rural dwelling scattered through the landscape, the highest concentration of dwellings are located to the south-west of the Project site.

Roads in proximity to the site are unsealed local roads including; Schulz Road, Bower Road, Mickan Road, Back Road, and Australia Plains (Emmaus) Road. An unformed road identified as Junction Road runs north-south through the site. The road corridor may be closed in the future as a result of the Project.

There are no aviation facilities within 5km of the Project.

There are no railway lines within 1km of the Project

There are no existing features in the landscape with the potential to contribute to glare.

4.2. Atmospheric Conditions

Atmospheric conditions such as cloud cover, dust and haze will impact light reflection, however these factors have not been accounted for in this glare assessment. The Bureau of Meteorology statistics for Eudunda 14km southwest of the Project site (the closest BOM records for cloud cover statistics) recorded 108.6 cloudy days per year (mean number over the period 1965 to 2010)[11]. Since atmospheric conditions have not been factored into this assessment modelling, statistically the glare potential represents a conservative assessment.

5. PROJECT DESCRIPTION

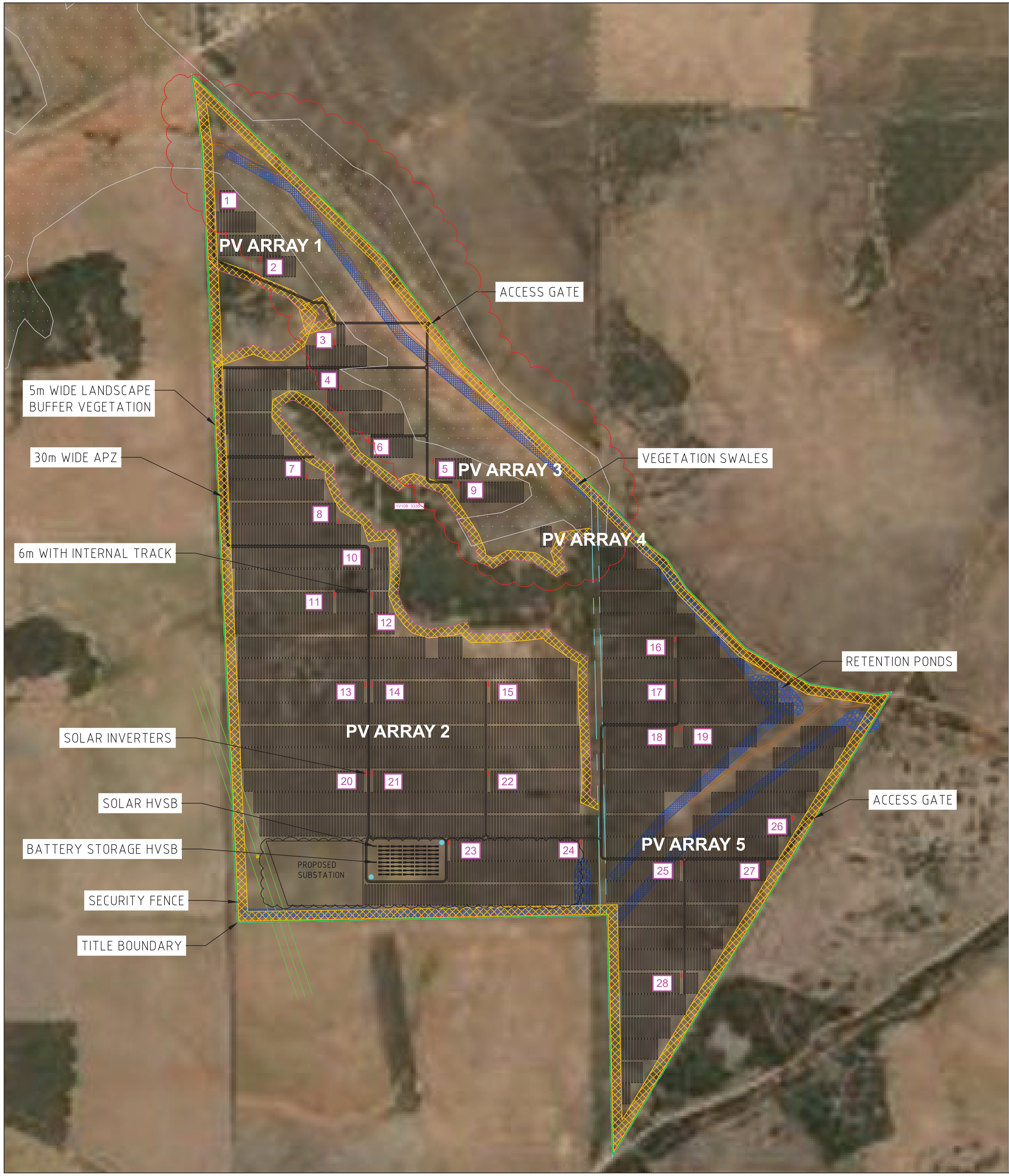
The general layout of the Project is as shown in *Figure 8.* The main elements of the solar farm with the potential to influence glare are the tilt, orientation, and optical properties of the PV modules in the solar array, and the rotational capabilities of the system. Whilst specific products are yet to be determined for the Project, the general technical properties of the main elements influencing glare are described below.

5.1. PV modules

PV modules aligned in portrait layout are currently proposed for the Project. The approximate dimensions for a typical solar panel is 2 metres x 1 metre. The proposed PV panel arrangement for this Project is two (2) solar panel in portrait, resulting in a maximum array width of approximately 4.06 metres.

Reflectance values for the PV modules were based on the default values for smooth glass with anti-reflective coating contained in SGHAT, and vary dependent on the sun/module incidence angle (refer *Figure 9*).

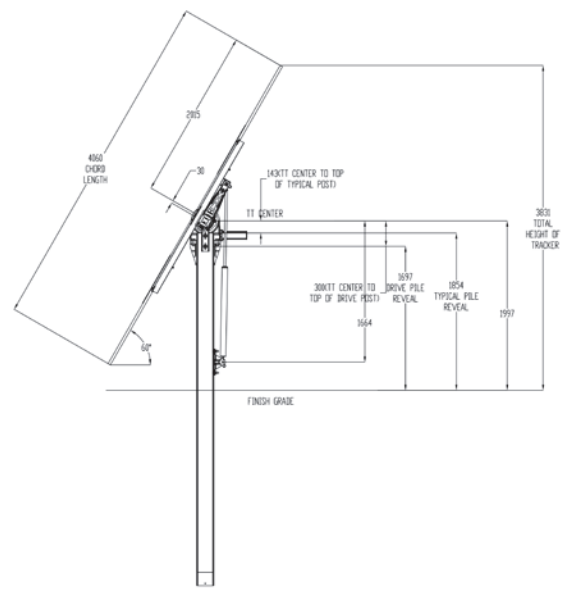
[11] http://www.bom.gov.au/climate/averages/tables/cw_024511.shtml



NOTE: PV ARRAY NUMBERS REFERS TO NUMBERING IN THE GLARE MODELLING AND SGHAT RESULTS.

NOTES

1. ACTUAL DIMENSIONS AND CLEARANCES MAY VARY SUBJECT TO SITE CONDITIONS.
2. DIMENSIONS OF ELECTRICAL EQUIPMENT ARE INDICATIVE ONLY. ACTUAL DIMENSIONS TO BE CONFIRMED.
3. EXISTING SAPN POLE IS FOR ILLUSTRATION ONLY. ACTUAL POSITION IS SUBJECT TO THE ACTUAL MEASUREMENT ON SITE.
4. TWO NEW POLES WILL BE INSTALLED TO CARRY OVERHEAD TRANSMISSION LINES AND CONNECT TO ESSENTIAL ENERGY NETWORK.
5. SITE STORAGE AND AMENITY FACILITIES TO BE ON SITE ONLY DURING CONSTRUCTION PHASE. NO PERMANENT BUILDINGS TO BE KEPT ON SITE AFTER CONSTRUCTION COMPLETED.
6. A TURNKEY BATTERY PCU CONSISTS OF 2 INVERTER MODULES AND 1 TRANSFORMER.



TYPICAL 2P ARRAY SECTION

ENVIRONMENTAL ETHOS

LEGEND

- PROPOSED PV ARRAY
- SECURITY FENCE
- PROPERTY BOUNDARY
- RESERVED AREA FOR VEGETATION
- POTENTIAL WATER PATHS
- ELECTRANET EASEMENT
- VEGETATION SWALES
- STORMWATER RETENTION PONDS
- FIREFIGHTING WATER TANKS
- ASSET PROTECTION ZONE
- INUNDATION ZONE

SOURCE: Green Gold Energy
Lot 315 Bower Road Australia Plains
SITE PLAN
REV. L 02/09/2024

PROJECT NO. 24010
CREATED BY: SC
DATE: 03/09/2024 VERSION: B

AUSTRALIA PLAINS SOLAR PROJECT
GLINT AND GLARE IMPACT ASSESSMENT

PROJECT LAYOUT PLAN

FIGURE 8.0

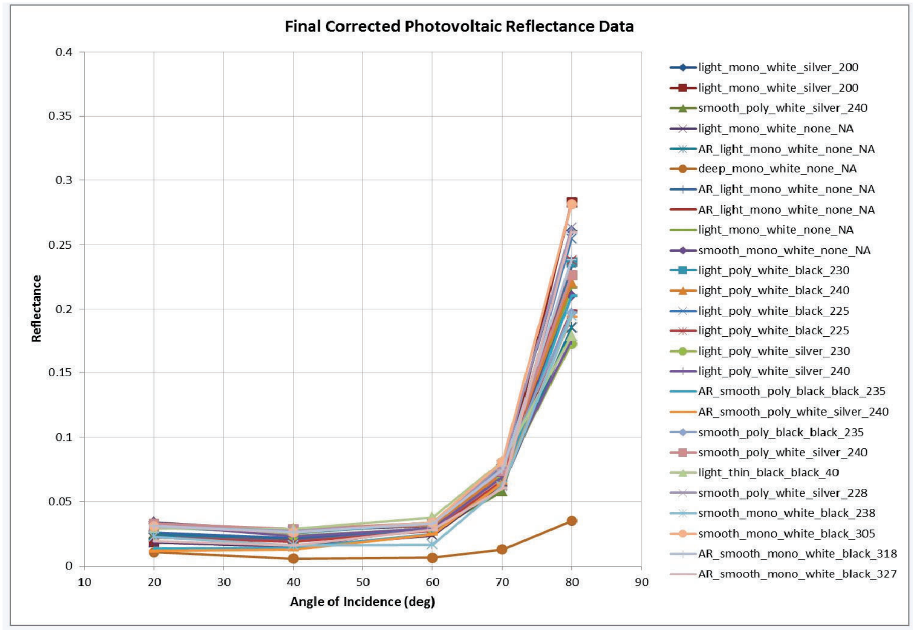


Figure 9. Photovoltaic Reflectance Data (Source Yellowhair[12])

5.2. Horizontal single axis tracking system

The Project will use a horizontal single axis tracking system aligned north-south, with a maximum rotation range of 120° (+/- 60°). The zenith tilt angle of the panels was assumed to be set at zero, that is, the panels are not tilted on a north–south alignment but remain horizontal along the plane of the tracker.

The height of the PV tracking system will depend on the final design, the current proposal is a maximum height to centroid of 2m and maximum height at full rotation 3.83m.

The configuration of the tracking system rows vary slightly dependent on the type of system used, generally rows are approximately 6 metres apart.

5.3. Associated infrastructure

In addition to the PV arrays, the Project will also include a BESS, electrical substation, solar inverters, and perimeter fencing. These elements do not generally create specular reflection as they comprise of non-reflective surfaces typically found in the built environment. The potential impact of these elements on visual amenity is considered in the Landscape and Visual Impact Assessment.

5.4. Landscape Screening

A 5m wide landscape buffer is proposed around the perimeter of the Project, with proposed planting sufficient to provide visual screening once established, refer to the Proposed Landscape Plan prepared by Landskap.

[12] Yellowhair, J. and C.K. Ho. "Assessment of Photovoltaic Surface Texturing on Transmittance Effects and Glint/Glare Impacts". *ASME 2015 9th International Conference on Energy Sustainability collocated with the ASME 2015 Power Conference*

6. DESKTOP GLARE ASSESSMENT

The aim of the desktop glare assessment is to identify if any sensitive receptors have the potential to be impacted by glare. The software modelling systems used in the desktop assessment include viewshed modelling to identify the location of sensitive receptors with line of sight to the Project, and the SGHAT to identify the potential and ocular significance of glare.

6.1. Viewshed Analysis

The results of the viewshed analysis (based on topography) are shown in *Figure 10.*

The Digital Elevation Model (DEM) for the viewshed modelling was set as 'Finest' (> 10 m). The viewshed analysis focussed on potential visibility of the Project within 3km of the site.

Contour information for the site shows the Project site is located within a gently undulating landscape. Visibility to the north-east and south-west of the site is fragmented due to the undulating topography.

Nine residential receivers were identified within the viewshed of the Project. All residential receiver locations and numbers shown in *Figure 10* are consist with the observation points (OP) in the glare modelling results provided in *Appendix A*. Additional rural properties were identified within 3km of the site but are considered outside the viewshed, these were included in the glare modelling as a conservative assessment approach.

The following roads pass through the viewshed and these were included in the glare modelling (both directions of travel) as follows:

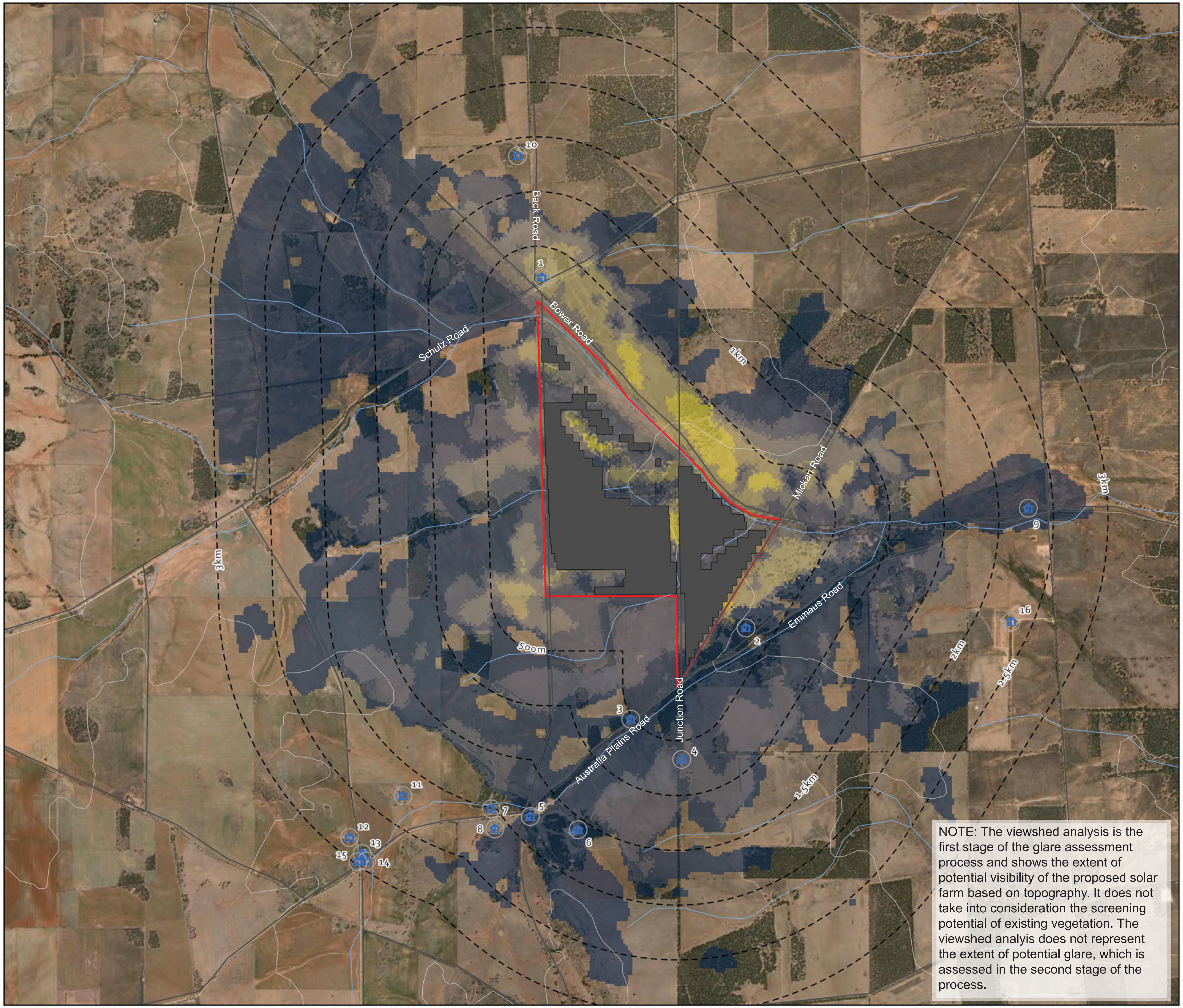
- Schulz Road
- Mickan Road
- Bower Road
- Back Road
- Australia Plains/Emmaus Road
- Junction Road (unformed road corridor)

The potential glare hazard impact for travellers along surrounding roads and highway were assessed for the sections of roads within a minimum 1km radius of the Project site

There is no railway infrastructure within the Project viewshed.

6.2. Solar Glare Hazard Analysis

The parameters used in the SGHAT model are detailed in *Table 1.*



NOTE: The viewshed analysis is the first stage of the glare assessment process and shows the extent of potential visibility of the proposed solar farm based on topography. It does not take into consideration the screening potential of existing vegetation. The viewshed analysis does not represent the extent of potential glare, which is assessed in the second stage of the process.

ENVIRONMENTAL ETHOS

N

DATUM GDA 1994,
PROJECTION MGA ZONE 56

0 0.5 1 2 Kilometers

SCALE 1:40,000 @ A3

Legend

- SITE BOUNDARY
- PV MODULE AREA
- DISTANCE FROM SOLAR FARM
- DWELLINGS

EXTENT OF VISIBILITY*

LESS VISIBLE

MORE VISIBLE

*(Analysis based on Digital Terrain Model)

*RURAL DWELLING LOCATIONS BASED ON DESKTOP ASSESSMENT GROUND-TRUTHING EXCLUDED

PROJECT No. 24010
CREATED BY: SC
DATE: 17 07 2024
VERSION: A

AUSTRALIA PLAINS SOLAR FARM

GLINT AND GLARE ASSESSMENT

VIEWSHED ANALYSIS

FIGURE 10.0

Table 1. Input data for SGHAT Analysis – Single Axis Tracking System

SGHAT Model Parameters	Values
Time Zone	UTC +9
Axis Tracking	Horizontal Single Axis
Backtracking	Shade slope (undulating land)
Tilt of tracking axis	0 (Parallel to ground)
Orientation of tracking axis	0
Offset angle of module	0
Module Surface material	Smooth glass with anti-reflective coating (ARC)
Maximum tracking angle	60 degrees
Resting (Stowing) angle	5 and 6 degrees
Reflectivity	Vary with sun
Correlate slope error with surface type?	Yes
Slope error	8.43 mrad
Height of panels above ground	2.0m to centroid

The glare modelling was compartmentalised into five groups of arrays due to the size and shape of the proposed solar farm, the numbering of PV Arrays detailed in *Appendix A and B* correspond to numbering in *Figure 8*.

Two tracking scenarios were investigated in the glare modelling based on different resting angles (PV Array 5 scenarios for 5 degrees and 6 degrees). Extracts from the SGHAT Component Data Files for the two modelled tracking/backtracking scenarios for summer and winter solstice are outlined in *Figures 11 to 14*.

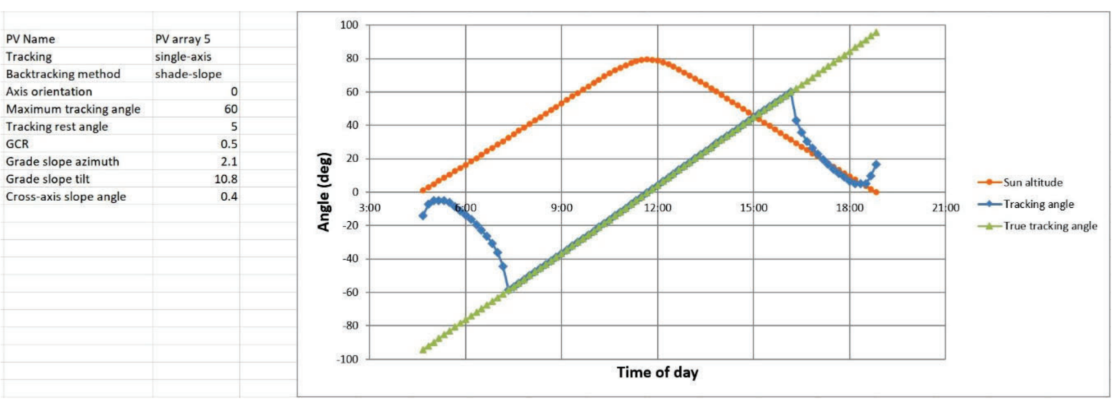


Figure 11. PV Array 5 tracking/backtracking angle per time slot –resting angle 5 degrees mid- summer

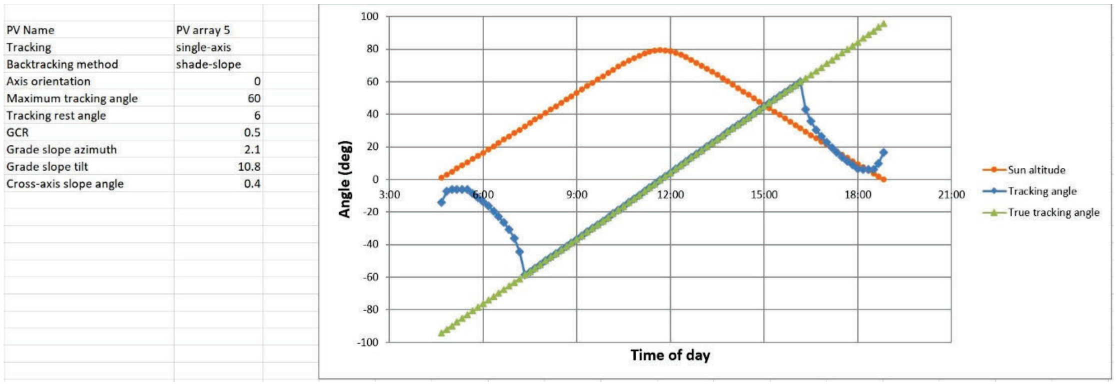


Figure 12. PV Array 5 tracking/backtracking angle per time slot – resting angle 6 degrees mid- summer

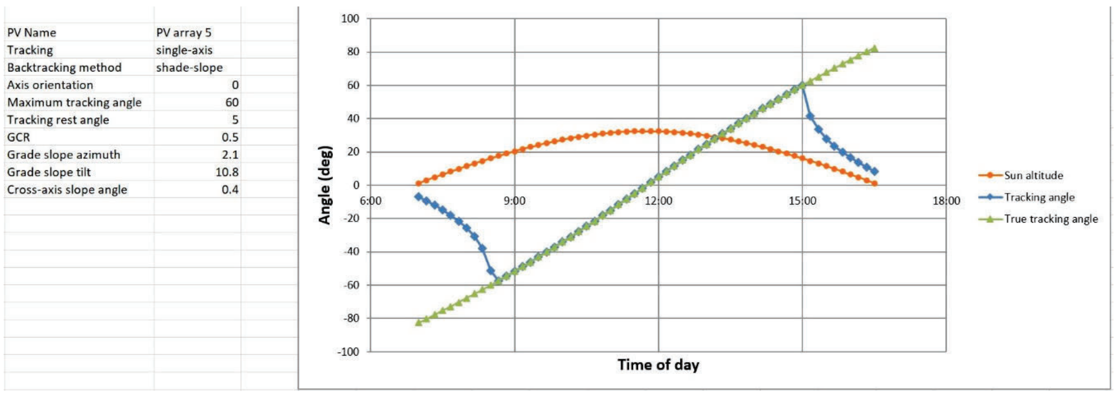


Figure 13. PV Array 5 tracking/backtracking angle per time slot – resting angle 5 degrees mid- winter

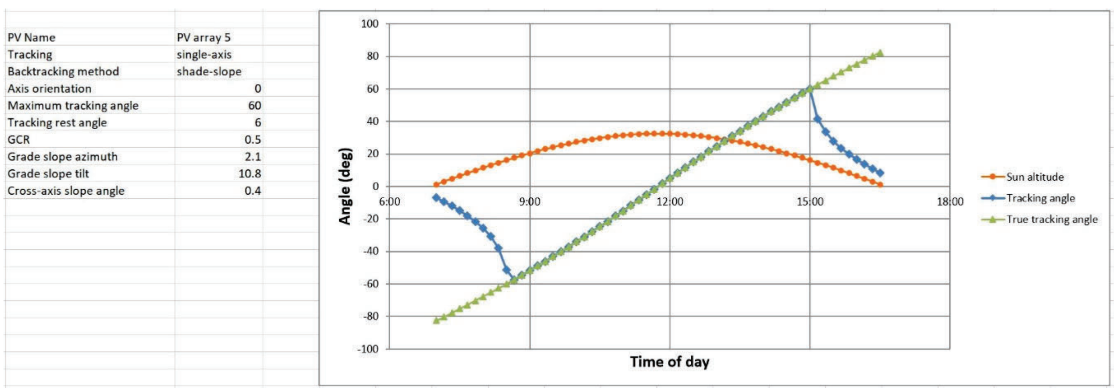


Figure 14. PV Array 5 tracking/backtracking angle per time slot – resting angle 6 degrees mid- winter

7. POTENTIAL IMPACTS

7.1. Solar Glare Hazard Analysis Tool (SGHAT) Results

The assessment outcomes for the SGHAT modelling are detailed in *Table 2.*

Table 2. SGHAT Assessment Results – Single Axis Tracking System

Sensitive Receptor	Resting Angle 5 degrees	Resting Angle 6 degrees
Rural Dwellings within the Project viewshed up to 3km from the site	No Glare	No Glare
Schulz Road	Glare Potential (Green)*	No Glare
Bower Road	No Glare	No Glare
Mickan Road	Glare Potential (Yellow and Green)*	No Glare
Back Road	No Glare	No Glare
Australia Plains/Emmaus Road	No Glare	No Glare
Junction Road (unformed road corridor)	Glare Potential (Yellow and Green)*	Glare Potential (Yellow and Green)*

*Green Glare = Glare with a low potential to cause temporary after-image
Yellow = Glare with potential to cause temporary after-image

The SGHAT modelling found no glare is likely to affect residential dwellings within 3km of the Project site, *refer Appendix A and B*.

Glare potential was identified for PV Array 3 and 5 affecting Mickan Road, Schulz Road, and the unformed Junction Road, when the backtracking resting angle is set to 5 degrees. When the resting angle for PV Array 5 was adjusted to 6 degrees no glare was identified for Mickan Road and Schulz Road, however glare hazard remains a potential issue on the unformed Junction road, *refer Appendix A and B*.

7.2. Existing Mitigation Factors

Junction Road is currently a road corridor with no formed road surface and a single dirt track weaving through remnant native trees within the corridor. The road corridor passes through the middle of the site with proposed solar arrays on either side. The proposed solar farm perimeter fence is currently shown straddling the road corridor and therefore restricting access. As Junction Road is unformed and the Project will curtail access along the road corridor during the life of the Project, the potential glare identified in this assessment is not considered likely to affect drivers of vehicles.

8. MANAGEMENT AND MITIGATION MEASURES

The SGHAT modelling identified that under normal operation of the solar farm tracking system, with a backtracking operation and minimum limit of 5 degree resting angle (being the fixed angle at which the backtracking process starts and finishes during daylight hours), no additional mitigation measures are required for PV Arrays 1 to 4 to manage the potential impacts of glare on receivers.

PV Array 5, which is located to the east of the Project site, generated a small amount of glare affecting Mickan Road and a very small amount of glare affecting Schulz Road. When the resting angle for this PV Array was adjusted to 6 degrees the potential glare hazard identified in the modelling was eliminated. Therefore the mitigation measures for PV Array 5 includes the requirement to limit the resting angle of the tracking system to a minimum 6 degrees.

Screen planting and the retention of areas of existing vegetation is proposed as part of the Project development, refer to Project Landscape Plan. When the screen planting has become established to a height and density sufficient to block line of site to the Project from Mickan Road and Schulz Road, the requirement to limit the resting angle of the tracking system for PV Array 5 to 6 degrees (minimum) would no longer apply.

The Project Environmental Management Plan (EMP) should detail glare management measures required to avoid impacts to receivers, including the limits recommended in this report regarding resting angles. In addition, monitoring of glare hazard potential is required and a process for managing complaints, including rectification, should be included in the Project EMP.

9. SUMMARY OF RESULTS

In summary, based on the assumptions and parameters of this desktop assessment, the following results were identified:

- The assessment identified no aviation facilities within 5km of the Project, and no railway infrastructure within 1km of the Project.
- Within 3km of the Project, nine residential receivers were identified in the viewshed model as having potential line of sight to the Project (based on the terrain model).
- The viewshed modelling also identified the five (5) local roads as having potential line of sight to the Project, and an unformed road corridor.
- Glare (SGHAT) modelling identified that under normal operation of the solar farm with a tracking/backtracking operation and a minimum limit of 5 degree resting angle (being the fixed angle at which the backtracking process starts and finishes during daylight hours), no potential glare hazard impacts were identified as affecting residential receivers within 3km of the Project site.
- Glare (SGHAT) modelling also identified no potential glare hazard affecting Bower Road, Back Road, and Australia Plains / Emmaus Roads.
- PV Array 5, which is located to the east of the Project site, was identified as generating a small amount of glare affecting Mickan Road and a very small amount of glare affecting Schulz Road, when the resting angle was set at 5 degrees. Adjustment to a 6 degrees resting angle eliminated potential glare in the modelling, therefore the mitigation measures for PV Array 5 includes the requirement to limit the resting angle of the tracking system to a minimum 6 degrees.
- Glare (SGHAT) modelling also identified potential glare affecting the unformed road corridor (Junction Road) generated by PV Arrays 3 and 5. As the Project will curtail access along the road corridor during the life of the Project, the potential glare identified in the modelling is not considered likely to affect drivers of vehicles.
- Screen planting and the retention of areas of existing vegetation is proposed as part of the Project development. When the screen planting has become established to a height and density sufficient to block line of site to the Project from Mickan Road and Schulz Road, the requirement to limit the resting angle of the tracking system for PV Array 5 to 6 degrees (minimum) would no longer apply.

- The Project EMP should detail glare management measures required to avoid impacts to sensitive receptors, including the limits recommended in this report regarding resting angles. In addition, monitoring of glare hazard potential is required and a process for managing complaints, including rectification, should be included in the Project EMP.

APPENDIX A:

SOLAR GLARE HAZARD ANALYSIS – RESIDENTIAL RECEIVERS AND ROADS RESTING ANGLE - 5 DEGREES

FORGESOLAR GLARE ANALYSIS

Project: **Australia Plains Solar Farm**
Site configuration: **Australia Plains Solar Farm**

Created 15 Jul, 2024
Updated 26 Jul, 2024
Time-step 1 minute
Timezone offset UTC9
Minimum sun altitude 0.0 deg
DNI peaks at 2,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 124100.21290

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

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

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	50	0.8	108	1.8	-
PV array 4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 5	SA tracking	SA tracking	7,394	123.2	22,934	382.2	-

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

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	7,250	120.8	22,853	380.9
Michan Road	40	0.7	188	3.1
Schulz Rd	154	2.6	1	0.0
OP 1	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

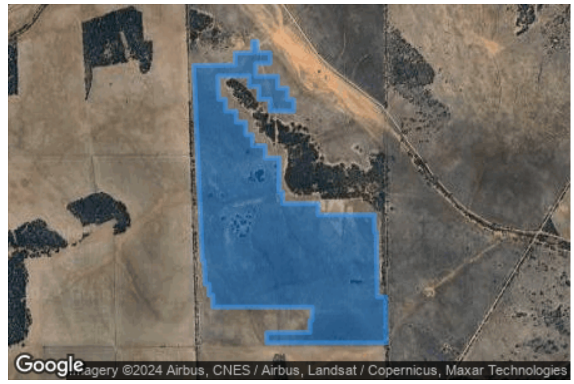
Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.054304	139.173936	257.52	2.00	259.52
2	-34.054304	139.174646	254.84	2.00	256.84
3	-34.054906	139.174658	255.73	2.00	257.73
4	-34.054905	139.175417	254.22	2.00	256.22
5	-34.055616	139.175427	256.27	2.00	258.27
6	-34.055627	139.176181	254.10	2.00	256.10
7	-34.056255	139.176198	254.93	2.00	256.93
8	-34.056257	139.176744	252.57	2.00	254.57
9	-34.056884	139.176769	253.34	2.00	255.34
10	-34.056882	139.175699	257.37	2.00	259.37
11	-34.056237	139.175691	257.12	2.00	259.12
12	-34.056251	139.173968	259.22	2.00	261.22

Name: PV array 2
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.059596	139.174152	260.73	2.00	262.73
2	-34.059565	139.176984	256.03	2.00	258.03
3	-34.058892	139.176993	253.45	2.00	255.45
4	-34.058868	139.178178	250.25	2.00	252.25
5	-34.058243	139.178181	250.82	2.00	252.82
6	-34.058241	139.178489	250.45	2.00	252.45
7	-34.058863	139.178500	249.81	2.00	251.81
8	-34.058872	139.179380	248.28	2.00	250.28
9	-34.059476	139.179390	249.04	2.00	251.04
10	-34.059485	139.178395	251.05	2.00	253.05
11	-34.060210	139.178409	253.05	2.00	255.05
12	-34.060196	139.179897	249.02	2.00	251.02
13	-34.060881	139.179913	249.55	2.00	251.55
14	-34.060885	139.180568	247.51	2.00	249.51
15	-34.061527	139.180568	249.42	2.00	251.42
16	-34.061534	139.181005	248.37	2.00	250.37
17	-34.062198	139.181005	250.96	2.00	252.96
18	-34.062181	139.179374	257.76	2.00	259.76
19	-34.061507	139.179369	254.30	2.00	256.30
20	-34.061505	139.178621	258.15	2.00	260.15
21	-34.060794	139.178607	254.73	2.00	256.73
22	-34.060785	139.177961	257.85	2.00	259.85
23	-34.060185	139.177958	254.91	2.00	256.91
24	-34.060196	139.175815	260.81	2.00	262.81
25	-34.061523	139.175863	263.83	2.00	265.83
26	-34.061521	139.176330	263.68	2.00	265.68
27	-34.062190	139.176333	263.34	2.00	265.34
28	-34.062194	139.177049	262.80	2.00	264.80
29	-34.062818	139.177070	261.42	2.00	263.42
30	-34.062816	139.177711	260.42	2.00	262.42
31	-34.063521	139.177725	259.40	2.00	261.40
32	-34.063529	139.178167	259.39	2.00	261.39
33	-34.064136	139.178189	258.00	2.00	260.00
34	-34.064147	139.179047	257.97	2.00	259.97
35	-34.064840	139.179052	256.48	2.00	258.48
36	-34.064838	139.180023	256.19	2.00	258.19
37	-34.066787	139.180018	253.00	2.00	255.00
38	-34.066782	139.180262	253.00	2.00	255.00
39	-34.067433	139.180262	253.29	2.00	255.29
40	-34.067442	139.182698	251.46	2.00	253.46
41	-34.068078	139.182690	253.23	2.00	255.23
42	-34.068078	139.186552	251.71	2.00	253.71
43	-34.069043	139.186549	255.84	2.00	257.84
44	-34.069043	139.186549	255.84	2.00	257.84
45	-34.069043	139.186549	255.84	2.00	257.84
46	-34.069043	139.186549	255.84	2.00	257.84
47	-34.069043	139.186549	255.84	2.00	257.84
48	-34.069043	139.186549	255.84	2.00	257.84
49	-34.069043	139.186549	255.84	2.00	257.84
50	-34.069055	139.186682	255.76	2.00	257.76
51	-34.069055	139.186682	255.76	2.00	257.76
52	-34.069055	139.186682	255.76	2.00	257.76
53	-34.069055	139.186682	255.76	2.00	257.76
54	-34.069055	139.186682	255.76	2.00	257.76
55	-34.069055	139.186682	255.76	2.00	257.76
56	-34.069055	139.186682	255.76	2.00	257.76
57	-34.072719	139.186740	253.24	2.00	255.24
58	-34.072719	139.187319	251.78	2.00	253.78
59	-34.075332	139.187351	250.09	2.00	252.09

Name: PV array 3
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.062198	139.181672	249.35	2.00	251.35
2	-34.062210	139.183062	248.34	2.00	250.34
3	-34.062885	139.183060	248.31	2.00	250.31
4	-34.062891	139.184698	244.72	2.00	246.72
5	-34.063505	139.184706	245.14	2.00	247.14
6	-34.063526	139.182531	249.82	2.00	251.82
7	-34.062829	139.182524	248.55	2.00	250.55
8	-34.062817	139.181679	251.12	2.00	253.12

Name: PV array 4
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.064203	139.185241	246.06	2.00	248.06
2	-34.064204	139.185792	245.59	2.00	247.59
3	-34.064810	139.185795	246.48	2.00	248.48
4	-34.064820	139.185252	247.28	2.00	249.28

Name: PV array 5
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

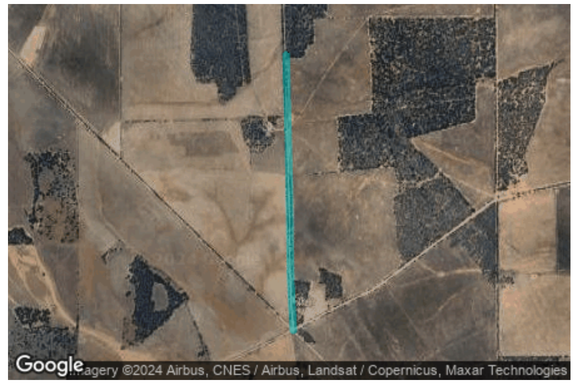
Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.064816	139.187526	245.42	2.00	247.42
2	-34.064812	139.188875	242.00	2.00	244.00
3	-34.065472	139.188886	241.34	2.00	243.34
4	-34.065469	139.189782	241.48	2.00	243.48
5	-34.066154	139.189782	240.20	2.00	242.20
6	-34.066165	139.190324	240.45	2.00	242.45
7	-34.066731	139.190326	239.11	2.00	241.11
8	-34.066747	139.190930	239.34	2.00	241.34
9	-34.067469	139.190946	239.52	2.00	241.52
10	-34.067476	139.191820	239.08	2.00	241.08
11	-34.068085	139.191823	239.46	2.00	241.46
12	-34.068096	139.192689	238.25	2.00	240.25
13	-34.068795	139.192695	239.21	2.00	241.21
14	-34.068795	139.194014	237.02	2.00	239.02
15	-34.069395	139.194020	237.01	2.00	239.01
16	-34.069404	139.194347	236.93	2.00	238.93
17	-34.070031	139.194341	236.82	2.00	238.82
18	-34.070020	139.193059	240.89	2.00	242.89
19	-34.070675	139.193070	241.80	2.00	243.80
20	-34.070662	139.192048	243.01	2.00	245.01
21	-34.071304	139.192054	242.07	2.00	244.07
22	-34.071277	139.191018	243.83	2.00	245.83
23	-34.071997	139.190973	243.48	2.00	245.48
24	-34.071988	139.189790	246.58	2.00	248.58
25	-34.073292	139.189803	248.10	2.00	250.10
26	-34.073295	139.190841	248.30	2.00	250.30
27	-34.072721	139.190839	244.99	2.00	246.99
28	-34.072711	139.191417	244.96	2.00	246.96
29	-34.072029	139.191401	243.00	2.00	245.00
30	-34.072023	139.192254	242.98	2.00	244.98
31	-34.071403	139.192254	242.07	2.00	244.07
32	-34.071387	139.193412	242.12	2.00	244.12
33	-34.070712	139.193403	240.99	2.00	242.99
34	-34.070702	139.194489	240.14	2.00	242.14
35	-34.070071	139.194481	236.84	2.00	238.84
36	-34.070089	139.196246	238.06	2.00	240.06
37	-34.070735	139.196257	239.62	2.00	241.62
38	-34.070740	139.195814	240.57	2.00	242.57
39	-34.071297	139.195822	241.69	2.00	243.69
40	-34.071302	139.195337	242.85	2.00	244.85
41	-34.072008	139.195337	243.96	2.00	245.96
42	-34.072002	139.194768	243.95	2.00	245.95
43	-34.072626	139.194773	244.00	2.00	246.00
44	-34.072619	139.194355	244.91	2.00	246.91
45	-34.073297	139.194344	247.16	2.00	249.16
46	-34.073304	139.193805	247.68	2.00	249.68
47	-34.074008	139.193818	250.89	2.00	252.89
48	-34.074019	139.193333	251.55	2.00	253.55
49	-34.074614	139.193354	254.98	2.00	256.98
50	-34.074628	139.192939	255.56	2.00	257.56
51	-34.075236	139.192957	258.26	2.00	260.26
52	-34.075241	139.192389	259.38	2.00	261.38
53	-34.075967	139.192389	261.56	2.00	263.56
54	-34.075972	139.191957	261.73	2.00	263.73
55	-34.076687	139.191957	261.99	2.00	263.99
56	-34.076692	139.191531	261.50	2.00	263.50
57	-34.077278	139.191517	260.71	2.00	262.71
58	-34.077276	139.190935	260.18	2.00	262.18
59	-34.077953	139.190954	259.70	2.00	261.70

Route Receptors

Name: Australia Plains - Emmaus Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.093697	139.169011	271.65	2.40	274.05
2	-34.093484	139.171908	270.49	2.40	272.89
3	-34.092595	139.173432	268.06	2.40	270.46
4	-34.092098	139.173797	268.24	2.40	270.64
5	-34.090250	139.176693	265.25	2.40	267.65
6	-34.088117	139.179054	263.87	2.40	266.27
7	-34.086571	139.181478	259.63	2.40	262.03
8	-34.086233	139.182380	257.96	2.40	260.36
9	-34.085878	139.182938	256.44	2.40	258.84
10	-34.081719	139.189375	252.79	2.40	255.19
11	-34.080742	139.192272	248.93	2.40	251.33
12	-34.079907	139.194074	248.47	2.40	250.87
13	-34.078698	139.195404	247.61	2.40	250.01
14	-34.078378	139.196692	244.46	2.40	246.86
15	-34.076921	139.198838	240.33	2.40	242.73
16	-34.076565	139.199717	240.40	2.40	242.80
17	-34.074699	139.202636	236.05	2.40	238.45
18	-34.073970	139.203580	235.46	2.40	237.86
19	-34.073793	139.205597	235.00	2.40	237.40
20	-34.072406	139.208386	233.00	2.40	235.40
21	-34.071269	139.213407	233.54	2.40	235.94
22	-34.069616	139.216283	221.30	2.40	223.70
23	-34.069473	139.220209	217.87	2.40	220.27
24	-34.068603	139.224179	215.90	2.40	218.30

Name: Back Road
Path type: Two-way
Observer view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.050381	139.173260	259.32	2.40	261.72
2	-34.049084	139.173174	264.89	2.40	267.29
3	-34.047359	139.173067	270.29	2.40	272.69
4	-34.041403	139.172960	275.26	2.40	277.66
5	-34.034735	139.172767	266.01	2.40	268.41

Name: Bower Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.040635	139.161298	277.07	2.40	279.47
2	-34.050396	139.173271	259.20	2.40	261.60
3	-34.053685	139.177300	250.01	2.40	252.41
4	-34.056050	139.180186	252.25	2.40	254.65
5	-34.059134	139.182803	247.95	2.40	250.35
6	-34.060103	139.184102	246.92	2.40	249.32
7	-34.061134	139.185818	245.69	2.40	248.09
8	-34.062103	139.187320	245.76	2.40	248.16
9	-34.063860	139.188811	242.36	2.40	244.76
10	-34.064829	139.189702	242.69	2.40	245.09
11	-34.065313	139.190195	242.22	2.40	244.62
12	-34.066039	139.190798	241.50	2.40	243.90
13	-34.067274	139.192182	238.98	2.40	241.38
14	-34.067879	139.193061	238.09	2.40	240.49
15	-34.068661	139.194660	237.00	2.40	239.40
16	-34.068892	139.195583	237.43	2.40	239.83
17	-34.069141	139.197836	235.79	2.40	238.19
18	-34.069976	139.201398	231.54	2.40	233.94
19	-34.069763	139.205088	230.81	2.40	233.21
20	-34.070171	139.206719	228.94	2.40	231.34
21	-34.070900	139.208243	230.69	2.40	233.09
22	-34.071220	139.208350	231.62	2.40	234.02
23	-34.072393	139.208543	232.61	2.40	235.01

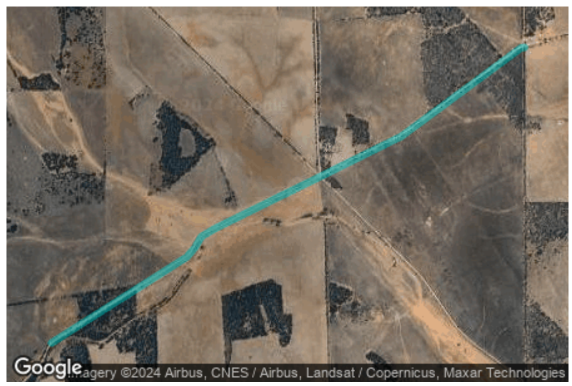
Name: Junction Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.089080	139.187501	271.37	2.40	273.77
2	-34.084220	139.187491	255.36	2.40	257.76
3	-34.083473	139.187705	253.13	2.40	255.53
3	-34.083473	139.187705	253.13	2.40	255.53
3	-34.083473	139.187705	253.13	2.40	255.53
3	-34.083473	139.187705	253.13	2.40	255.53
4	-34.082976	139.187555	253.06	2.40	255.46
5	-34.081566	139.187428	256.35	2.40	258.75
5	-34.081566	139.187428	256.35	2.40	258.75
5	-34.081566	139.187428	256.35	2.40	258.75
5	-34.081566	139.187428	256.35	2.40	258.75
6	-34.075339	139.187473	250.02	2.40	252.42
6	-34.075339	139.187473	250.02	2.40	252.42
6	-34.075339	139.187473	250.02	2.40	252.42
6	-34.075339	139.187473	250.02	2.40	252.42
7	-34.059027	139.187284	259.51	2.40	261.91
7	-34.059027	139.187284	259.51	2.40	261.91
7	-34.059027	139.187284	259.51	2.40	261.91
7	-34.059027	139.187284	259.51	2.40	261.91
8	-34.043295	139.187442	252.35	2.40	254.75

Name: Michan Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.082811	139.187582	253.31	2.40	255.71
2	-34.076995	139.191932	261.71	2.40	264.11
3	-34.069228	139.197780	235.54	2.40	237.94
4	-34.061976	139.203198	250.42	2.40	252.82
5	-34.058100	139.206095	241.48	2.40	243.88

Name: Schulz Rd
Path type: Two-way
Observer view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.059844	139.154792	270.00	2.40	272.40
2	-34.054973	139.164083	259.67	2.40	262.07
3	-34.054440	139.164641	259.50	2.40	261.90
4	-34.053800	139.165091	259.07	2.40	261.47
5	-34.053337	139.166057	258.29	2.40	260.69
6	-34.050457	139.173116	258.47	2.40	260.87
7	-34.048128	139.178803	272.82	2.40	275.22
8	-34.047506	139.179833	271.36	2.40	273.76
9	-34.043097	139.187043	253.17	2.40	255.57
10	-34.043061	139.187279	252.53	2.40	254.93

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-34.049295	139.173946	264.56	1.50
OP 2	2	-34.078133	139.194223	254.93	1.50
OP 3	3	-34.085650	139.182786	256.85	1.50
OP 4	4	-34.088937	139.187834	270.84	1.50
OP 5	5	-34.093622	139.172795	269.42	1.50
OP 6	6	-34.094724	139.177526	271.07	1.50
OP 7	7	-34.092964	139.168922	274.08	1.50
OP 8	8	-34.094599	139.169244	271.09	1.50
OP 9	9	-34.068310	139.222297	214.33	1.50
OP 10	10	-34.039251	139.171585	273.93	1.50
OP 11	11	-34.091972	139.160162	277.33	1.50
OP 12	12	-34.095411	139.154834	285.00	1.50
OP 13	13	-34.096735	139.156087	282.99	1.50
OP 14	14	-34.097326	139.156519	283.09	1.50
OP 15	15	-34.097386	139.155642	283.92	1.50
OP 16	16	-34.077745	139.220507	222.49	1.50

Glare Analysis Results

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

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	50	0.8	108	1.8	-
PV array 4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 5	SA tracking	SA tracking	7,394	123.2	22,934	382.2	-

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

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	7,250	120.8	22,853	380.9
Michan Road	40	0.7	188	3.1
Schulz Rd	154	2.6	1	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 1 and Route: Australia Plains - Emmaus Road

No glare found

PV array 1 and Route: Back Road

No glare found

PV array 1 and Route: Bower Road

No glare found

PV array 1 and Route: Junction Road

No glare found

PV array 1 and Route: Michan Road

No glare found

PV array 1 and Route: Schulz Rd

No glare found

PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 7

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 14

No glare found

PV array 1 and OP 15

No glare found

PV array 1 and OP 16

No glare found

PV: PV array 2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 2 and Route: Australia Plains - Emmaus Road

No glare found

PV array 2 and Route: Back Road

No glare found

PV array 2 and Route: Bower Road

No glare found

PV array 2 and Route: Junction Road

No glare found

PV array 2 and Route: Michan Road

No glare found

PV array 2 and Route: Schulz Rd

No glare found

PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 7

No glare found

PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 14

No glare found

PV array 2 and OP 15

No glare found

PV array 2 and OP 16

No glare found

PV: PV array 3 potential temporary after-image

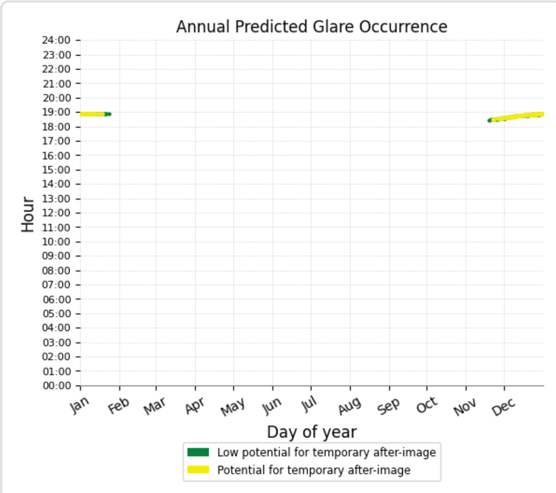
Receptor results ordered by category of glare

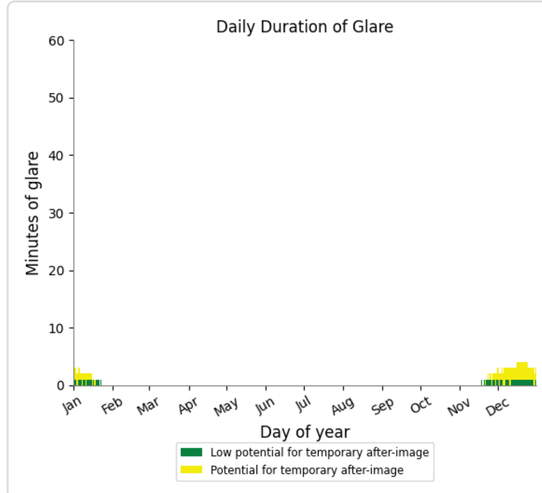
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Junction Road	50	0.8	108	1.8
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

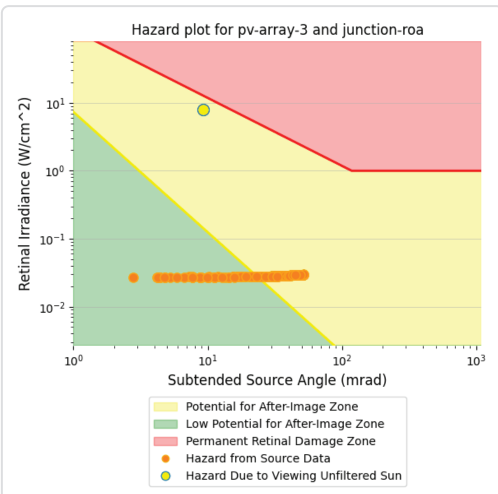
PV array 3 and Route: Junction Road

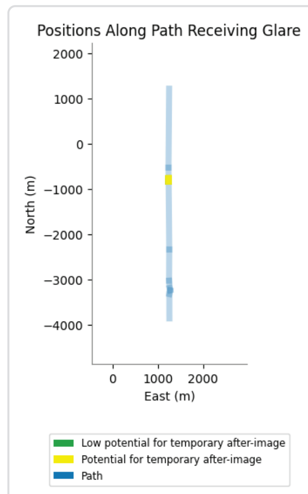
Yellow glare: 108 min.

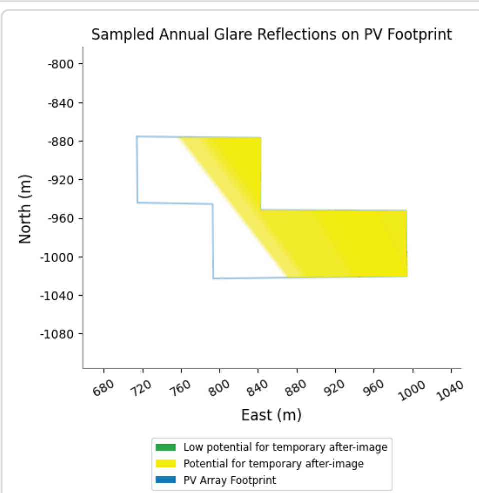
Green glare: 50 min.











PV array 3 and Route: Australia Plains - Emmaus Road

No glare found

PV array 3 and Route: Back Road

No glare found

PV array 3 and Route: Bower Road

No glare found

PV array 3 and Route: Michan Road

No glare found

PV array 3 and Route: Schulz Rd

No glare found

PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 14

No glare found

PV array 3 and OP 15

No glare found

PV array 3 and OP 16

No glare found

PV: PV array 4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 4 and Route: Australia Plains - Emmaus Road

No glare found

PV array 4 and Route: Back Road

No glare found

PV array 4 and Route: Bower Road

No glare found

PV array 4 and Route: Junction Road

No glare found

PV array 4 and Route: Michan Road

No glare found

PV array 4 and Route: Schulz Rd

No glare found

PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 3

No glare found

PV array 4 and OP 4

No glare found

PV array 4 and OP 5

No glare found

PV array 4 and OP 6

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 8

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 14

No glare found

PV array 4 and OP 15

No glare found

PV array 4 and OP 16

No glare found

PV: PV array 5 potential temporary after-image

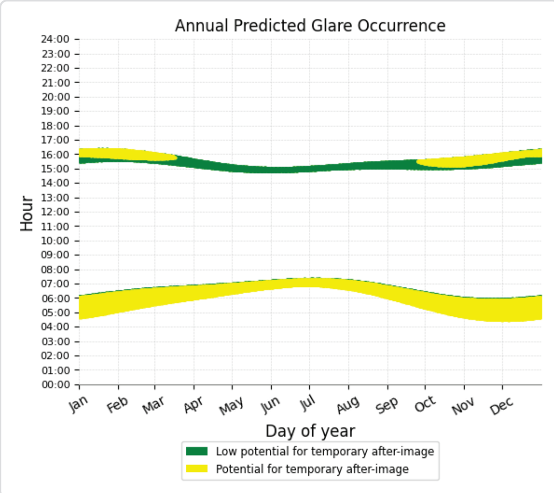
Receptor results ordered by category of glare

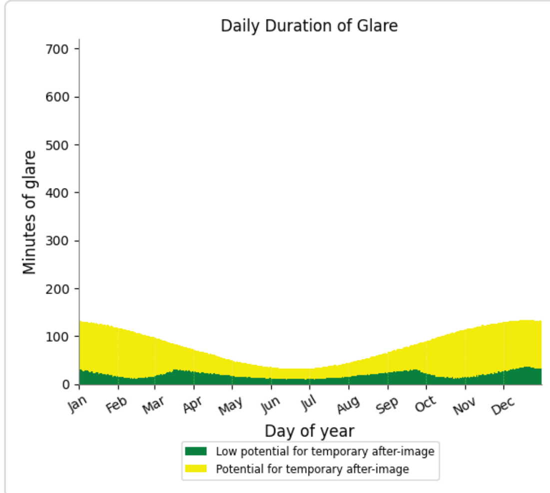
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
Junction Road	7,200	120.0	22,745	379.1
Michan Road	40	0.7	188	3.1
Schulz Rd	154	2.6	1	0.0
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

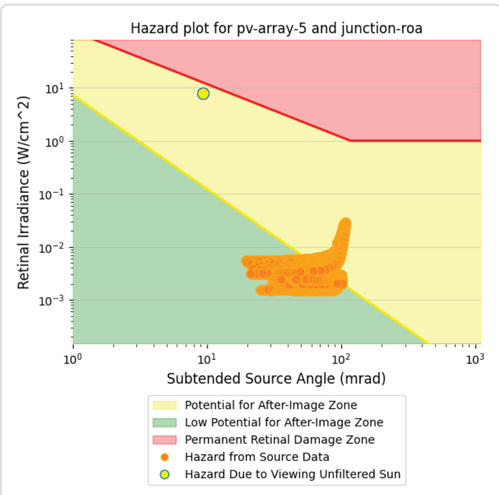
PV array 5 and Route: Junction Road

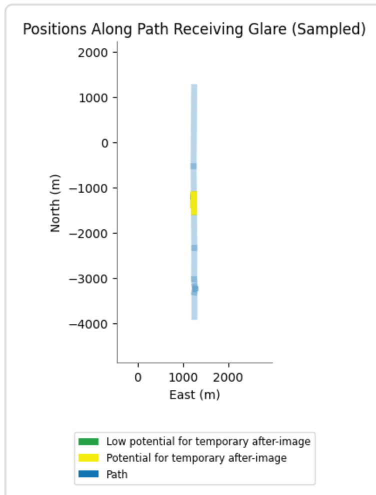
Yellow glare: 22,745 min.

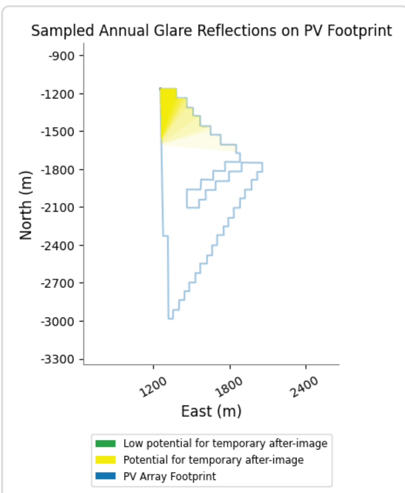
Green glare: 7,200 min.







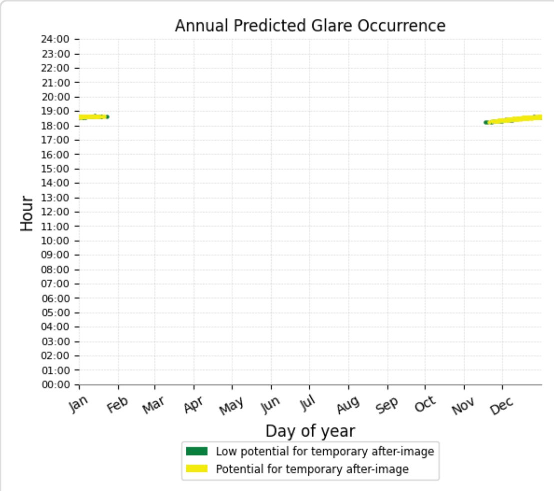


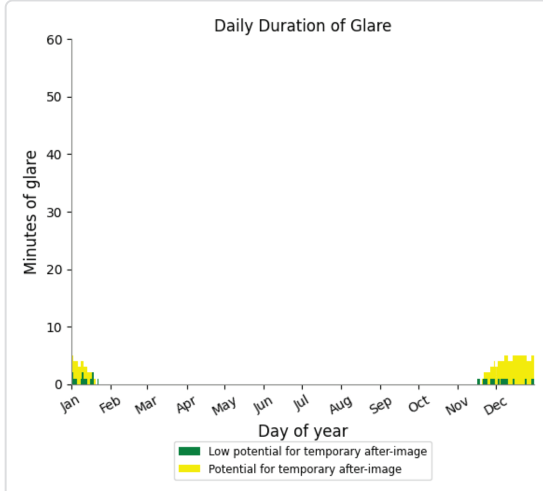


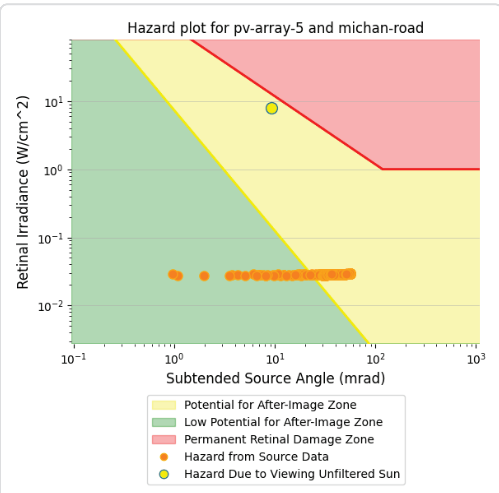
PV array 5 and Route: Michan Road

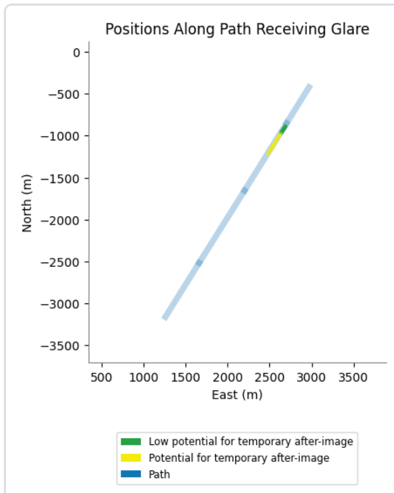
Yellow glare: 188 min.

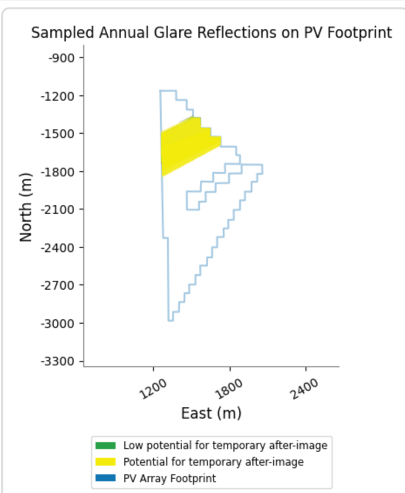
Green glare: 40 min.







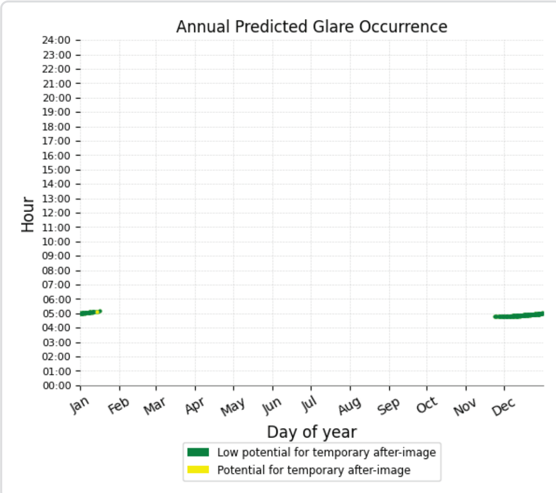


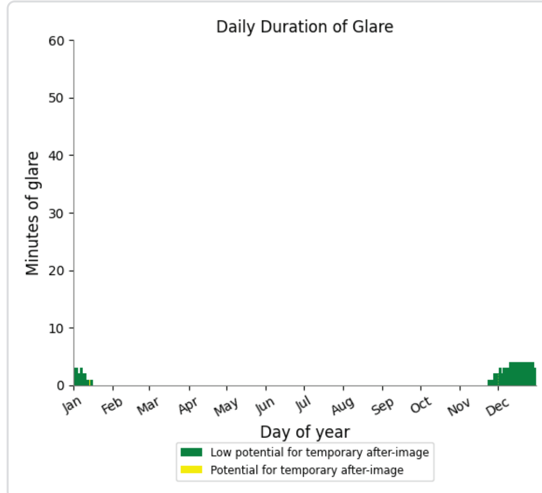


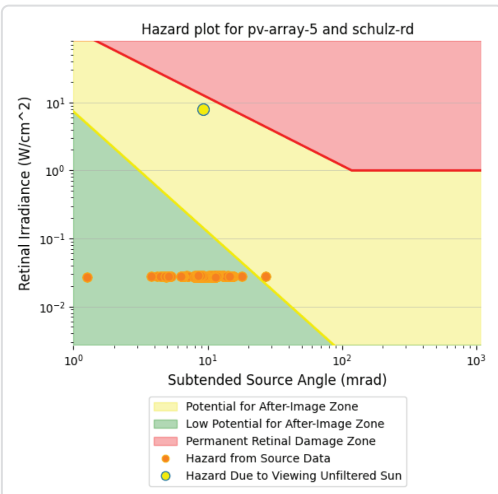
PV array 5 and Route: Schulz Rd

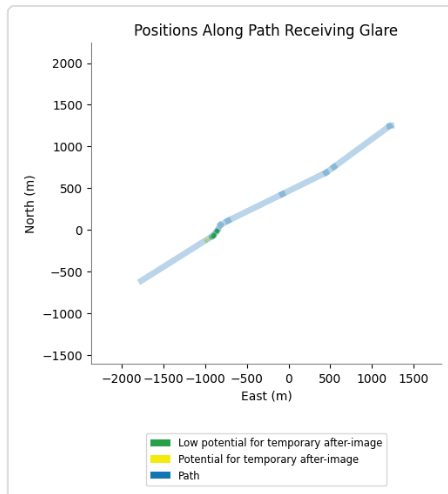
Yellow glare: 1 min.

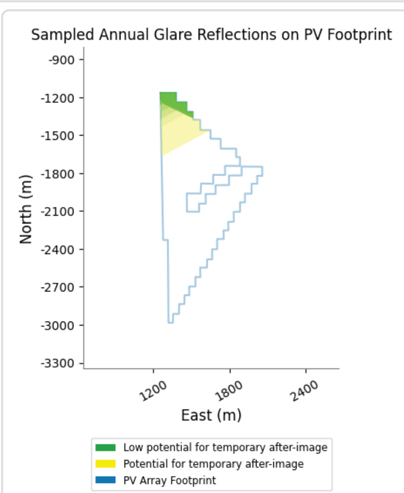
Green glare: 154 min.











PV array 5 and Route: Australia Plains - Emmaus Road

No glare found

PV array 5 and Route: Back Road

No glare found

PV array 5 and Route: Bower Road

No glare found

PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 3

No glare found

PV array 5 and OP 4

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 6

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 8

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 14

No glare found

PV array 5 and OP 15

No glare found

PV array 5 and OP 16

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

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

APPENDIX B:

SOLAR GLARE HAZARD ANALYSIS – RESIDENTIAL RECEIVERS AND ROADS - RESTING ANGLE 6 DEGREES

FORGESOLAR GLARE ANALYSIS

Project: **Australia Plains Solar Farm**
Site configuration: **Australia Plains Solar Farm**

Created 15 Jul, 2024
Updated 26 Jul, 2024
Time-step 1 minute
Timezone offset UTC9
Minimum sun altitude 0.0 deg
DNI peaks at 2,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 124100.21290

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

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	50	0.8	108	1.8	-
PV array 4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 5	SA tracking	SA tracking	7,195	119.9	22,751	379.2	-

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

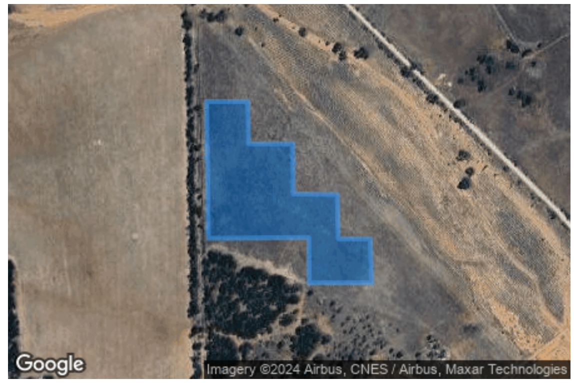
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	7,245	120.8	22,859	381.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

Component Data

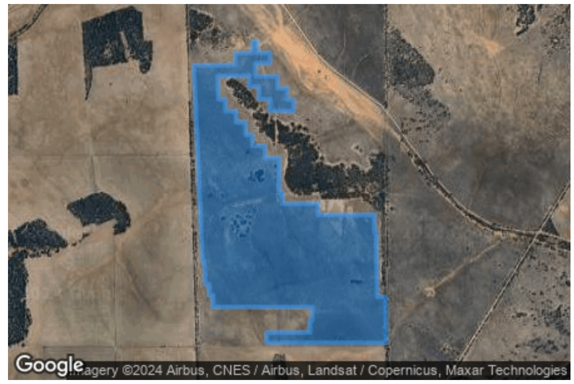
PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.054304	139.173936	257.52	2.00	259.52
2	-34.054304	139.174646	254.84	2.00	256.84
3	-34.054906	139.174658	255.73	2.00	257.73
4	-34.054905	139.175417	254.22	2.00	256.22
5	-34.055616	139.175427	256.27	2.00	258.27
6	-34.055627	139.176181	254.10	2.00	256.10
7	-34.056255	139.176198	254.93	2.00	256.93
8	-34.056257	139.176744	252.57	2.00	254.57
9	-34.056884	139.176769	253.34	2.00	255.34
10	-34.056882	139.175699	257.37	2.00	259.37
11	-34.056237	139.175691	257.12	2.00	259.12
12	-34.056251	139.173968	259.22	2.00	261.22

Name: PV array 2
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.059596	139.174152	260.73	2.00	262.73
2	-34.059565	139.176984	256.03	2.00	258.03
3	-34.058892	139.176993	253.45	2.00	255.45
4	-34.058868	139.178178	250.25	2.00	252.25
5	-34.058243	139.178181	250.82	2.00	252.82
6	-34.058241	139.178489	250.45	2.00	252.45
7	-34.058863	139.178500	249.81	2.00	251.81
8	-34.058872	139.179380	248.28	2.00	250.28
9	-34.059476	139.179390	249.04	2.00	251.04
10	-34.059485	139.178395	251.05	2.00	253.05
11	-34.060210	139.178409	253.05	2.00	255.05
12	-34.060196	139.179897	249.02	2.00	251.02
13	-34.060881	139.179913	249.55	2.00	251.55
14	-34.060885	139.180568	247.51	2.00	249.51
15	-34.061527	139.180568	249.42	2.00	251.42
16	-34.061534	139.181005	248.37	2.00	250.37
17	-34.062198	139.181005	250.96	2.00	252.96
18	-34.062181	139.179374	257.76	2.00	259.76
19	-34.061507	139.179369	254.30	2.00	256.30
20	-34.061505	139.178621	258.15	2.00	260.15
21	-34.060794	139.178607	254.73	2.00	256.73
22	-34.060785	139.177961	257.85	2.00	259.85
23	-34.060185	139.177958	254.91	2.00	256.91
24	-34.060196	139.175815	260.81	2.00	262.81
25	-34.061523	139.175863	263.83	2.00	265.83
26	-34.061521	139.176330	263.68	2.00	265.68
27	-34.062190	139.176333	263.34	2.00	265.34
28	-34.062194	139.177049	262.80	2.00	264.80
29	-34.062818	139.177070	261.42	2.00	263.42
30	-34.062816	139.177711	260.42	2.00	262.42
31	-34.063521	139.177725	259.40	2.00	261.40
32	-34.063529	139.178167	259.39	2.00	261.39
33	-34.064136	139.178189	258.00	2.00	260.00
34	-34.064147	139.179047	257.97	2.00	259.97
35	-34.064840	139.179052	256.48	2.00	258.48
36	-34.064838	139.180023	256.19	2.00	258.19
37	-34.066787	139.180018	253.00	2.00	255.00
38	-34.066782	139.180262	253.00	2.00	255.00
39	-34.067433	139.180262	253.29	2.00	255.29
40	-34.067442	139.182698	251.46	2.00	253.46
41	-34.068078	139.182690	253.23	2.00	255.23
42	-34.068078	139.186552	251.71	2.00	253.71
43	-34.069043	139.186549	255.84	2.00	257.84
44	-34.069043	139.186549	255.84	2.00	257.84
45	-34.069043	139.186549	255.84	2.00	257.84
46	-34.069043	139.186549	255.84	2.00	257.84
47	-34.069043	139.186549	255.84	2.00	257.84
48	-34.069043	139.186549	255.84	2.00	257.84
49	-34.069043	139.186549	255.84	2.00	257.84
50	-34.069055	139.186682	255.76	2.00	257.76
51	-34.069055	139.186682	255.76	2.00	257.76
52	-34.069055	139.186682	255.76	2.00	257.76
53	-34.069055	139.186682	255.76	2.00	257.76
54	-34.069055	139.186682	255.76	2.00	257.76
55	-34.069055	139.186682	255.76	2.00	257.76
56	-34.069055	139.186682	255.76	2.00	257.76
57	-34.072719	139.186740	253.24	2.00	255.24
58	-34.072719	139.187319	251.78	2.00	253.78
59	-34.075332	139.187351	250.09	2.00	252.09

Name: PV array 3
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.062198	139.181672	249.35	2.00	251.35
2	-34.062210	139.183062	248.34	2.00	250.34
3	-34.062885	139.183060	248.31	2.00	250.31
4	-34.062891	139.184698	244.72	2.00	246.72
5	-34.063505	139.184706	245.14	2.00	247.14
6	-34.063526	139.182531	249.82	2.00	251.82
7	-34.062829	139.182524	248.55	2.00	250.55
8	-34.062817	139.181679	251.12	2.00	253.12

Name: PV array 4
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.064203	139.185241	246.06	2.00	248.06
2	-34.064204	139.185792	245.59	2.00	247.59
3	-34.064810	139.185795	246.48	2.00	248.48
4	-34.064820	139.185252	247.28	2.00	249.28

Name: PV array 5
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 6.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

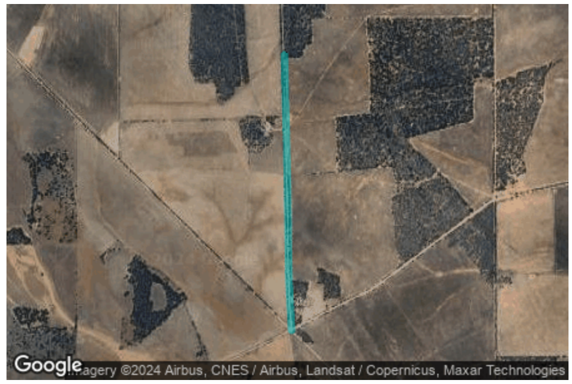
Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.064816	139.187526	245.42	2.00	247.42
2	-34.064812	139.188875	242.00	2.00	244.00
3	-34.065472	139.188886	241.34	2.00	243.34
4	-34.065469	139.189782	241.48	2.00	243.48
5	-34.066154	139.189782	240.20	2.00	242.20
6	-34.066165	139.190324	240.45	2.00	242.45
7	-34.066731	139.190326	239.11	2.00	241.11
8	-34.066747	139.190930	239.34	2.00	241.34
9	-34.067469	139.190946	239.52	2.00	241.52
10	-34.067476	139.191820	239.08	2.00	241.08
11	-34.068085	139.191823	239.46	2.00	241.46
12	-34.068096	139.192689	238.25	2.00	240.25
13	-34.068795	139.192695	239.21	2.00	241.21
14	-34.068795	139.194014	237.02	2.00	239.02
15	-34.069395	139.194020	237.01	2.00	239.01
16	-34.069404	139.194347	236.93	2.00	238.93
17	-34.070031	139.194341	236.82	2.00	238.82
18	-34.070020	139.193059	240.89	2.00	242.89
19	-34.070675	139.193070	241.80	2.00	243.80
20	-34.070662	139.192048	243.01	2.00	245.01
21	-34.071304	139.192054	242.07	2.00	244.07
22	-34.071277	139.191018	243.83	2.00	245.83
23	-34.071997	139.190973	243.48	2.00	245.48
24	-34.071988	139.189790	246.58	2.00	248.58
25	-34.073292	139.189803	248.10	2.00	250.10
26	-34.073295	139.190841	248.30	2.00	250.30
27	-34.072721	139.190839	244.99	2.00	246.99
28	-34.072711	139.191417	244.96	2.00	246.96
29	-34.072029	139.191401	243.00	2.00	245.00
30	-34.072023	139.192254	242.98	2.00	244.98
31	-34.071403	139.192254	242.07	2.00	244.07
32	-34.071387	139.193412	242.12	2.00	244.12
33	-34.070712	139.193403	240.99	2.00	242.99
34	-34.070702	139.194489	240.14	2.00	242.14
35	-34.070071	139.194481	236.84	2.00	238.84
36	-34.070089	139.196246	238.06	2.00	240.06
37	-34.070735	139.196257	239.62	2.00	241.62
38	-34.070740	139.195814	240.57	2.00	242.57
39	-34.071297	139.195822	241.69	2.00	243.69
40	-34.071302	139.195337	242.85	2.00	244.85
41	-34.072008	139.195337	243.96	2.00	245.96
42	-34.072002	139.194768	243.95	2.00	245.95
43	-34.072626	139.194773	244.00	2.00	246.00
44	-34.072619	139.194355	244.91	2.00	246.91
45	-34.073297	139.194344	247.16	2.00	249.16
46	-34.073304	139.193805	247.68	2.00	249.68
47	-34.074008	139.193818	250.89	2.00	252.89
48	-34.074019	139.193333	251.55	2.00	253.55
49	-34.074614	139.193354	254.98	2.00	256.98
50	-34.074628	139.192939	255.56	2.00	257.56
51	-34.075236	139.192957	258.26	2.00	260.26
52	-34.075241	139.192389	259.38	2.00	261.38
53	-34.075967	139.192389	261.56	2.00	263.56
54	-34.075972	139.191957	261.73	2.00	263.73
55	-34.076687	139.191957	261.99	2.00	263.99
56	-34.076692	139.191531	261.50	2.00	263.50
57	-34.077278	139.191517	260.71	2.00	262.71
58	-34.077276	139.190935	260.18	2.00	262.18
59	-34.077953	139.190954	259.70	2.00	261.70

Route Receptors

Name: Australia Plains - Emmaus Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.093697	139.169011	271.65	2.40	274.05
2	-34.093484	139.171908	270.49	2.40	272.89
3	-34.092595	139.173432	268.06	2.40	270.46
4	-34.092098	139.173797	268.24	2.40	270.64
5	-34.090250	139.176693	265.25	2.40	267.65
6	-34.088117	139.179054	263.87	2.40	266.27
7	-34.086571	139.181478	259.63	2.40	262.03
8	-34.086233	139.182380	257.96	2.40	260.36
9	-34.085878	139.182938	256.44	2.40	258.84
10	-34.081719	139.189375	252.79	2.40	255.19
11	-34.080742	139.192272	248.93	2.40	251.33
12	-34.079907	139.194074	248.47	2.40	250.87
13	-34.078698	139.195404	247.61	2.40	250.01
14	-34.078378	139.196692	244.46	2.40	246.86
15	-34.076921	139.198838	240.33	2.40	242.73
16	-34.076565	139.199717	240.40	2.40	242.80
17	-34.074699	139.202636	236.05	2.40	238.45
18	-34.073970	139.203580	235.46	2.40	237.86
19	-34.073793	139.205597	235.00	2.40	237.40
20	-34.072406	139.208386	233.00	2.40	235.40
21	-34.071269	139.213407	233.54	2.40	235.94
22	-34.069616	139.216283	221.30	2.40	223.70
23	-34.069473	139.220209	217.87	2.40	220.27
24	-34.068603	139.224179	215.90	2.40	218.30

Name: Back Road
Path type: Two-way
Observer view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.050381	139.173260	259.32	2.40	261.72
2	-34.049084	139.173174	264.89	2.40	267.29
3	-34.047359	139.173067	270.29	2.40	272.69
4	-34.041403	139.172960	275.26	2.40	277.66
5	-34.034735	139.172767	266.01	2.40	268.41

Name: Bower Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.040635	139.161298	277.07	2.40	279.47
2	-34.050396	139.173271	259.20	2.40	261.60
3	-34.053685	139.177300	250.01	2.40	252.41
4	-34.056050	139.180186	252.25	2.40	254.65
5	-34.059134	139.182803	247.95	2.40	250.35
6	-34.060103	139.184102	246.92	2.40	249.32
7	-34.061134	139.185818	245.69	2.40	248.09
8	-34.062103	139.187320	245.76	2.40	248.16
9	-34.063860	139.188811	242.36	2.40	244.76
10	-34.064829	139.189702	242.69	2.40	245.09
11	-34.065313	139.190195	242.22	2.40	244.62
12	-34.066039	139.190798	241.50	2.40	243.90
13	-34.067274	139.192182	238.98	2.40	241.38
14	-34.067879	139.193061	238.09	2.40	240.49
15	-34.068661	139.194660	237.00	2.40	239.40
16	-34.068892	139.195583	237.43	2.40	239.83
17	-34.069141	139.197836	235.79	2.40	238.19
18	-34.069976	139.201398	231.54	2.40	233.94
19	-34.069763	139.205088	230.81	2.40	233.21
20	-34.070171	139.206719	228.94	2.40	231.34
21	-34.070900	139.208243	230.69	2.40	233.09
22	-34.071220	139.208350	231.62	2.40	234.02
23	-34.072393	139.208543	232.61	2.40	235.01

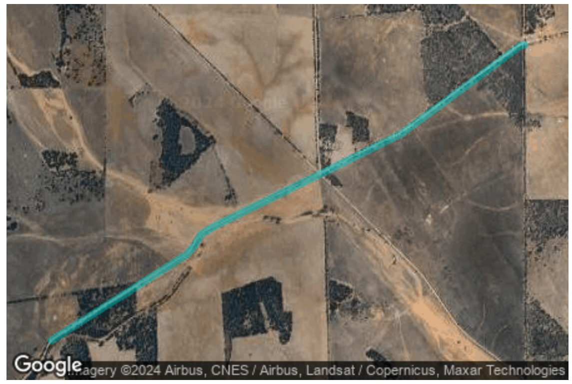
Name: Junction Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.089080	139.187501	271.37	2.40	273.77
2	-34.084220	139.187491	255.36	2.40	257.76
3	-34.083473	139.187705	253.13	2.40	255.53
3	-34.083473	139.187705	253.13	2.40	255.53
4	-34.082976	139.187555	253.06	2.40	255.46
5	-34.081566	139.187428	256.35	2.40	258.75
5	-34.081566	139.187428	256.35	2.40	258.75
6	-34.075339	139.187473	250.02	2.40	252.42
6	-34.075339	139.187473	250.02	2.40	252.42
7	-34.059027	139.187284	259.51	2.40	261.91
7	-34.059027	139.187284	259.51	2.40	261.91
8	-34.043295	139.187442	252.35	2.40	254.75

Name: Michan Road
Path type: Two-way
Observer view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.082811	139.187582	253.31	2.40	255.71
2	-34.076995	139.191932	261.71	2.40	264.11
3	-34.069228	139.197780	235.54	2.40	237.94
4	-34.061976	139.203198	250.42	2.40	252.82
5	-34.058100	139.206095	241.48	2.40	243.88

Name: Schulz Rd
Path type: Two-way
Observer view angle: 90.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-34.059844	139.154792	270.00	2.40	272.40
2	-34.054973	139.164083	259.67	2.40	262.07
3	-34.054440	139.164641	259.50	2.40	261.90
4	-34.053800	139.165091	259.07	2.40	261.47
5	-34.053337	139.166057	258.29	2.40	260.69
6	-34.050457	139.173116	258.47	2.40	260.87
7	-34.048128	139.178803	272.82	2.40	275.22
8	-34.047506	139.179833	271.36	2.40	273.76
9	-34.043097	139.187043	253.17	2.40	255.57
10	-34.043061	139.187279	252.53	2.40	254.93

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-34.049295	139.173946	264.56	1.50
OP 2	2	-34.078133	139.194223	254.93	1.50
OP 3	3	-34.085650	139.182786	256.85	1.50
OP 4	4	-34.088937	139.187834	270.84	1.50
OP 5	5	-34.093622	139.172795	269.42	1.50
OP 6	6	-34.094724	139.177526	271.07	1.50
OP 7	7	-34.092964	139.168922	274.08	1.50
OP 8	8	-34.094599	139.169244	271.09	1.50
OP 9	9	-34.068310	139.222297	214.33	1.50
OP 10	10	-34.039251	139.171585	273.93	1.50
OP 11	11	-34.091972	139.160162	277.33	1.50
OP 12	12	-34.095411	139.154834	285.00	1.50
OP 13	13	-34.096735	139.156087	282.99	1.50
OP 14	14	-34.097326	139.156519	283.09	1.50
OP 15	15	-34.097386	139.155642	283.92	1.50
OP 16	16	-34.077745	139.220507	222.49	1.50

Glare Analysis Results

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

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	50	0.8	108	1.8	-
PV array 4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 5	SA tracking	SA tracking	7,195	119.9	22,751	379.2	-

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

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	7,245	120.8	22,859	381.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 1 and Route: Australia Plains - Emmaus Road

No glare found

PV array 1 and Route: Back Road

No glare found

PV array 1 and Route: Bower Road

No glare found

PV array 1 and Route: Junction Road

No glare found

PV array 1 and Route: Michan Road

No glare found

PV array 1 and Route: Schulz Rd

No glare found

PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 7

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 14

No glare found

PV array 1 and OP 15

No glare found

PV array 1 and OP 16

No glare found

PV: PV array 2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 2 and Route: Australia Plains - Emmaus Road

No glare found

PV array 2 and Route: Back Road

No glare found

PV array 2 and Route: Bower Road

No glare found

PV array 2 and Route: Junction Road

No glare found

PV array 2 and Route: Michan Road

No glare found

PV array 2 and Route: Schulz Rd

No glare found

PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 7

No glare found

PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 14

No glare found

PV array 2 and OP 15

No glare found

PV array 2 and OP 16

No glare found

PV: PV array 3 potential temporary after-image

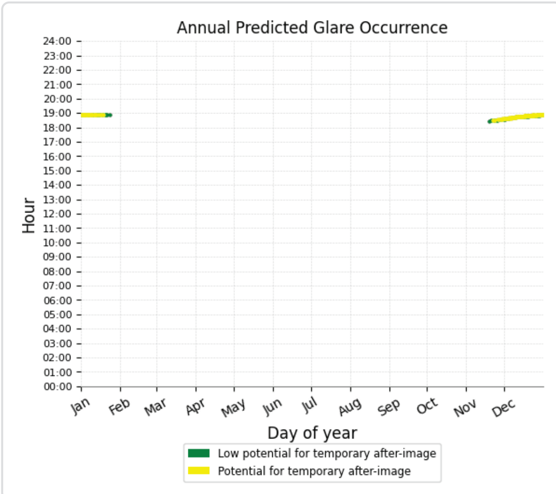
Receptor results ordered by category of glare

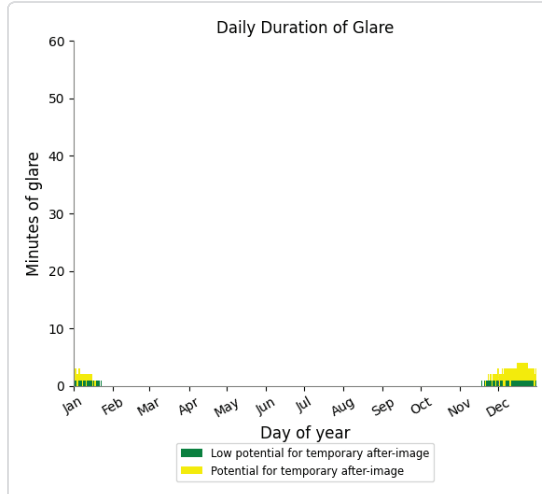
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Junction Road	50	0.8	108	1.8
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

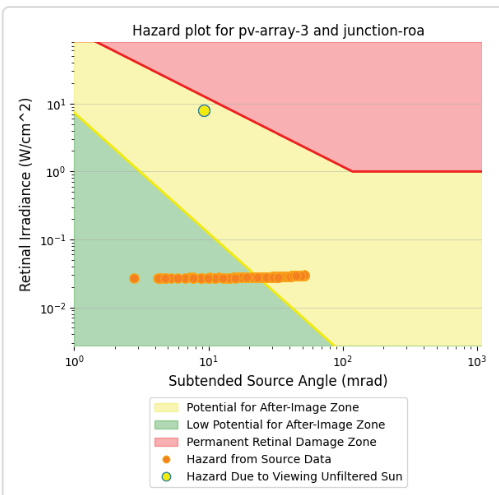
PV array 3 and Route: Junction Road

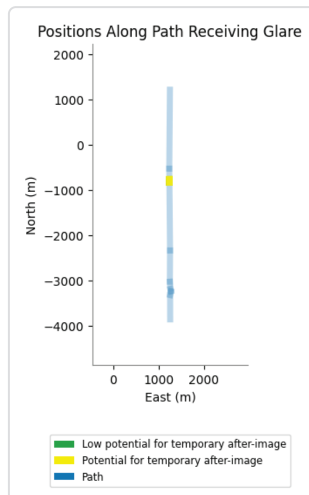
Yellow glare: 108 min.

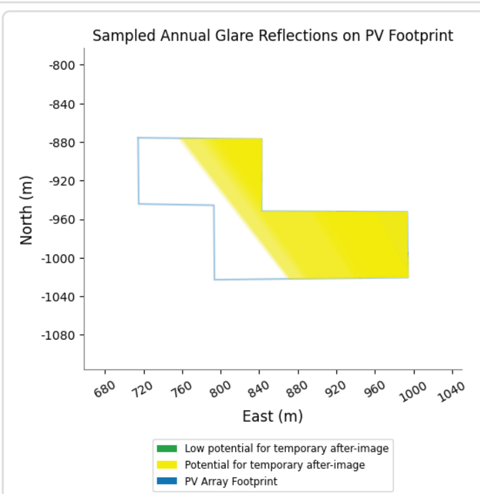
Green glare: 50 min.











PV array 3 and Route: Australia Plains - Emmaus Road

No glare found

PV array 3 and Route: Back Road

No glare found

PV array 3 and Route: Bower Road

No glare found

PV array 3 and Route: Michan Road

No glare found

PV array 3 and Route: Schulz Rd

No glare found

PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 14

No glare found

PV array 3 and OP 15

No glare found

PV array 3 and OP 16

No glare found

PV: PV array 4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Junction Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

PV array 4 and Route: Australia Plains - Emmaus Road

No glare found

PV array 4 and Route: Back Road

No glare found

PV array 4 and Route: Bower Road

No glare found

PV array 4 and Route: Junction Road

No glare found

PV array 4 and Route: Michan Road

No glare found

PV array 4 and Route: Schulz Rd

No glare found

PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 3

No glare found

PV array 4 and OP 4

No glare found

PV array 4 and OP 5

No glare found

PV array 4 and OP 6

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 8

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 14

No glare found

PV array 4 and OP 15

No glare found

PV array 4 and OP 16

No glare found

PV: PV array 5 potential temporary after-image

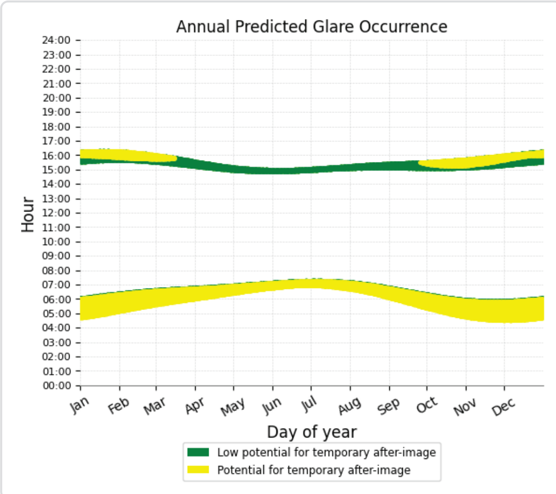
Receptor results ordered by category of glare

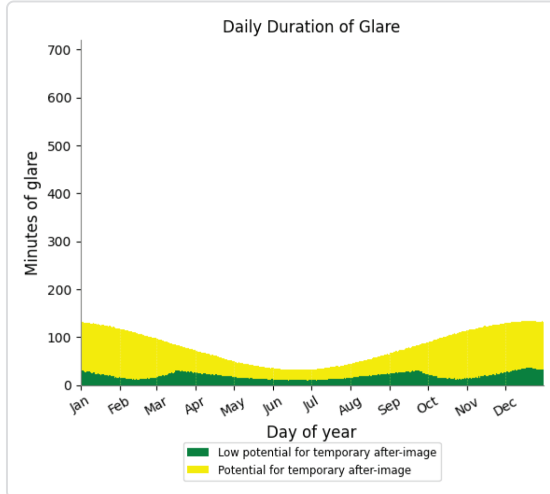
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
Junction Road	7,195	119.9	22,751	379.2
Australia Plains - Emmaus Road	0	0.0	0	0.0
Back Road	0	0.0	0	0.0
Bower Road	0	0.0	0	0.0
Michan Road	0	0.0	0	0.0
Schulz Rd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0

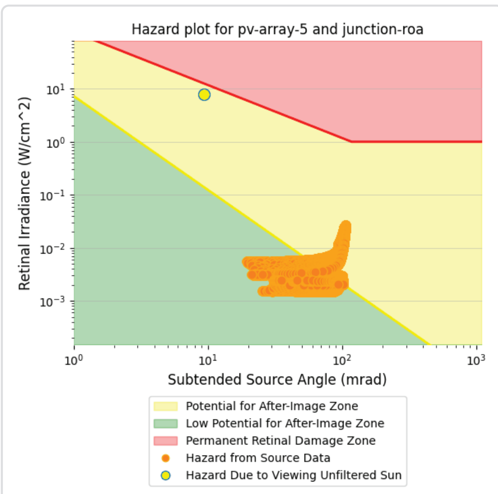
PV array 5 and Route: Junction Road

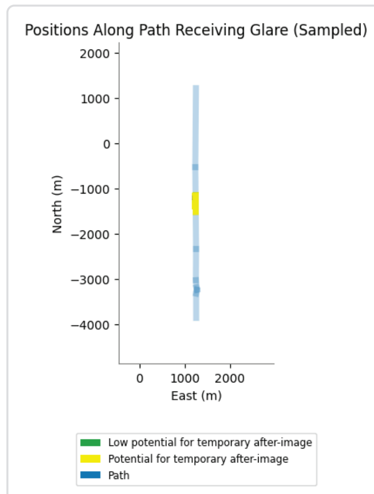
Yellow glare: 22,751 min.

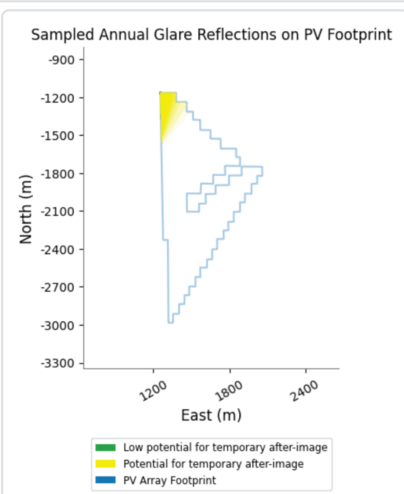
Green glare: 7,195 min.











PV array 5 and Route: Australia Plains - Emmaus Road

No glare found

PV array 5 and Route: Back Road

No glare found

PV array 5 and Route: Bower Road

No glare found

PV array 5 and Route: Michan Road

No glare found

PV array 5 and Route: Schulz Rd

No glare found

PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 3

No glare found

PV array 5 and OP 4

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 6

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 8

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 14

No glare found

PV array 5 and OP 15

No glare found

PV array 5 and OP 16

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

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

Australian Plains Solar Project

EPBC Act Self-assessment

Australian Plains Solar Project EPBC Act Self-assessment

25 March 2024

Version 2

Prepared by EBS Ecology for Green Gold Energy Pty Ltd

Document Control					
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Cover photograph: Plains mallee box woodlands TEC found in the Project Area (VA6).

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GLOSSARY AND ABBREVIATION OF TERMS

AOO	Area of occupancy
BAM	Bushland Assessment Methodology
BDBSA	Biological Database of South Australia (managed by the Department for Environment and Water)
BESS	Battery Energy Storage System
cm	Centimetre(s)
DCCEEW	Department of Climate Change, Energy, Environment and Water
DEW	Department for Environment and Water
EBS	Environmental and Biodiversity Services Pty Ltd – trading as EBS Ecology
EOO	Extent of occurrence
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GGE	Green Gold Energy Pty Ltd
ha	Hectare(s)
IBRA	Interim Biogeographical Regionalisation for Australia, Version 7
km	Kilometre(s)
m	metre(s)
mm	Millimetre(s)
MBC	Mallee Bird Community
MDD	Murray Darling Depression
MNES	Matters of National Environmental Significance, as defined by the EPBC Act
NPW Act	*National Parks and Wildlife Act 1972*
NSW	New South Wales
PMBW	Plains Mallee Box Woodland
PMST	Protected Matters Search Tool
Proponent	Green Gold Energy Pty Ltd
SA	South Australia(n)
sp.	Species
ssp.	Subspecies
TEC(s)	Threatened Ecological Community(s)
the Project	Australian Plains Solar Farm
the Project Area	The outer boundary of the area (CT/5972/348) proposed as the site of the Australia Plains solar farm.
the Search Area	A 5 km buffer surrounding the Project Area.
VA(s)	Vegetation Association(s)

EXECUTIVE SUMMARY

Green Gold Energy Pty Ltd (GGE) is proposing to construct the Australia Plains Solar Farm (the Project) on at Lot 315 Bower Road, Australia Plains (CT/5972/348). The Project is located approximately 12.5 kilometres (km) southeast of the township of Robertstown, and 14.5 km northeast of Eudunda, in the Northern and Yorke region of South Australia (SA). The proposed construction requires the clearing of native vegetation, with potential for impact to Matters of National Environmental Significance (MNES), as protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Desktop research and field surveys undertaken in the Project Area identified the following MNES as potentially impacted by the proposal:

- Mallee Bird Community (MBC) of the Murray Darling Depression Bioregion - Endangered Ecological Community (TEC).
- Plains Mallee Box Woodland (PMBW) of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plain Bioregions – Critically Endangered TEC.
- Southern Whiteface (*Aphelocephala leucopsis*) – Vulnerable threatened species.
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – Endangered threatened species.
- Blue-wing Parrot (*Neophema chrysostoma*) – Vulnerable threatened species.

The objective of this report was to prepare an EPBC self-assessment report to assess possible impacts to threatened species and ecological communities identified by the Protected Matters search Tool (PMST) report as likely or known to occur in the Project Area.

Surveys conducted for the Project, documented in *Australia Plains Solar Project Native Vegetation Clearance Data Report* (EBS 2024), found that two Vegetation Associations within the Project Area met the criteria for listing as the TECs listed above. Vegetation surveys also indicated potential habitat does exist within the Project Area for all three threatened fauna species, although there were only recent records within 5 km for South-eastern Hooded Robin.

The significance of potential impacts to the MNES listed above was assessed according to EPBC Act guidelines and criteria. The significant impact assessment is based on the Project design information available at the time of writing. Any change in impact area and/or Project designs may require the significance of the potential impact on MNES to be re-assessed and updated.

EPBC self-assessment outcome

The EPBC Act Self-assessment found that there will be no significant impact to any MNES resulting from the development of the proposed Australia Plains Solar Farm. A referral to the Minister for the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is deemed not required.

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1 INTRODUCTION

Green Gold Energy Pty Ltd (GGE, the Proponent) is proposing to construct the Australia Plains Solar Farm (the Project) at Lot 315 Bower Road, Australia Plains (the Project Area). The Project is located approximately 12.5 kilometres (km) southeast of the township of Robertstown, and 14.5 km northeast of Eudunda, in the Northern and Yorke region of South Australia (SA).

The Proponent plans to construct a solar farm, Battery Energy Storage System (BESS) and a substation which covers 111.50 hectares (ha) of native vegetation. The proposed construction will require clearing of native vegetation, with potential for impact to Matters of National Environmental Significance (MNES).

EBS Ecology (EBS) was engaged by GGE to undertake an EPBC Act self-assessment that would inform whether any Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* could be significantly impacted (as per the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*) by the proposed solar farm, BESS, substation, and associated infrastructure required for its operation within the 348.67 hectares (ha) Project Area (Figure 1).

1.1 Objectives

The objective of this report is to determine whether a significant impact may result from the proposed project on MNES under the EPBC Act, as identified as likely or known by the Protected Matters Search Tool (PMST) report. MNES include Threatened Ecological Communities (TEC), threatened flora and fauna, and migratory species listed under the EPBC Act.

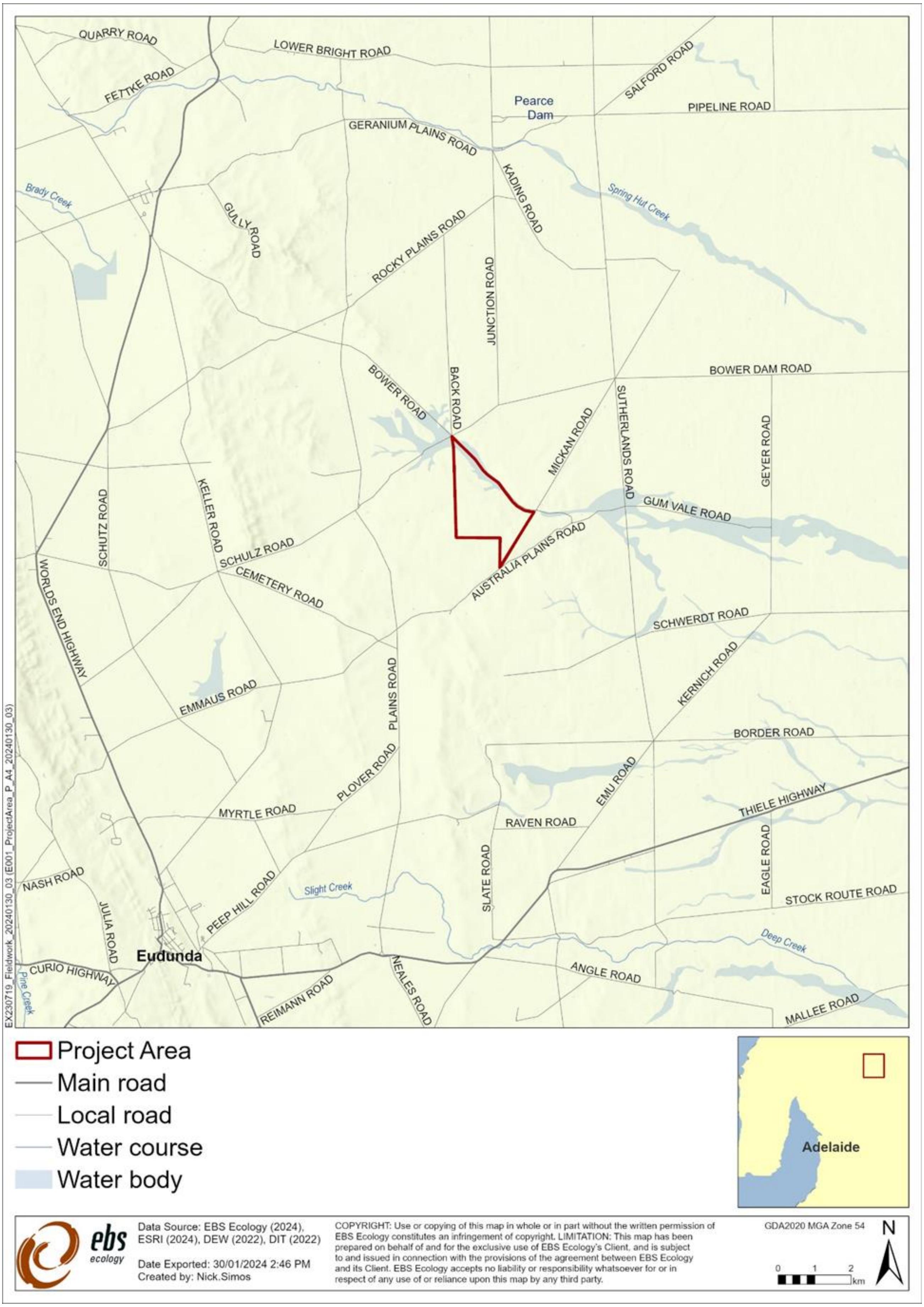


Figure 1: Location of the Australia Plains Solar Farm.

2 BACKGROUND INFORMATION

2.1 Project details

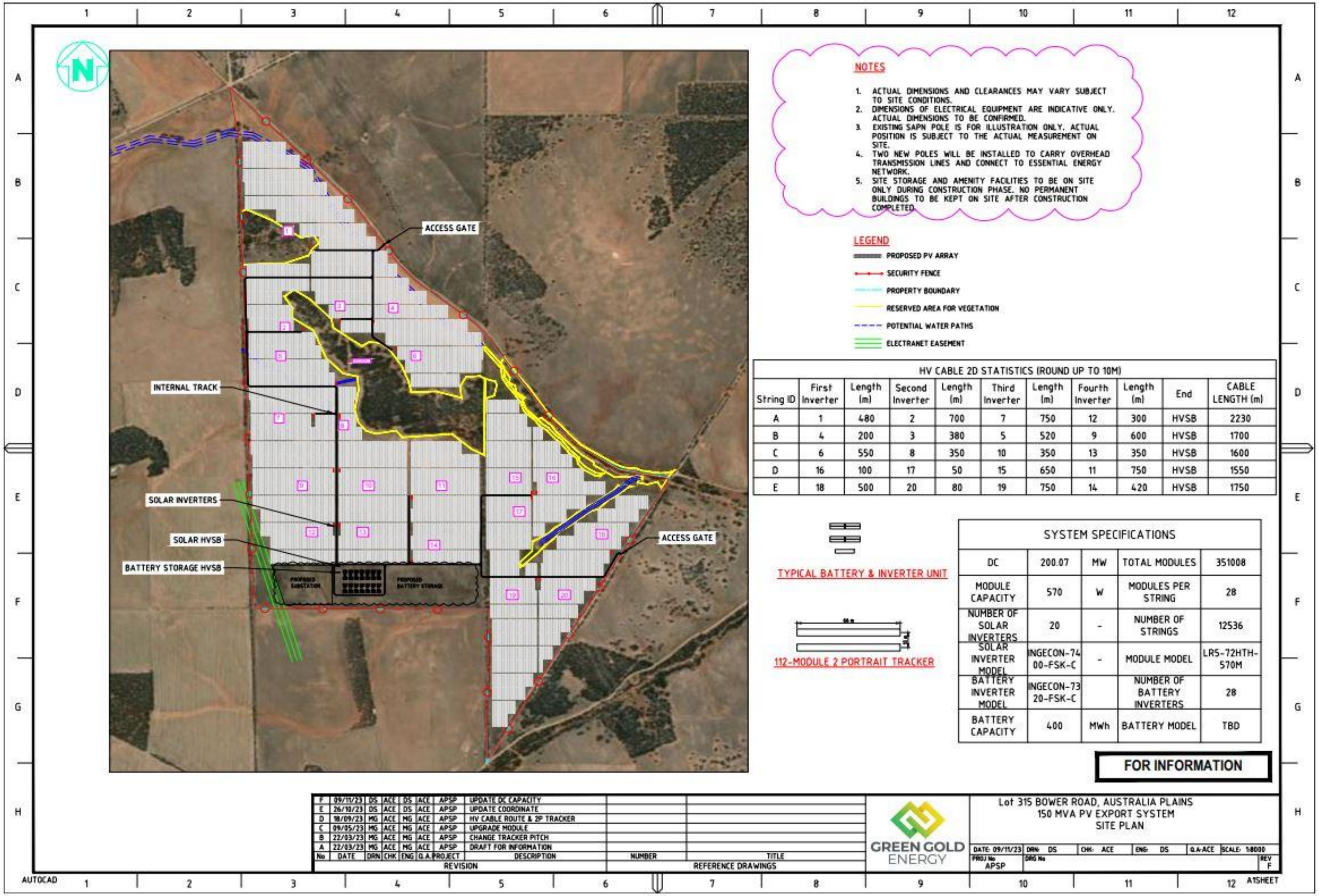
The Australia Plains Solar Farm Project Area is 348.67 hectares (ha) in size. The proponent intends to construct a solar farm along with a BESS covering approximately 111.50 ha (Figure 2).

The proposed Project will be made up of the following infrastructure components:

- Installation of approximately 435,450 solar panels with a total export capacity of 200 megawatts. Panels will be attached to trackers in a 2P (or vertical two-panel) arrangement with approximately 4032 rows of trackers, each containing around 108 panels, distributed across the site (Figure 2).
- Installation of underground cabling connecting the panels to Inverters and inverters to the on-site substation.
- Development of an on-site substation located in the south-western corner of the site, near the existing 275 kilovolt transmission lines which traverse the at that location.
- Installation of an overhead transmission line connecting the on-site substation to the transmission network.
- Development of buildings and structures to support the operation of the solar farm, including:
- Site offices (containers); and
- storage containers housing equipment, general items, and staff amenities.
- Installation of rainwater tanks for fire-fighting purposes (with the precise number and location to be determined in liaison with the SA Country Fire Service).
- Development of two site access points on the northern boundary of the site as follows:
    - at the intersection of Bower and Junction Roads; and
    - off Bower Road approximately 340 metres (m) north-west of the intersection of Bower and Junction Roads.
- Development of internal access roads / tracks within the subject site.
- Installation of closed-circuit TV devices.
- Development of cyclone mesh security fencing around the perimeter of the site.

2.1.1 Australia Plains Solar Project impact footprint

The impact footprint is presented in Figure 3 and is based on designs provided to EBS on 15/01/2024. Clearance of vegetation will be permanent. More information on the clearance of the Project is discussed in the *Australia Plains Solar Project Native Vegetation Clearance Data Report* (EBS 2024).



HV CABLE 2D STATISTICS (ROUND UP TO 10M)

String ID	First Inverter	Length (m)	Second Inverter	Length (m)	Third Inverter	Length (m)	Fourth Inverter	Length (m)	End	CABLE LENGTH (m)
A	1	480	2	700	7	750	12	300	HVSB	2230
B	4	200	3	380	5	520	9	600	HVSB	1700
C	6	550	8	350	10	350	13	350	HVSB	1600
D	16	100	17	50	15	650	11	750	HVSB	1550
E	18	500	20	80	19	750	14	420	HVSB	1750

SYSTEM SPECIFICATIONS

DC	200.07	MW	TOTAL MODULES	351008
MODULE CAPACITY	570	W	MODULES PER STRING	28
NUMBER OF SOLAR INVERTERS	20	-	NUMBER OF STRINGS	12536
SOLAR INVERTER MODEL	INGECON-7400-FSK-C	-	MODULE MODEL	LR5-72HTH-570M
BATTERY INVERTER MODEL	INGECON-7320-FSK-C		NUMBER OF BATTERY INVERTERS	28
BATTERY CAPACITY	400	MWh	BATTERY MODEL	TBD

No	DATE	DRN	CHK	ENG	Q.A.	PROJECT	DESCRIPTION
F	09/11/23	DS	ACE	DS	ACE	APSP	UPDATE DC CAPACITY
E	26/10/23	DS	ACE	DS	ACE	APSP	UPDATE COORDINATE
D	18/09/23	MG	ACE	MG	ACE	APSP	HV CABLE ROUTE & 2P TRACKER
C	09/05/23	MG	ACE	MG	ACE	APSP	UPGRADE MODULE
B	22/03/23	MG	ACE	MG	ACE	APSP	CHANGE TRACKER PITCH
A	22/03/23	MG	ACE	MG	ACE	APSP	DRAFT FOR INFORMATION

Figure 2. Site Plan provided by GGE (supplied to EBS on 15/01/2024).

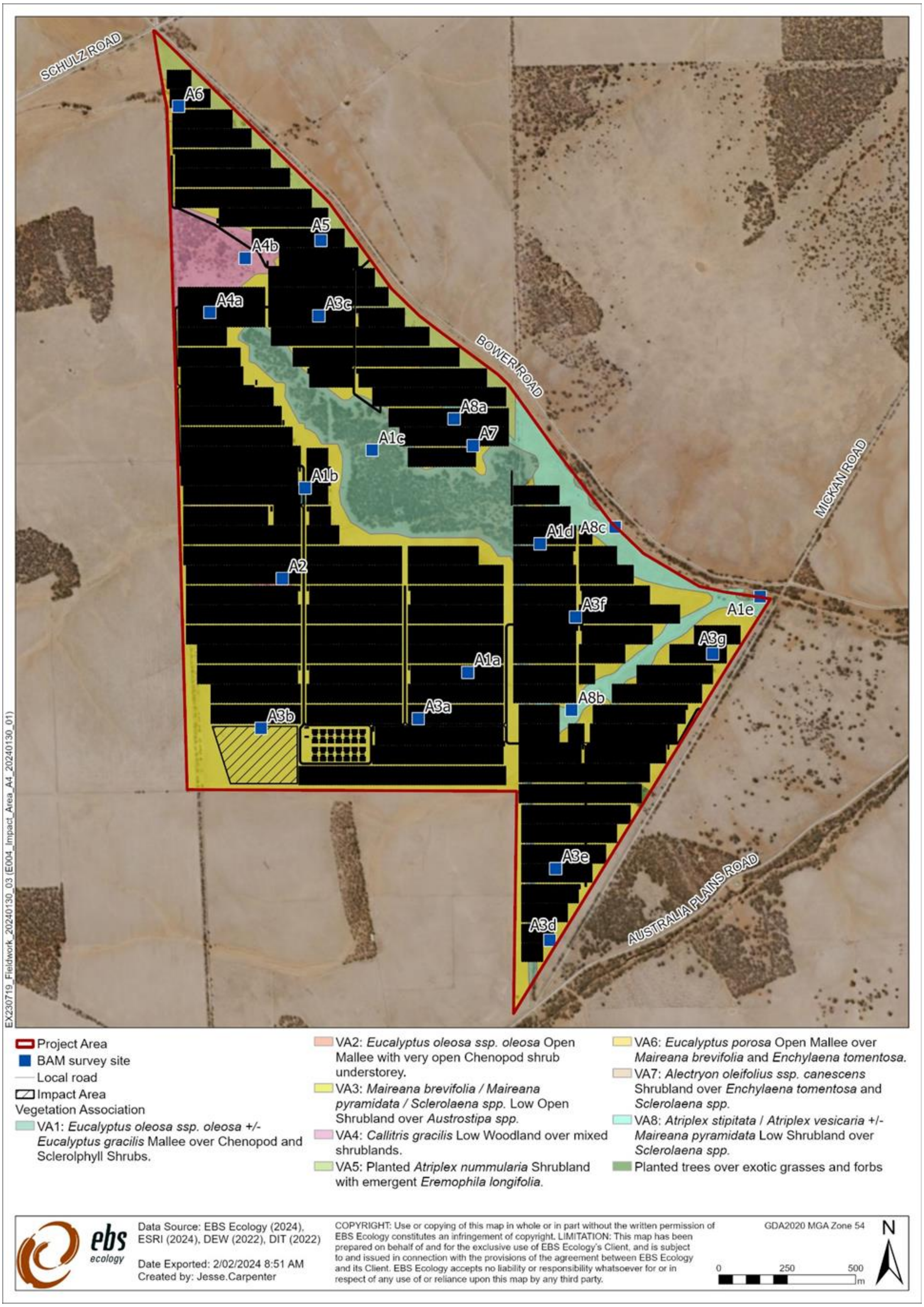


Figure 3. Extent of the solar farm impact areas and vegetation associations mapped during the 2023 field assessment (based on the Project design from 15/01/2024).

2.2 Previous studies

Table 1 outlines the previous studies undertaken for the Australia Plains Solar Farm Project to date. These include field assessments to map vegetation and target threatened species potentially occurring within the Project Area, as well as an ecological desktop study: The desktop study included the following:

- Database search of historical threatened species records within 5 km of the Project Area.
- PMST report for an area within 5 km of the Project Area.
- Literature review of previous flora and fauna surveys in the area.
- Likelihood of occurrence assessment of threatened species identified by the database search, PMST report and literature review.

Table 1. Reports documenting Australia Plains Solar Farm flora and fauna survey methods and results.

Report Title	Report Objectives	Date of Survey	Author
Australia Plains Solar Farm Ecological Assessment	• Broad level assessment to describe and map native vegetation. • Identify ecological constraints in the Project Area.	3 - 6 February 2020	EBS Ecology (2020a)
Australia Plains Solar Farm Ecological Assessment	• A spring follow up survey. • Identify and record flora, fauna, and vegetation communities within the Project Area. • Undertake targeted survey for threatened species. • Provide recommendations to help avoid, minimise, and mitigate environmental impacts.	14 -16 October 2020	EBS Ecology (2020b)
Australia Plains Solar Project Native Vegetation Clearance Data Report	• Assessment of vegetation clearance under the *Native Vegetation Act 1991* for the purpose of development of meteorological evaluation towers.	28 September 2023	EBS Ecology (2024)

2.3 Environmental Setting

2.3.1 Current and historical land use

The Project has been proposed to be constructed on agricultural land in the Regional Council of Goyder within the Northern and Yorke landscape management region and the Hundred of English. Most of the Project Area has been cleared historically of trees and mallee and used for agriculture and livestock grazing. Currently however, there are no grazing activities occurring on the site, with regrowth of native vegetation throughout.

2.3.2 Interim Biogeographical Regionalisation of Australia

Interim Biogeographical Regionalisation of Australia (IBRA) is a landscape-based approach to classifying the land surface across a range of environmental attributes, which is used to assess and plan for the protection of biodiversity. The Project Area is located within the Murray Darling Depression IBRA bioregion, Murray Mallee IBRA subregion, and Sutherlands Environmental Association. Approximately 21% (44,4401 ha) of the Murray Mallee IBRA Subregion and approximately 47% (32,682 ha) of the Sutherlands

Environmental Association is mapped as remnant native vegetation. Of this, 17% (7,6180 ha) and 0% (159 ha) is formerly conserved and protected, respectively.

2.3.3 Vegetation associations

The previous survey mapped eight vegetation associations (VAs) as per the Bushland Assessment Methodology (BAM) (NVC 2020), as listed in Table 2 and outlined in Figure 4 (EBS 2024). Native vegetation associations present across the Project Area include mallee, woodlands and tall shrublands. Of the total 348.67 ha, 268.8 ha (~77.1 %) is comprised of degraded woodlands which now more resembles shrublands due to historical clearance and use as agriculture (VA3 and VA8). There is also a historical plantation of *Atriplex nummularia* on the northern boundary of the Project Area which covers 26.76 ha (~7.6%) (VA5).

The majority of the mallee had an overstorey of *Eucalyptus oleosa* spp. *oleosa* (Red Mallee) with a chenopod midstorey and some patches more open (VA2) than others (VA1). Mallee present in the northwestern corner of the Project Area has an overstory of *Eucalyptus porosa* (1.35 ha) over chenopods such as *Maireana brevifolia* (Short-leaf Bluebush) and *Enchylaena tomentosa* (Ruby Saltbush) (VA6). The woodland present was a low woodland with *Callitris gracilis* (10.61 ha) as the overstorey and chenopods, wattles, and grasses present in the understoreys (VA4). There was also a small patch of *Alectryon oleifolius* ssp. *canescens* (0.32 ha) tall shrubland (VA7).

The Project Area is not within a recognised surface water catchment. There are multiple creeklines that branch across the Project Area and both the northern and southern edge of the Project Area may be subject to flooding. However, no evidence of flooding or water was noted during the field assessment.

Table 2. Overall summary of vegetation associations within the Australia Plains Solar Farm Project Area.

Vegetation association	Total Area (ha)	Impact area (ha)	% of VA impacted by Project
VA1: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mallee over *Maireana brevifolia* (Short-leaf Bluebush).	37.85	3.65	9.64
VA2: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Open Mallee with very open understorey.	2.37	1.01	42.54
VA 3: *Maireana brevifolia* (Short-leaf Bluebush) / *Salsola australis* (Buckbush) +/- *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) Low Open Shrubland.	251.06	94.39	37.60
VA 4: *Callitris gracilis* (Southern Cyress Pine) Low Woodland over mixed shrublands.	10.61	1.21	11.40
VA 5: *Planted Atriplex nummularia* (Oldman Saltbush) Shrubland with emergent *Eremophila longifolia* (Weeping Embush).	26.76	8.47	31.66
VA 6: *Eucalyptus porosa* (Mallee Box) Open Mallee over *Maireana brevifolia* (Short-leaf Bluebush) / *Enchylaena tomentosa* (Ruby Saltbush).	1.35	0.45	33.42
VA 7: *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) Shrubland over *Maireana scleroptera* (Hard-wing Bluebush) +/- *Enchylaena tomentosa* (Ruby Saltbush).	0.32	0.11	33.95
VA 8: *Atriplex vesicaria* (Bladder Saltbush) Low Shrubland over *Maireana* sp. (Bluebush) and *Carrichtera annua* (Wards Weed).	17.74	2.21	12.46
Planted trees over exotic grasses and forbs.	0.61	N/A	N/A
Totals	**348.67**	**111.50**	

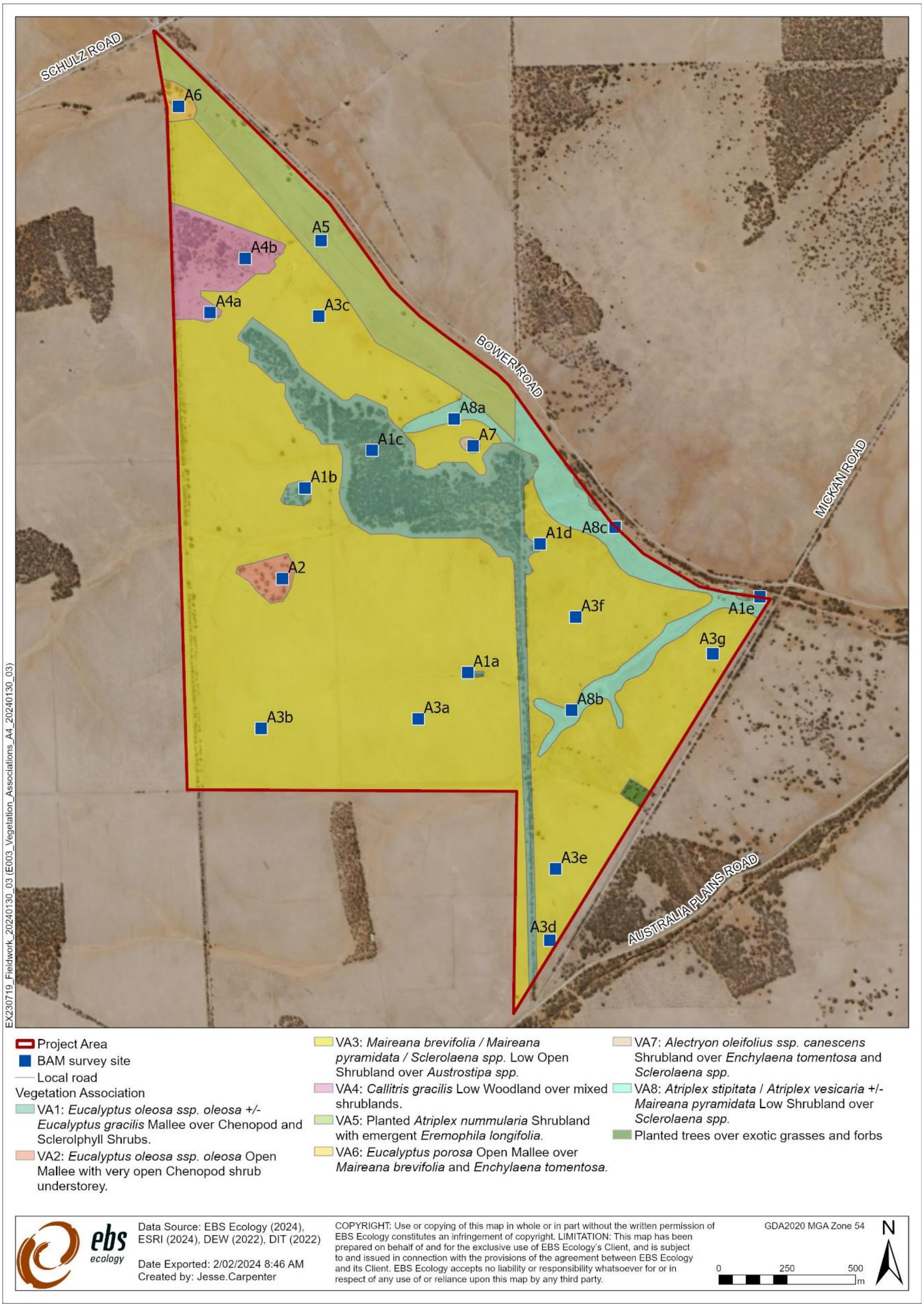


Figure 4. Vegetation associations and BAM sites within the Project Area (EBS Ecology 2024).

3 METHODOLOGY

3.1 Desktop assessment

A desktop assessment was undertaken by EBS to determine the potential for any threatened flora and fauna species and Threatened Ecological Communities (TECs) (both Commonwealth and State listed under the *National Parks and Wildlife Act 1972* (NPW Act) to occur within the Project Area (EBS 2024)). This was achieved by undertaking database searches using a 5 km buffer of the Project Area (the Search Area).

3.1.1 Protected Matters Search Tool report

A PMST report was generated on 14 November 2023 (DCCEEW 2023a) to identify nationally threatened flora and fauna, migratory fauna and TECs under the EPBC Act relevant to the Project Area. An updated PMST report was generated on 9 February 2024 to in order to capture any newly listed threatened species (DCCEEW 2024). Threatened species and TECs that were identified in the PMST report as Likely or Known to occur within the Search Area were assessed for their likelihood of occurrence within the Project Area.

3.1.2 Biological Databases of South Australia

A data extract from the Biological Databases of South Australia (BDBSA) was obtained through a data request from the Department for Environment and Water (DEW) to identify flora and fauna species that have been recorded within 5 km of the Project Area (Record set number DEWNRBDBSA230912-4.; Received: 12 September 2023; (DEW 2023a). The BDBSA is comprised of an integrated collection of species records from the South Australian Museum, conservation organisations, private consultancies, Birds SA, Birdlife Australia, and the Australasian Wader Study Group, which meet the DEW standards for data quality, integrity, and maintenance. Only species with records that had a spatial reliability of less than 1 km were assessed for their likelihood of occurrence.

3.2 Environment Protection and Biodiversity Conservation Act 1999

The 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 (MNES).

This EPBC Self-assessment has been prepared in line with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment (DotE) 2013) which provide overarching guidance to help determine whether an action is likely to have a significant impact on a MNES. Nine significant impact criteria are detailed within the guidelines which are required to be addressed to determine the potential for a Project to have a significant impact on MNES. The criteria vary depending on the conservation rating of a particular species.

The EPBC Act self-assessment process determines the potential for the Project to have a significant impact on MNES and whether a referral under the EPBC Act is required. Substantial penalties apply for undertaking an action that has, will have, or is likely to have a significant impact on a MNES without approval.

3.2.1 Significant impact guidelines

The significant impact guidelines for species listed by the EPBC Act under each conservation level are as listed in Table 3. Terminology used in the table is defined under the EPBC Act as set out below:

Population of a species – an occurrence of the species in a particular area. In relation to a critically endangered, endangered, or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or a collection of local populations, that occurs within a particular bioregion.

Invasive species – an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

Important population – a population that is necessary for a species' long-term survival and recovery. This may include populations that are identified as such in recovery plans, and/or that area:

- Key source populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity.
- Populations that are near the limit of the species range.

Habitat critical to the survival of a species – refers to areas that are necessary:

- For activities such as foraging, breeding, roosting or dispersal.
- For the long-term maintenance of the species or ecological community.
- To maintain genetic diversity and long-term evolutionary development.
- For the reintroduction of populations or recovery of the species or ecological community.

Important habitat (migratory species) – refers to:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at a particular life-cycle stage, and/or
- Habitat utilised by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining.

Ecologically significant proportion (migratory species) – what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness, and species-specific behavioural patterns (for example, site fidelity and dispersal rates).

Population (migratory species) – means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Table 3. MNES significant impact guidelines (DotE 2013).

Critically Endangered and Endangered	Vulnerable	Migratory
1. Lead to a long-term decrease in the size of a population of a species. 2. Reduce the area of occupancy of the species. 3. Fragment an existing population into two or more populations. 4. Adversely affect habitat critical to the survival of a species. 5. Disrupt the breeding cycle of a population. 6. Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline. 7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the species' habitat. 8. Introduce disease that may cause the species to decline. 9. Interfere with the recovery of the species.	1. Lead to a long-term decrease in the size of an important population of a species. 2. Reduce the area of occupancy of an important population. 3. Fragment an existing population into two or more populations. 4. Adversely affect habitat critical to the survival of a species. 5. Disrupt the breeding cycle of an important population. 6. Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. 7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. 8. Introduce disease that may cause the species to decline. 9. Interfere substantially with the recovery of the species.	1. Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species. 2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. 3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

3.3 Extent of Occurrence and Area of Occupancy

Impact to each relevant threatened species resulting from the proposal has been assessed considering the species' extent of occurrence (EOO) and area of occupancy (AOO). EOO and AOO figures for MNES were obtained from the Department of Climate Change, Energy, Environment and Water (DCCEEW) Conservation Advice documents for the species in question.

Extent of occurrence

The EOO is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known records (occurrences) of a species, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of a species, such as large areas of obviously unsuitable habitat.

Area of occupancy

The AOO of a species is defined as the area within the EOO which is occupied by that species. The AOO reflects the fact that a species is unlikely to occur throughout the entire area of its EOO. The size of the area of occupancy will be a function of the scale at which it is measured and should be at a scale appropriate to relevant biological aspects of the species, the nature of threats and the available data.

3.4 Limitations

This impact assessment is based on the information available at the time of writing. Any change in impact area, Project design, or updated flora and fauna survey results, may require the significance of impact to be re-assessed.

Threatened species records include only those listed as a result of the database searches at the time of the assessment and may include records that may not have been adequately verified or may not include all species that could occur in the Project Area. Furthermore, limitations exist within the PMST and BDBSA data collection methods and so the type of presence that can be determined from the data is indicated in general terms. The following limitations should be considered:

- BDBSA only includes verified flora and fauna records submitted to DEW or partner organisation, and it is recognised that knowledge is often poorly captured, and the presence of species may not be adequately represented by database records.
- DEW gives no warranty that the data is accurate or fit for any particular purpose of the user or any other person to whom the user discloses the information.

4 LIKELIHOOD ASSESSMENT

The PMST reports (DCCEEW 2023a; 2024) identified three Threatened Ecological Communities (TEC), 11 threatened species and one migratory species as Likely or Known to occur in the Search Area. No newly listed species were identified in the 2024 PMST. Species that the PMST assessed as May occur have not been assessed any further due to a low probability of utilising the habitat in the Project Area as there was a lack of suitable habitat for the species during the field survey (EBS 2024).

The self-assessment was only undertaken on MNES that were assessed by EBS as Known, Highly Likely, Likely, or Possibly occurring in the Project Area (EBS 2024) and have suitable habitat that will be impacted by the development of the Project. There was one exception to this: the TEC Plains mallee box woodlands (PMBW) of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plain Bioregions, which was identified by the PMST as May occur but was found to occur in the Project Area during the field survey (EBS 2024).

Based on data gathered during field surveys and database searches, EBS identified five MNES (two TEC and three threatened fauna) that may be impacted by the Project (Table 4). The potential for a significant impact to each of these five MNES was assessed using the *Significant impact guidelines 1.1*.

See EBS (2024) for full Likelihood of Occurrence Assessment of all threatened species identified by the desktop study (EBS 2020).

Table 4: The occurrence of MNES identified by the PMST report and BDBSA dataset within the Search and Project Area.

Species	Common name	EPBC Act Status	PMST occurrence status	Likelihood of occurrence within Project Area - comments
Threatened Ecological Communities				
Mallee Bird Community of the Murray Darling Depression Bioregion		EN	Likely to occur	**Known to occur in Project Area**, recorded by field survey.
Plains mallee box woodlands (PMBW) of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plain Bioregions		CE	May occur	**Known to occur in Project Area**, recorded by field survey.
Threatened Fauna Species				
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU	Known to occur	**Highly likely -** Despite no recent (<40 years) records, habitat is present within Project Area.
Melanodryas cucullata cucullata	South-eastern Hooded Robin,	EN	Known to occur	**Likely -** Habitat in the Project Area is suitable and recent (<20 years old) records.
Neophema chrysostoma	Blue-winged Parrot	VU	Likely to occur	**Possible -** Suitable habitat is present in Project Area, however no recent records.

EPBC Act Status: CE: Critically Endangered. EN: Endangered. VU: Vulnerable.

5 MALLEE BIRD COMMUNITY OF THE MURRAY DARLING DEPRESSION BIOREGION

5.1 Conservation listing

The Mallee Bird Community of the Murray Darling Depression Bioregion, hereafter referred to as the "Mallee Bird Community" (MBC) TEC is listed as Endangered under the EPBC Act as of 7 December 2021.

5.2 Biology and description

5.2.1 Community description

This community is described as the type of fauna community found in the Murray Darling Depression (MDD) bioregion. It is an assemblage of 20 bird species that are dependent on mallee vegetation (Mallee specialists and mallee dependents (Table 5)). The community is also characterised by vegetation, of which there are four broad types, based on the understorey features and environmental variables:

- Triodia Mallee – this includes mallee with a relatively open understorey with hummock grass and sparse sclerophyll shrubs with an arid affinity. Upper story components include *Eucalyptus socialis* and *E. dumosa* with key understorey species such as *Triodia scariosa*.
- Chenopod (and Tussock Grass) Mallee – this mallee has an open understorey with semi-succulent chenopod shrubs and tussock grass. *Eucalyptus gracilis*, *E. behriana* and *E. oleosa* compose the upper storey with chenopod species such as *Maireana*, *Atriplex* and *Rhagodia* comprising the understorey.
- Shrubby Mallee – relatively open understorey of sclerophyll shrubs and with an arid affinity, these species tend to be long lived with regenerative organs. Upper storey includes mallee species such as *Eucalyptus socialis*, *E. dumosa* and *E. gracilis* with understorey consisting of taller shrub species such as *Acacia*, *Senna*, *Dodonaea* and *Eremophila*.
- Heathy Mallee – dense understorey of sclerophyll shrubs with temperate affinities, grasses and forbs less common. Overstory species such are *Eucalyptus incrassata*, *E. diversifolia*, *E. dumosa* and *Callitris verrucosa.* Understorey species usually consist of *Acacia*, *Cryptandra*, *Daviesia*, *Grevillea*, *Hakea*, *Melaleuca* and *Phebalium*.

Table 5: Species of the Mallee Bird Community and their conservation status.

Mallee Bird Community Status	Species Name	Common Name	Conservation Status	
			Aus	SA
Mallee specialists	*Amytornis striatus*	Striated Grasswren		R
	Cinclosoma castanotum	Chestnut Quail-thrush		R
	Leipoa ocellata	Malleefowl	VU	V
	Manorina melanotis	Black-eared Miner	EN	E
	Neophema splendida	Scarlet-chested Parrot		R
	Pachycephala rufogularis	Red-lored Whistler	VU	R
	Psophodes nigrogularis	Mallee Western Whipbird	VU	E
	Stipiturus mallee	Mallee Emu-wren	EN	E

Mallee Bird Community Status	Species Name	Common Name	Conservation Status Aus	SA
Mallee dependents	*Hylacola cauta*	Shy Heathwren		R
	Drymodes brunneopygia	Southern Scrub-robin		
	Lichenostomus cratitius	Purple-gaped Honeyeater		
	Malurus splendens	Splendid Fairy-wren		
	Microeca fascinans	Jacky Winter		
	Nesoptilotis leucotis	White-eared Honeyeater		
	Oreoica gutturalis	Crested Bellbird		
	Pardalotus punctatus	Spotted Pardalote		
	Polytelis anthopeplus	Regent Parrot	VU	E
	Ptilotula ornata	Yellow-plumed Honeyeater		
	Ptilotula plumula	Grey-fronted Honeyeater		
	Purnella albifrons	White-fronted Honeyeater		

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

5.2.2 Distribution

The MBC TEC is limited to the following IBRA bioregions and subregions (Department of Agriculture, Water and the Environment (DAWE) 2021a):

- The MDD bioregion and all seven sub regions.
- The Riverina subregion where the Murray River intrudes into the MDD: Murray Fans, Robinvale Plains and Murray Scroll Belt; and
- Darling Riverine Plains subregion where the Darling River anabranches intrude into the MDD, Great Darling Anabranch and Pooncarie-Darling.

5.2.3 Key diagnostic characteristics

EBS (2024) undertook an assessment of the MBC TEC within the Project Area. In addition to opportunistic records, dedicated 20-minute, 2-hectare (ha) bird surveys (Birdlife Australia 2023) were undertaken during the field survey within VAs. Historical records of species listed in Table 5 were also considered as part of this assessment. Table 6 highlights the key diagnostic characteristics for the MBC TEC and the relevance to the Project Area.

Table 6: Determining criteria of the MBC based on habitat presence, location and bird species present within (DAWE 2021a).

Citeria	Criteria Description	VA1 - *Eucalyptus oleosa* ssp. *oleosa +/- Eucalyptus gracilis* Mallee over Chenopod and Sclerophyll Shrubs	VA2 - *Eucalyptus oleosa* spp. *oleosa* Open Mallee with very open understorey
1	Is the Project Area in any of the following IBRA bioregions or subregions? • Murray Darling Depression • Riverina • Darling Riverine Plains	Yes.	Yes.
2	Is a patch of native vegetation >10 ha present in the Project Area.	Yes.	Yes.

Citeria	Criteria Description	VA1 - *Eucalyptus oleosa* ssp. *oleosa +/- Eucalyptus gracilis* Mallee over Chenopod and Sclerophyll Shrubs	VA2 - *Eucalyptus oleosa* spp. *oleosa* Open Mallee with very open understorey
3	Does the patch of native vegetation contain an area of at least 5 ha dominated by mallee?	Yes. Patch size >30 ha.	No. Patch size 2.4 ha.
4	Have at least 3 MBC bird species been recorded within 20 km of the Project Area (including observed during field survey or represented by historical records <10 years old)?	Yes. • Jacky Winter (historical). • Regent Parrot (historical). • Spotted Pardalote (historical). • White-eared Honeyeater (historical). • White-fronted Honeyeater (historical). • Yellow-plumed Honeyeater (historical).	Yes. • Jacky Winter (historical). • Regent Parrot (historical). • Spotted Pardalote (historical). • White-eared Honeyeater (historical). • White-fronted Honeyeater (historical). • Yellow-plumed Honeyeater (historical).
Assessment – Vegetation Association VA1 is the MBC TEC. Vegetation Association VA2 is not regarded as the MBC TEC due to patch size being <5 ha.			

5.3 Occurrence within the Project Area

The 37.85 ha of the MBC TEC occurs scattered in the Project Area as VA1. This vegetation consists of *Eucalyptus oleosa* spp. and chenopod shrubs, reflecting the mallee system as outlined in Section 5.2 (Chenopod (and Tussock Grass) Mallee). The location of this VA/TEC within the Project Area and extent of the proposed impact are shown in Figure 5.

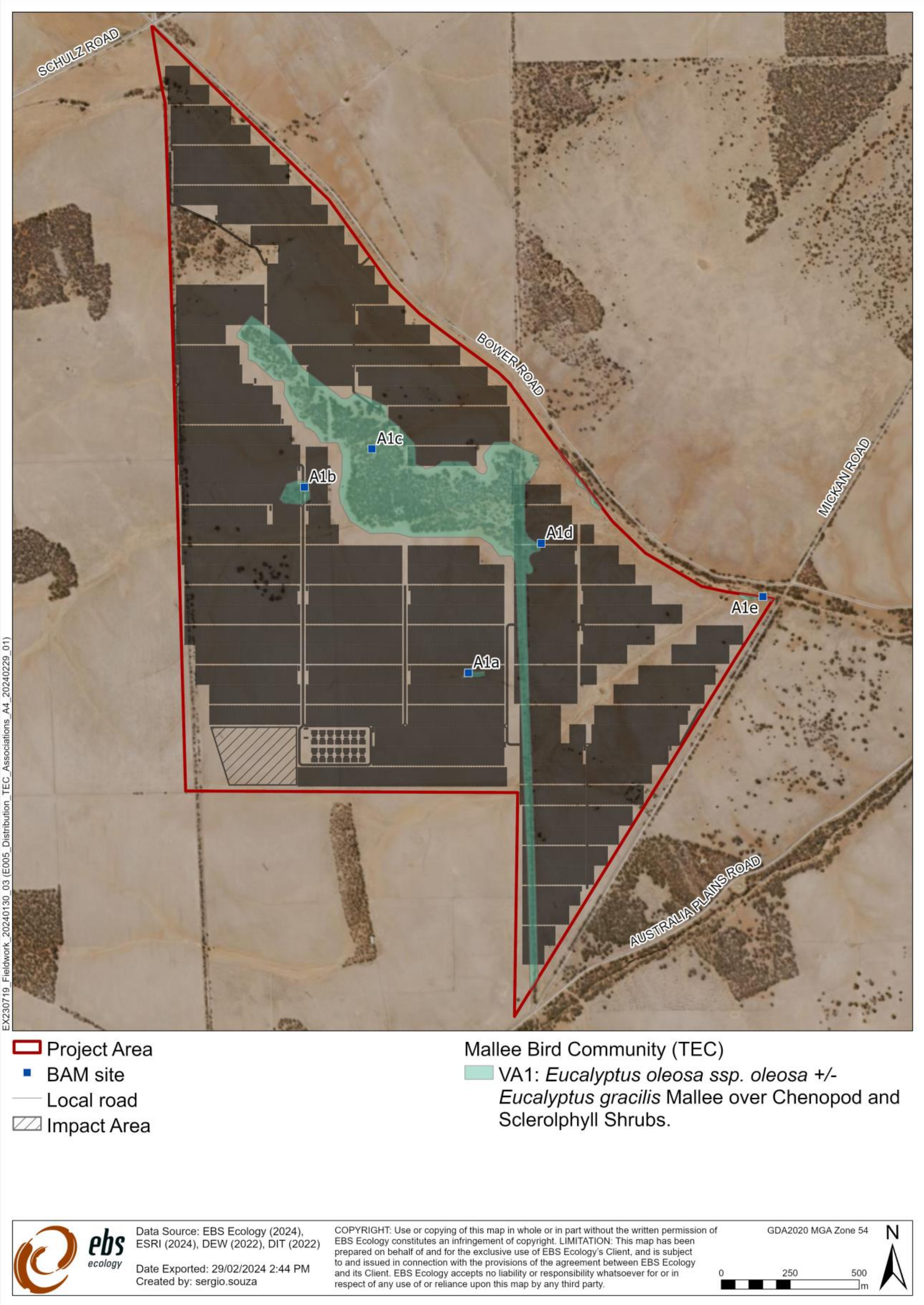


Figure 5: Distribution of VA1 (which was assessed as the MBC TEC) within the Project Area and proposed extent of impact.

5.4 Mallee Bird Community significant impact assessment

A significant impact assessment for the MBC TEC is presented in Table 7. The significant impact criteria for an Endangered ecological community have been obtained from the EPBC Act Matters of *National Environmental Significance Significant impact guidelines 1.1*.

Table 7: The MBC of the Murray Darling Depression Bioregion assessed against the Significant Impact Criteria for an Endangered ecological community (DotE 2013).

Significant Impact Criteria	Significant Impact?	Justification
Reduce the extent of an ecological community	**No**	The extent of the MBC TEC extends across much of the Riverland in SA and some in Victoria and New South Wales. As the Project involves the clearance of 3.65 ha of the MBC TEC, it is unlikely that much mallee habitat will be impacted and as such a reduction of the extent of the MBC TEC is unlikely.
Fragment or increase fragmentation of an ecological community, by clearing vegetation.	**No**	The areas of the TEC that will be impacted is small patches that are already fragmentated. An increase of fragmentation between other PMBWs should not occur as there is a large patch of the VA not being impacted.
Adversely affect habitat critical to the survival of an ecological community	**No**	The clearance of the MBC TEC at the site is only 3.65 ha out of the 37.85 ha present.
Modify or destroy abiotic factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**No**	The Project is not likely to modify or destroy abiotic factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	**No**	Given the extent of mallee vegetation in the greater surrounds of the Project Area, a substantial change in species composition of the MBC TEC is unlikely to occur as a result of the Project. No regular burning or flora harvesting is involved.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	**No**	Many invasive species that are harmful to the MBC TEC are already established in the Project Area. Similarly, the Project will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the MBC TEC. As such, the Project will not cause a substantial reduction in the quality or integrity of an occurrence of the MBC TEC.
Interfere with the recovery of an ecological community	**No**	The Project will not interfere with the recovery of the MBC TEC.
Outcome	No Significant Impact	

6 PLAINS MALLEE BOX WOODLANDS (PMBW) OF THE MURRAY DARLING DEPRESSION, RIVERINA, AND NARACOORTE COASTAL PLAIN BIOREGIONS

6.1 Conservation listing

Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plains Bioregions, hereafter referred to as the "Plains Mallee Box Woodlands" (PMBW) TEC is listed as a Critically Endangered TEC under the EPBC Act as of 10 June 2021.

6.2 Biology and description

6.2.1 Community description

The PMBW TEC is described as a medium to tall open mallee eucalypt woodland which a canopy typically dominated by 'mallee box' Eucalyptus species. Other features of the community may include an understory of tussock grasses being prominent in relatively wet years, low chenopod shrubs occurring in variable densities, and taller shrubs being sparse. The community is often associated with relatively medium to heavy textured soils but may occasionally be sandy clay loams or light clays on near-level to gently sloping plains.

6.2.2 Distribution

PMBW TEC is found in in south-west New South Wales (NSW), north-west Victoria, and south-east South Australia (SA) in the Murray Darling Depression, Riverina, and Naracoorte Coastal Plains Bioregions. The community is associated within semi-arid regions with the average rainfall of 260 – 450 mm.

6.2.3 Key diagnostic characteristics

EBS (2024) undertook an assessment of the PMBW TEC in the Project Area. Table 8 highlights the key diagnostic characteristics for the PMBW TEC and the relevance to the Project Area.

Table 8: Determining criteria of the PMBW TEC based on habitat presence, location and bird species present within (DAWE 2021b).

Citeria	Criteria Description (DAWE 2021a)	VA6 - *Eucalyptus porosa* Open Mallee over *Maireana brevifolia* and *Enchylaena tomentosa*
1	Occurs in the Murray darling Depression, Riverina, or Naracoorte Coastal Plains	Yes – Murray Darling Depression Bioregion.
2	Occurs on near-level plains or occasionally on gently sloping terrain surrounding and within run-on landscape depressions where soil textures are typically clay loams but may occasionally be sandy clay loams or light clays.	Yes.
3	Primary diagnostic species particular to PMBW are the dominance of box-barked eucalypt species like *Eucalyptus porosa* or *E. behriana*, however other species may dominate (*including E. calycogona* or *E. Dumosa*).	Yes - *Eucalyptus porosa* is the dominant species

Citeria	Criteria Description (DAWE 2021a)	VA6 - *Eucalyptus porosa* Open Mallee over *Maireana brevifolia* and *Enchylaena tomentosa*
4	Mature tree canopy is usually 5-10m tall, but can occasionally occur around 15m, with a tree canopy cover typically 10-15%	Yes.
5	A small tree and/or large shrub layer may be present, but is typically very sparse with < 5% cover and a height range of 3-5 m. A medium shrub layer 1-3 m tall may also be present with typically very sparse cover < 10%. A distinctive low to decumbent chenopod sub-shrub layer can be a key feature in many occurrences. Triodia spp. (spinifex) are typically absent from the ground layer and never dominant	Yes.
Assessment – Vegetation Association A6 is the PMBW TEC.		

6.3 Occurrence within the Project Area

A total of 1.35 ha of the PMBW TEC occurs within the northwestern corner of the Project Area as VA 6. This vegetation consists of *Eucalyptus porosa* (Mallee Box) Open Mallee over Chenopod shrubs like *Maireana brevifolia* (Short-leaf Bluebush) and *Enchylaena tomentosa* (Ruby Saltbush) reflecting the mallee system as outlined in Section 6.2.3. The location of this VA/TEC within the Project Area and the extent of impact is shown in Figure 6.

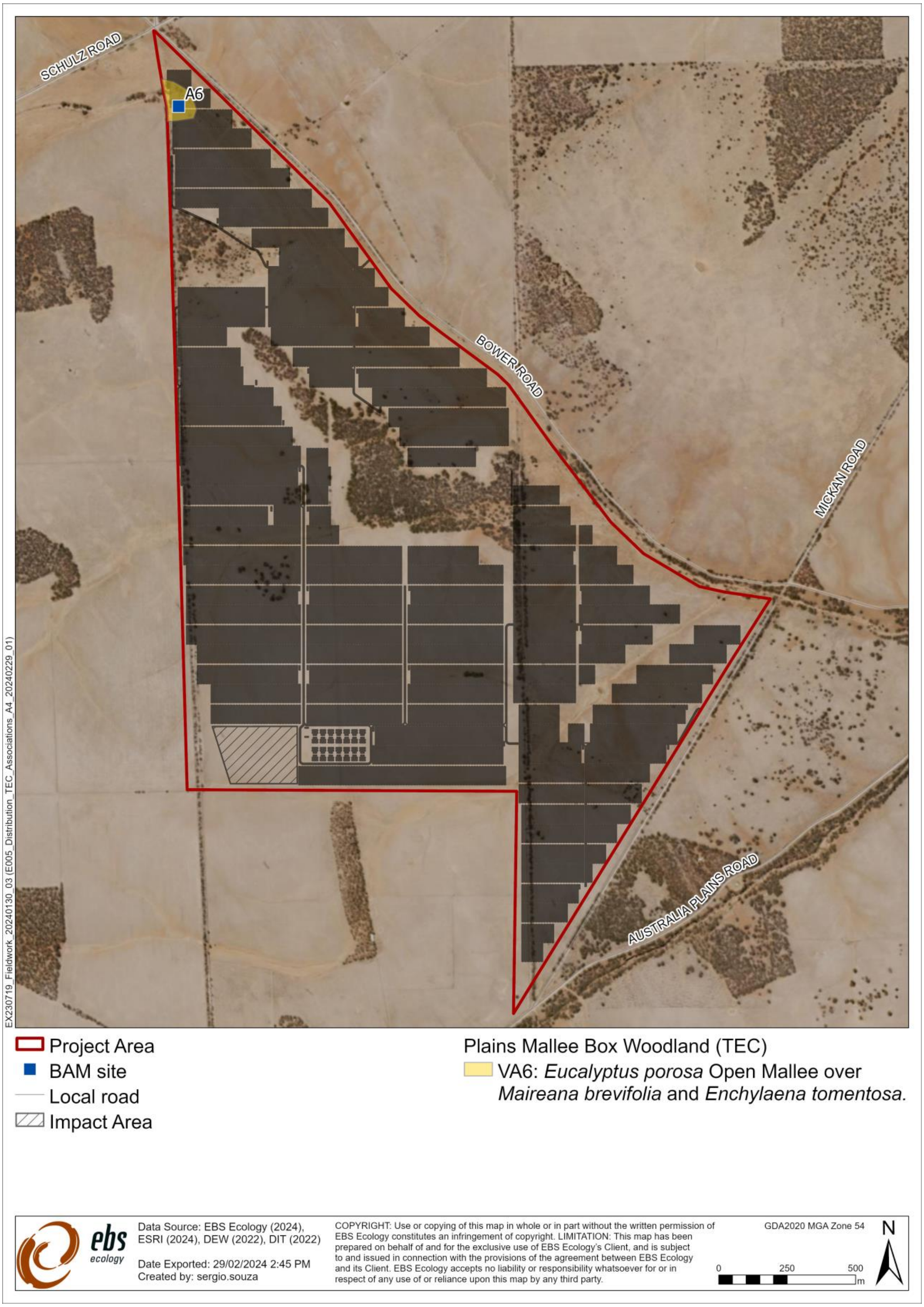


Figure 6: Distribution of VA 6 (which was assessed as the PMBW TEC) within the Project Area and proposed extent of impact.

6.4 Plains Mallee Box Woodlands significant impact assessment

A significant impact assessment for The PMBW TEC is presented in Table 9. The significant impact criteria for a Critically Endangered ecological community have been obtained from the EPBC Act *Matters of National Environmental Significance Significant impact guidelines 1.1.*

Table 9: The PMBW TEC of the Murray Darling Depression, Riverina, and Naracoorte Coastal Plains Bioregions assessed against the Significant Impact Criteria for a Critically Endangered ecological community (DotE 2013).

Significant Impact Criteria	Significant Impact?	Justification
Reduce the extent of an ecological community	**No**	The extent of the PMBW TEC extends across much of the Riverland in SA and some in Victoria and New South Wales. As the Project involves the clearance of 0.42 ha of the PMBW TEC, it is unlikely that much mallee habitat will be impacted and as such a reduction of the extent of the PMBW TEC is unlikely.
Fragment or increase fragmentation of an ecological community, by clearing vegetation.	**No**	The PMBW TEC that is identified was a small patch that is already fragmentated. An increase of fragmentation between other areas of the PMBW TEC should not occur as not the entire VA is being cleared.
Adversely affect habitat critical to the survival of an ecological community	**No**	The clearance of the PMBW TEC at the site is only 0.45 ha out of the 1.35 ha present which itself is not a significantly sized patch in the context of the distribution of the PMBW TEC.
Modify or destroy abiotic factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**No**	The Project is not likely to modify or destroy abiotic factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	**No**	Given the extent of mallee vegetation in the greater surrounds of the Project Area, a substantial change in species composition of the PMBW TEC is unlikely to occur as a result of the Project. No regular burning or flora harvesting is involved.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	**No**	Many invasive species that are harmful to the PMBW TEC are already established in the Project Area. Similarly, the Project will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the PMBW TEC. As such, the Project will not cause a substantial reduction in the quality or integrity of an occurrence of the PMBW TEC.
Interfere with the recovery of an ecological community	**No**	The Project will not interfere with the recovery of the PMBW TEC.
Outcome	No Significant Impact	

7 SOUTHERN WHITEFACE (APHELOCEPHALA LEUCOPSIS)

7.1 Conservation listing

The Southern Whiteface is listed as Vulnerable under the EPBC Act as of 31 March 2023.

7.2 Biology and Description

7.2.1 Species description

The Southern Whiteface is a small stocky thornbill-like bird with a brown dorsum, white belly, dark brown wings and a black tail with narrow white tip. A grey wash on the belly is sometimes present, along with a grey or rufous tinge to the flanks. The species displays the characteristic facial markings of the genus: a white band across the forehead, with a darker streak along the top edge. Adult birds are approximately 11.5 centimetres (cm) in length with a cream-coloured eye, grey legs and a stubby dark grey bill of finch-like appearance (DCCEEW 2023b).

7.2.2 Distribution and habitat

The Southern Whiteface occurs across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range. There is a broad hybrid zone between the two subspecies extending north from the western edge of the Nullarbor Plain. The northern boundary extends to about Carnarvon in the west, to the southern Northern Territory in central Australia, but is slightly further south in Queensland where the species is largely confined to the south-west of the Mitchell Grass Downs and along the southern state border (DCCEEW 2023b).

The Southern Whiteface occurs in open woodland and shrubland habitat with an understorey of grasses and / or low shrubs. Suitable habitat is usually dominated by *Acacia* spp. or *Eucalyptus* spp. on ranges, foothills, lowlands and plains. Critical habitat for the Southern Whiteface includes areas of (DCCEEW 2023b):

- Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs or both.
- Habitat with low tree densities and an herbaceous understorey litter cover which provides essential foraging habitat.
- Living and dead trees with hollows and crevices which are essential for roosting and nesting.

7.2.3 Extent of occurrence and area of occupancy

The EOO and AOO of the Southern Whiteface has been estimated as listed in Table 10.

Table 10: The Extent of Occurrence and Area of Occupancy of the Southern Whiteface (DCCEEW 2023b).

Extent of Occurrence (km^2)	Area of Occupancy (km^2)	Impacted Habitat (ha)	Percent of AOO Impacted (%)
4,910,000	70,000	6.32	0.000001

7.3 Occurrence in the Project Area

Southern Whiteface were not observed during the field survey of the Project Area undertaken by EBS in September 2023. A search for historical records held by BDBSA found that there were no records of the Southern Whiteface since 1995 within the Search Area, with the most recent records being in 1985. There are 362 records of the species since 1995 with the spatial reliability of less than 1 km within 50 km of the Project Area, with the closest record being within 10 km of the Project Area.

7.3.1 Suitable habitat

Four suitable VAs that exist within the Project Area that are likely to provide habitat for Southern Whiteface. These are outlined in Table 11.

Table 11: VAs of the Project Area likely to provide habitat for Southern Whiteface.

Vegetation Association	Total in Project Area (ha)	Area of Impact (ha)
VA1: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mallee over *Maireana brevifolia* (Short-leaf Bluebush)	37.85	3.65
VA2: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Open Mallee with very open understorey	2.37	1.01
VA4: *Callitris gracilis* (Southern Cyress Pine) Low Woodland over mixed shrublands	10.61	1.21
VA6: *Eucalyptus porosa* (Mallee Box) Open Mallee over *Maireana brevifolia* (Short-leaf Bluebush) / *Enchylaena tomentosa* (Ruby Saltbush)	1.35	0.45
Total	**52.18**	**6.32**
% Project Area habitat impacted		**12.11%**

7.4 Southern Whiteface significant impact assessment

7.4.1 Direct and indirect impacts to species and species habitat

Given that four vegetation associations in the Project Area are suitable habitat for Southern Whiteface, the current proposal would involve clearing 6.32 ha (12.11%) of the total 52.18 ha of suitable habitat within the Project Area (Table 11).

7.4.2 Assessment against significant impact guidelines

Assessment of impact to Southern Whiteface against the significant impact guidelines is discussed in Table 12.

Table 12: Impact to Southern Whiteface assessed against the Significant Impact Criteria for a Vulnerable species (DotE 2013).

<table>
<tr><th>Significant Impact Criterion</th><th>Impact Likelihood*</th><th>Comments</th></tr>
<tr><td>Lead to a long-term decrease in the size of an important population.</td><td>No impact</td><td>There are no important populations defined under the EPBC Act for the Southern Whiteface and the species has a continuous distribution throughout its range. This assessment has therefore considered that the species exists as a single population.
While the Project may impact some individual Southern Whiteface and a relatively small amount of habitat in the Project Area, 87.9% of suitable habitat in the Project Area will remain unimpacted. This level of impact is not likely to cause a long-term decrease in the size of the Southern Whiteface population.</td></tr>
<tr><td>Reduce the area of occupancy of an important population.</td><td>No impact</td><td>The AOO has been estimated at 70,000 km^2. The clearance of 6.32 ha, or 0.000001%, of this area is not likely to reduce the AOO of the population.</td></tr>
<tr><td>Fragment an existing important population into two or more populations.</td><td>No impact</td><td>No new access roads or other long, linear developments that might fragment the population are being constructed. Extensive suitable habitat will remain surrounding areas cleared of vegetation, maintaining connection between areas of Southern Whiteface habitat.</td></tr>
<tr><td>Adversely affect habitat critical to the survival of a species.</td><td>Rare</td><td>6.32 ha of habitat will be impacted. However, this represents only 12.11% of suitable habitat in the Project Area and 0.000001% of the species' AOO. Given the extensive distribution of this species and large amount of suitable intact habitat in the surrounding landscape, it is not likely that this impact would cause the species to decline.</td></tr>
<tr><td>Disrupt the breeding cycle of an important population.</td><td>No impact</td><td>Clearance of habitat in relation to the total habitat available in the Project Area is unlikely to disrupt the breeding cycle of the population, although some individuals may be affected.</td></tr>
<tr><td>Modify, destroy, remove and isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</td><td>No impact</td><td>The removal of 12.11% of suitable habitat in the Project Area is not of sufficient scale to cause the species to decline.</td></tr>
<tr><td>Result in an invasive species that is harmful to a vulnerable species becoming established in the vulnerable species' habitat.</td><td>No impact</td><td>Habitat loss and degradation caused by land clearing and grazing by livestock and feral herbivores is thought to be a contributing factor in the decline of the species. Invasive species are already established in the Project Area. It is unlikely that the development of the Solar Farm will result in harmful invasive species that are a threat to the Southern Whiteface.</td></tr>
<tr><td>Introduce disease that may cause the species to decline.</td><td>No impact</td><td>There are no known disease or pathogens that may impact the species.</td></tr>
<tr><td>Interfere with the recovery of the species.</td><td>No impact</td><td>The Solar Farm development does not interfere with any proposed recovery actions for the species and does not exacerbate threatening processes that have been identified for the species, listed below (DCCEEW 2023b):
• Habitat loss caused by clearance for agriculture.
• Habitat degradation caused by domestic livestock grazing.
• Increased frequency or length of droughts caused by climate change.
• Increased likelihood of extreme events caused by climate change.</td></tr>
<tr><td>Outcome</td><td colspan="2">No significant impact</td></tr>
</table>

***Impact Likelihood:**

- **Rare – the impact may only occur in exceptional circumstances.**
- **No impact – impact to the species or species habitat is avoided.**

8 SOUTH-EASTERN HOODED ROBIN (*MELANODRYAS CUCULLATA CUCULLATA*)

8.1 Conservation listing

The South-eastern Hooded Robin is listed as Endangered under the EPBC Act as of 31 March 2023.

8.2 Biology and Description

8.2.1 Species description

The South-eastern Hooded Robin is a large robin that can reach 17 cm in length. The male is marked in black and white, with a bold black hood extending down a white breast. The back is black with a distinct white shoulder and wing-bar. The tail is also black with obvious white side-panels. Female and juvenile Hooded Robins are duller in colour, with light brownish-grey upperparts, but with the same obvious black and white wings. The southeastern subspecies are described as shy and largely sedentary and are mostly seen in pairs or small groups (DCCEEW 2023c).

8.2.2 Distribution and habitat

South-eastern Hooded robins occur in southeastern Australia from far southeast Queensland to Yorke Peninsula, South Australia, intergrading with the subspecies *Melanodryas cucullata picata* in the southern Murray-Darling basin (Schodde & Mason 1999). The subspecies is now absent from many formerly occupied sites, particularly in the wetter areas of the south and east (Barrett *et al.* 1994; Paton *et al.* 1994; Ford *et al.* 2009). The population is not severely fragmented, and the number of locations is greater than 10. However, fragmented populations do occur in some areas, and these are assumed to be genetically isolated (Ford *et al.* 2021).

This species prefers dry eucalypt and acacia woodlands and shrublands with an open understorey, some grassy areas and a complex ground layer. They avoid woodlands with tall trees or dense tree cover but sometimes occur in tall, dense heaths with scattered open areas. While they can occur in patches as small as 2.9 ha (Montague-Drake *et al.* 2009), in agricultural landscapes they prefer larger patches greater than 10 ha (Watson *et al.* 2000) with moderately deep to deep soils (Priday 2010).

8.2.3 Extent of occurrence and area of occupancy

The EOO and AOO of the South-eastern Hooded Robin has been estimated as listed in Table 13.

Table 13: The Extent of Occurrence and Area of Occupancy of South-eastern Hooded Robin (DCCEEW 2023c).

Extent of Occurrence (km^2)	Area of Occupancy (km^2)	Impacted Habitat (ha)	Percent of AOO Impacted (%)
1,200,000	30,000	6.32	0.000002

8.3 Occurrence in the Project Area

There were three South-eastern Hooded Robin records within 5 km of the Project Area in 2010, details of which are provided in Table 14. The South-eastern Hooded Robin was not observed during the field survey of the Project Area undertaken by EBS in September 2023.

Table 14: BDBSA records of the South-eastern Hooded Robin within 5 km of the Project Area.

Easting	Northing	Location	Year	No of individuals
330890	6232506	3.1 km ESE of Rocky Plain	2010	2
330887	6232521	3.1 km ESE of Rocky Plain	2010	2
330887	6232521	3.1 km ESE of Rocky Plain	2010	1

8.3.1 Suitable habitat

There are four suitable VAs that exist within the Project Area that may provide habitat for South-eastern Hooded Robin. These are outlined in Table 15.

Table 15: VAs of the Project Area likely to provide habitat for South-eastern Hooded Robin.

Vegetation Association	Total in Project Area (ha)	Area of Impact (ha)
VA1: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mallee over *Maireana brevifolia* (Short-leaf Bluebush)	37.85	3.65
VA2: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Open Mallee with very open understorey	2.37	1.01
VA4: *Callitris gracilis* (Southern Cyress Pine) Low Woodland over mixed shrublands	10.61	1.21
VA6: *Eucalyptus porosa* (Mallee Box) Open Mallee over *Maireana brevifolia* (Short-leaf Bluebush) / *Enchylaena tomentosa* (Ruby Saltbush)	1.35	0.45
Total	**52.18**	**6.32**
% Project Area habitat impacted		**12.11%**

8.4 South-eastern Hooded Robin significant impact assessment

8.4.1 Direct and indirect impacts to species and species habitat

Given that four vegetation associations in the Project Area is suitable habitat for South-eastern Hooded Robin, the current proposal would involve clearing 6.32 ha (12.11%) of the total 52.18 ha of suitable habitat within the Project Area.

8.4.2 Assessment against significant impact guidelines

Assessment of impact to South-eastern Hooded Robin against the significant impact guidelines is discussed in Table 16.

Table 16: Impact to South-eastern Hooded Robin assessed against the Significant Impact Criteria for an Endangered species (DotE 2013).

Significant Impact Criterion	Impact Likelihood*	Comments
Lead to a long-term decrease in the size of a population.	**Rare**	While there will be some short-term impact to South-eastern Hooded Robin habitat that may indirectly impact the species, the extent of habitat affected is small and would not lead to a long-term decrease in the size of the population. Given that South-eastern Hooded Robin are mobile and able to vacate the small impact areas during development, no individuals are likely to be directly harmed by the proposal.
Reduce the area of occupancy of the species.	**Rare**	The AOO has been estimated at 30,000 km^2. The clearance of 6.32 ha, or 0.000002%, of this area is not likely to reduce the AOO of the population.
Fragment an existing population into two or more populations.	**No impact**	No new access roads or other long, linear developments that might fragment the population are being constructed. Extensive suitable habitat will remain surrounding areas cleared of vegetation, maintaining connection between areas of South-eastern Hooded Robin habitat.
Adversely affect habitat critical to the survival of a species.	**Rare**	6.32 ha of habitat will be impacted. However, 45.86 ha of habitat will remain in the Project Area. It is not likely that this impact would cause the species to decline.
Disrupt the breeding cycle of a population.	**Rare**	Clearance of habitat in relation to the total habitat available in the Project Area is unlikely to disrupt the breeding cycle of the population, although some individuals may be affected.
Modify, destroy, remove and isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	**Rare**	The removal of 6.32 ha of the 52.18 ha of suitable habitat in the Project Area is not of sufficient scale to cause the species to decline.
Result in an invasive species that is harmful to an endangered species becoming established in the endangered species' habitat.	**No impact**	Invasive species are already established in the Project Area. It is unlikely that the development of the Solar Farm will result in harmful invasive species that are a threat to the South-eastern Hooded Robin.
Introduce disease that may cause the species to decline.	**No impact**	There are no known disease or pathogens that may impact the species.
Interfere with the recovery of the species.	**No impact**	The Solar Farm development does not interfere with any proposed recovery actions for the species and does not exacerbate threatening processes that have been identified for the species, listed below (DCCEEW 2023c): • Habitat loss caused by clearance for agriculture. • Habitat degradation caused by domestic livestock grazing. • Increased frequency or length of droughts caused by climate change. • Increased likelihood of extreme events caused by climate change.
Outcome	**No significant impact**	

***Impact Likelihood:**

- **Rare – the impact may only occur in exceptional circumstances.**
- **No impact – impact to the species or species habitat is avoided.**

9 BLUE-WINGED PARROT (*NEOPHEMA CHRYSOSTOMA*)

9.1 Conservation listing

The Blue-winged Parrot is listed as Vulnerable under the EPBC Act as of 31 March 2023.

9.2 Biology and Description

9.2.1 Species description

The Blue-winged Parrot is a slender parrot with an olive-green head and upper body, grading to light green on the fore-neck. The upper tail is green-blue with yellow sides and underparts, and they may have an orange belly (Higgins 1999). A yellow facial patch extends back to the eye and a dark narrow blue band runs from the eye to eye across the forehead. This species is named after the dark obvious blue patch on the wings. Females are similar to the males but with slightly duller colours (DCCEEW 2023d).

9.2.2 Distribution and habitat

A partial migrant, a number of birds will migrate across the Bass Strait in winter. During the non-breeding period, from autumn to early spring, birds are recorded from northern Victoria, eastern SA and south-western Queensland and western NSW. Some birds will even reach south-eastern NSW and eastern Vicotria (Higgins 1999).

The Blue-winged Parrot inhabits a range of coastal, sub-coastal and inland areas through to semi-arid zones. They favour grasslands and grassy woodlands and are often found near wetlands both near the coast and semi-arid zones including chenopod shrubland with native and introduced grasses, herbs and forbs (Higgins 1999). Eucalypt forests and woodlands within the breeding range in Tasmania, coastal south-eastern SA and southern Victoria. All these areas are habitat critical to the survival of the Blue-winged Parrot.

9.2.3 Extent of occurrence and area of occupancy

The EOO and AOO of Blue-winged Parrot has been estimated as listed in Table 17.

Table 17: The Extent of Occurrence and Area of Occupancy of Blue-winged Parrot (DCCEEW 2023d).

Extent of Occurrence (km^2)	Area of Occupancy (km^2)	Impacted Habitat (ha)	Percent of AOO Impacted (%)
170,000	11,000	105.18	0.00001

9.3 Occurrence in the Project Area

Blue-winged Parrot was not observed within the Project Area during the field survey undertaken in September 2023. A NatureMaps search identified ten Blue-winged Parrot records within 50 km of the Project Area, with the closest being approximately 31 km southwest of the Project Area (DEW 2023b).

9.3.1 Suitable habitat

There are five suitable VAs that exist within the Project Area, which are likely to provide habitat for Blue-winged Parrot. These are outlined in Table 18.

Table 18: VAs of the Project Area likely to provide habitat for Blue-winged Parrot.

Vegetation Association	Total in Project Area (ha)	Area of Impact (ha)
VA3: *Maireana brevifolia* (Short-leaf Bluebush)/*Salsola australis* (Buckbush) +/- *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) Low Open Shrubland	251.06	94.39
VA5: Planted *Atriplex nummularia* (Oldman Saltbush) Shrubland with emergent *Eremophila longifolia* (Weeping Embush)	26.76	8.47
VA6: *Eucalyptus porosa* (Mallee Box) Open Mallee over *Maireana brevifolia* (Short-leaf Bluebush) / *Enchylaena tomentosa* (Ruby Saltbush)	1.35	0.45
VA7: *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) shrubland over *Maireana scleroptera* (Hard-wing Bluebush) +/- *Enchylaena tomentosa* (Ruby Saltbush)	0.32	0.11
VA8: *Atriplex vesicaria* (Bladder Saltbush) low shrubland over *Maireana* sp. (Bluebush) and Carrichtera annua (Wards Weed).	17.74	2.21
Total	**297.23**	**105.63**
% Project Area habitat impacted		**35.54%**

9.4 Blue-winged Parrot significant impact assessment

9.4.1 Direct and indirect impacts to species and species habitat

Given that a large area may provide suitable habitat for the Blue-winged Parrot, the current proposal may clear 105.18 ha (35.54%) of 297.23 ha of habitat. Given that suitable habitat is widespread surrounding the impact area and no records of the Blue-winged Parrot were observed within 5 km of the Project Area, the clearance of vegetation is unlikely to have a direct or indirect impact on this species.

9.4.2 Assessment against significant impact guidelines

Assessment of impact to Blue-winged Parrot against the significant impact guidelines is discussed in Table 19.

Table 19: Blue-winged Parrot (*Neophema chrysostoma*) assessed against the Significant Impact Criteria for a Vulnerable species (DotE 2013).

Significant Impact Criterion	Significant Impact?	Rationale
Lead to a long-term decrease in the size of an important population	Rare	No observations and previous records have been observed within the Project Area or 5 km from the Project Area. Although habitat within the Project Area may be suitable for this species, the extent of habitat affected is very small and would not lead to a long-term decrease in the size of the population.
Reduce the area of occupancy of an important population	Unlikely	The AOO has been estimated at 11,000km^2. The clearance of 105.18 ha, or 0.00001%, of this area is not likely to reduce the AOO of the population.

Significant Impact Criterion	Significant Impact?	Rationale
Fragment an existing important population into two or more populations	Unlikely	No individuals were observed on site and no records have been observed within 5 km of the Project Area. Therefore, it is unlikely that the development of the Solar Farm will fragment existing important populations. The design does not contain new access roads or other long, linear developments that might fragment the population are being constructed. Extensive suitable habitat will remain surrounding areas cleared of vegetation, maintaining connection between areas of Blue-Winged Parrot habitat.
Adversely affect habitat critical to the survival of a species	Unlikely	105.63 ha of habitat will be impacted. However, this represents 35.54% of habitat in the Project Area and 0.00001% of the species' AOO.
Disrupt the breeding cycle of an important population	Rare	Blue-winged Parrots breed in Tasmania, coastal south-eastern South Australia and Southern Victoria. The Project Area is not within the coastal south-eastern region of South Australia. Therefore, it is unlikely to disrupt an important breeding population of this species.
Modify, destroy, remove and isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely	The removal of 35.54% of suitable habitat in the Project Area is unlikely to cause a species decline. Suitable habitat exists outside of the Project Area with a majority of habitat being retained.
Result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No impact	As invasive species are already established within the Project Area it is unlikely that the Project will result in in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. Management of pest species may be required to account for any residual impacts on pest animal numbers associated with the proposed works.
Introduce disease that may cause the species to decline	Rare	Psittacine Beak and Feather Disease (PBFD) is a widespread and lethal parrot disease. Blue-winged Parrots are susceptible to PBFD. It is estimated that the threat level is relatively low. A reduction in suitable nesting hollows and increased competition due to removal of suitable breeding habitat is likely to increase the threat in the future. However, the Project Area is not located within a suitable breeding habitat for this species it is unlikely that disease will be introduced.
Interfere substantially with the recovery of the species	Rare	The development of the solar farm does not interfere with any proposed recovery actions for the species and does not exacerbate threatening processes that have been identified for the species, listed below (Department of Climate Change, Energy, the Environment and Water, 2023b): • Habitat loss caused by land clearing. • Inappropriate fire regimes. • Habitat degradation caused by domestic livestock grazing. • Increased frequency or length of droughts caused by climate change. • Increased likelihood of extreme events.
Outcome		**No significant impact.**

***Impact Likelihood:**

- **Unlikely – there is little opportunity, reason or means of the impact occurring as a result of Proposal.**
- **Rare – the impact may only occur in exceptional circumstances.**
- **No impact – impact to the species or species habitat is avoided.**

10 EPBC SELF-ASSESSMENT CONCLUSION

10.1 Significant impact outcome

This EPBC Act Self-assessment finds that the proposed development and/or operation of the Project will:

- not have a significant impact on the EPBC Endangered Mallee Bird Community of the Murray Darling Depression Bioregion TEC.
- not have a significant impact the EPBC Critically Endangered Plains Mallee Box Woodland of the Murray Darling Depression, Riverina and Naracoorte TEC.
- not have a significant impact the EPBC Act Vulnerable Southern Whiteface or its habitat.
- not have a significant impact the EPBC Act Endangered Hooded Robin or its habitat.
- not have a significant impact the EPBC Act Vulnerable Blue-winged Parrot or its habitat.

10.2 Referral advice

None of the MNES are significantly impacted by the proposed Project. As such a EPBC Act referral to the Minister for the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is deemed not required, so long as the level of impact (impact footprint based on Project design plans of 15/01/2024) discussed in this assessment remains unchanged.

Any increase in the extent of the Project impact footprint or changes in impact location may require re-assessment against significant impact guidelines.

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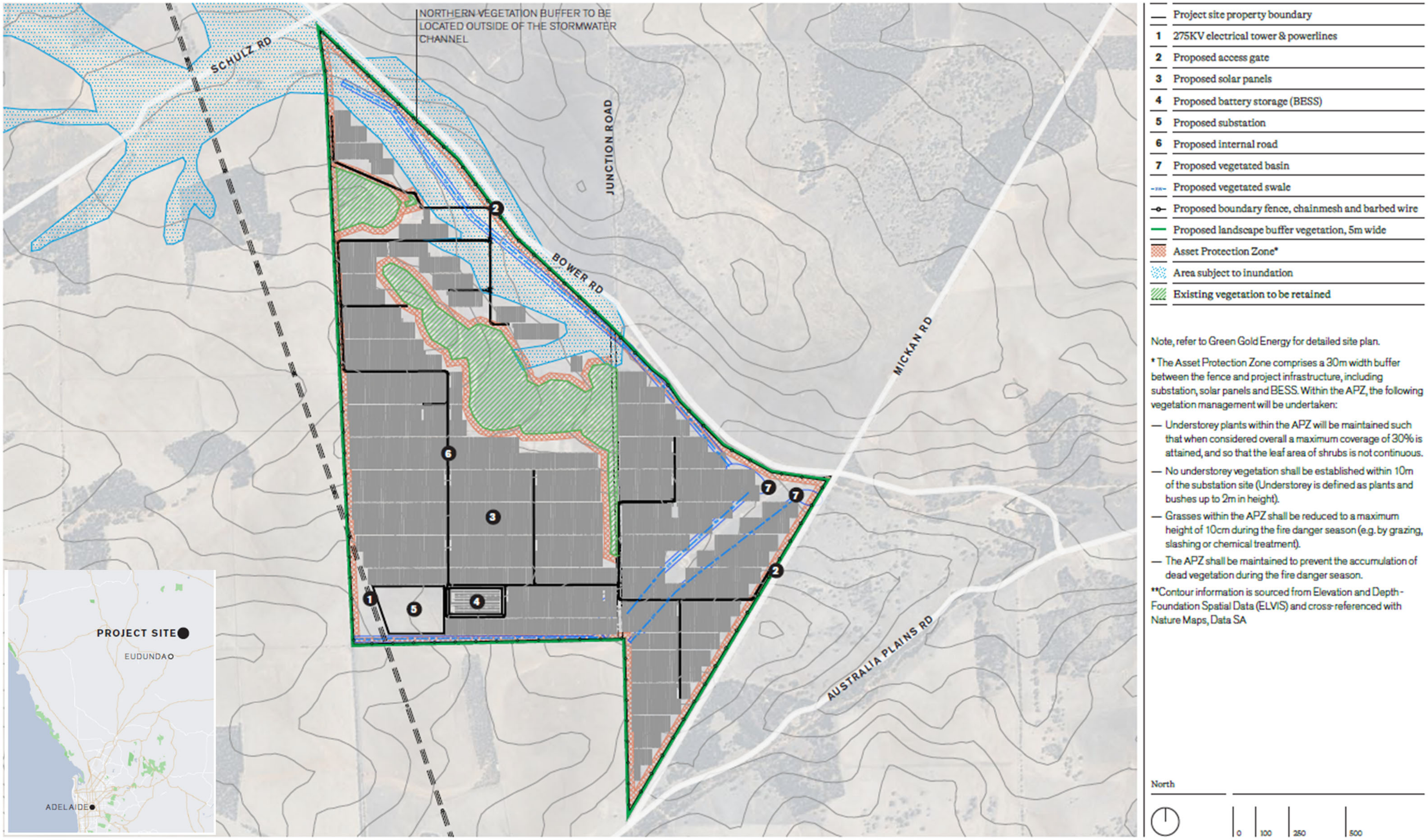
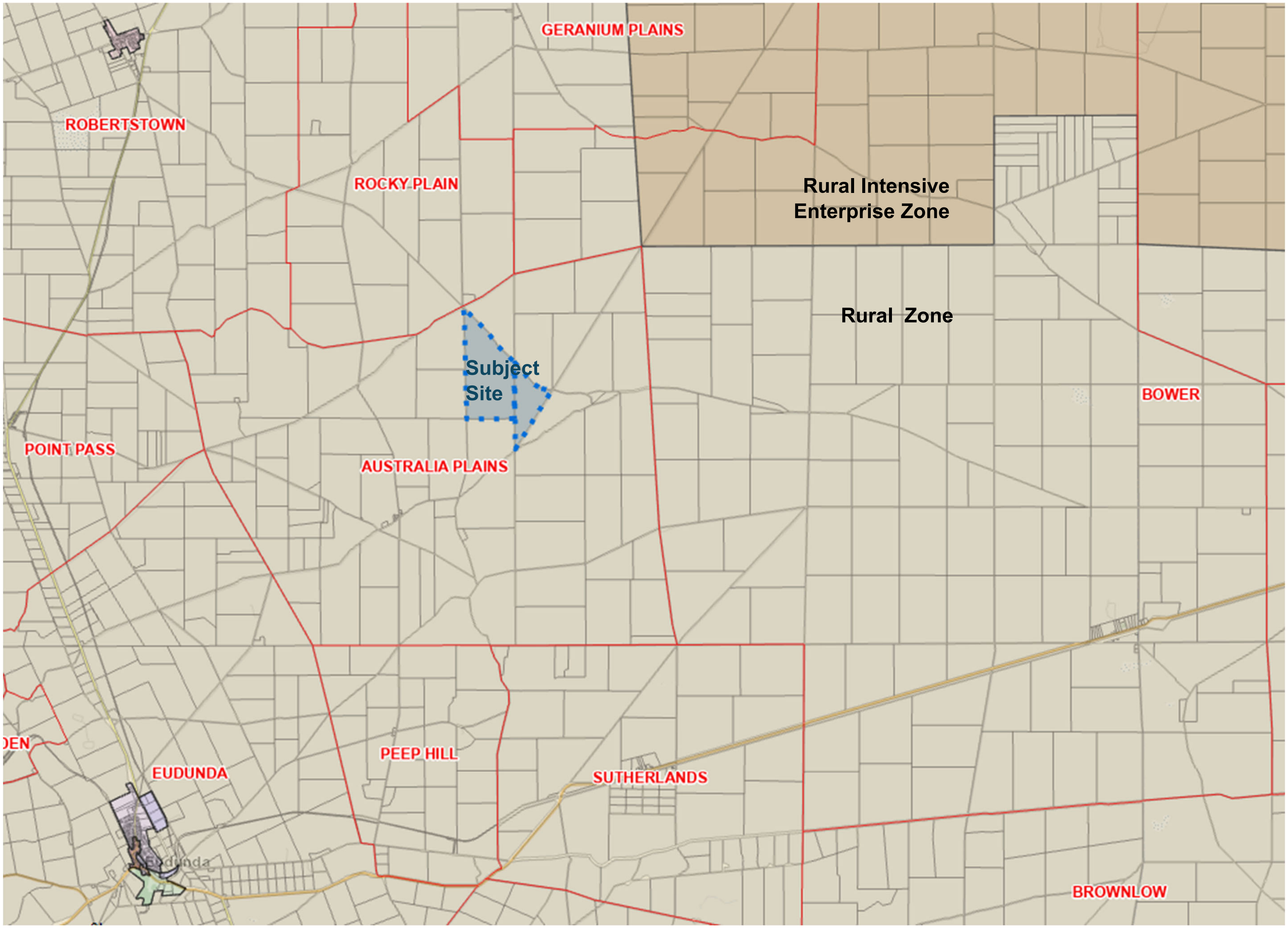
EBS Ecology
112 Hayward Avenue
Torrensville, SA 5031
www.ebsecology.com.au
t. 08 7127 5607

ATTACHMENT 2A – SUBJECT LAND MAP



ATTACHMENT 2B – SUBJECT LAND ZONING MAP



Referral Snapshot

Development Application number:
24003878

Consent:
Planning Consent

Relevant authority:
Minister for Planning

Consent type for distribution:
Planning

Referral body:
Regional Council of Goyder

Response type:
Technical Referral

Referral type:
Comment

Response date:
3 Jun 2024

Advice:
With comments, conditions and/or notes

Condition 1
The proposal shall be developed in accordance with the details and plans lodged with the application, except where varied by the conditions herein.
Reason: *To ensure the proposal is established in accordance with the submitted plans.*

Referral Snapshot

Development Application number:
24003878

Consent:
Planning Consent

Relevant authority:
Minister for Planning

Consent type for distribution:

Referral body:
Native Vegetation Council

Response type:
Schedule 9 - Regard - (3)(11) Native Vegetation Overlay

Referral type:
Advice

Response date:
10 Sept 2024

Advice:
With comments, conditions and/or notes

Condition 1
Prior to any clearance of native vegetation, the Native Vegetation Council must provide written confirmation that the Significant Environmental Benefit requirements under the *Native Vegetation Act 1991* have been satisfied.

Condition 2
Clearance areas are to be defined with barriers, pegs, flags or temporary fencing to ensure that native vegetation outside the approved area is not damaged.

Condition 3

Stockpiled materials, including cleared vegetation and excavated soil is not to be placed under native trees or on top of native understorey outside the approved area;

Condition 4

Construction vehicles, equipment or materials are not to be stored or placed on top of native vegetation outside the approved clearance area.

Advisory Note 1

The clearance of native vegetation must be undertaken in accordance with the approval of the Native Vegetation Council under the *Native Vegetation Act 1991* as set out in Decision Notification 2024/3149/422

In reply please quote #2024/00429, ID: 1989 & 2056
Enquiries to Reece Loughron – dit.landusecoordination@sa.gov.au

Government of South Australia
Department for Infrastructure and Transport

TRANSPORT STRATEGY AND PLANNING DIVISION

GPO Box 1533
Adelaide SA 5001
DX 171

T 1300 872 677
W dit.sa.gov.au

ABN 92 366 288 135

Build. Move. Connect.

9 May 2024

Ms Fiona Selleck
State Planning Commission
GPO Box 1815
ADELAIDE SA 5000
fiona.selleck@sa.gov.au

Dear Ms Selleck,

SECTION 131 – TECHNICAL ADVICE

Development No.	24003878
Applicant	Green Gold Energy Pty Ltd C/- Planning Aspects Pty Ltd, Ms Shanti Ditter
Location	Lot 315 Bower Rd Australia Plains
Proposal	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure.

The above application has been referred to the Commissioner of Highways (CoH) in accordance with Section 131 of the Planning, Development and Infrastructure Act 2016, as the prescribed body listed in Schedule 9 of the Planning, Development and Infrastructure (General) Regulations 2017.

CONSIDERATION

The subject site abuts Bower Road, Mickan Road Smart Road which are local roads under the care and control of the Regional Council of Goyder. The closest arterial roads are located approximately 9.3km to the west being Worlds End Highway and 8.3km to the south being Thiele Highway.

Access

The Department has reviewed the referral documentation including the Planning Aspects, Development Application Report (Rev. 1 dated 22 January 2024) which includes a Traffic Impact Assessment undertaken by CIRQA (Project No. 23527, V1 dated 19 December 2023) as Appendix E and the recent addendum to the planning application provided by Planning Aspects dated 1 May 2024.

The Traffic Impact Assessment identifies several potential transport routes from the closest arterial roads that could be used to access the main construction site. Figure 2 identifies these routes, and the report goes on to evaluate each route with particular focus on the available sight distances at road junctions along the route (including the DIT maintained roads) as well as identifying other constraints such as road cross sections and/or road upgrades that may result in land acquisition to cater for access by larger vehicles.

The report recommends Route 2 (Emmaus Road Route) and Route 3 (Schulz Road Route) being the preferred routes as they provide the most direct route to the subject site. It is assumed that either of these routes (with some minor upgrades to local roads) could provide access to both of the proposed access gates (refer Green Gold Energy, Site Plan, Project No. APSP, Revision G dated 9 January 2024) and adopting either of these routes would result in the least number of junctions requiring upgrade.

The CIRQA report goes on to identify a potential 24-month construction period and likely peak movements associated with the solar farm and the BESS component. The report concludes that there would be an approximate forecast of 11,288 commercial vehicles movements or an average of 19 (rounded up) commercial vehicle movements per day. There would potentially be periods where higher traffic volumes are required as well as lower movements depending on the project phase. In addition to these commercial vehicle movements, it is expected that around 30 light vehicles are likely to access the site per day.

Of the two preferred routes, the CIRQA report identifies that with respect to the movements via Worlds End Highway these movements are low and would not warrant turning treatment upgrades. However, DIT considers that the intersection assessment undertaken in Section 3.2.1 for Route 2 (Emmaus Road Route) and Section 3.2.2 for Route 3 (Schulz Road Route), require further review to ensure the commercial vehicles movements can be adequately catered for. Whilst DIT supports the sightline assessment, Figure 12 identifies that the turning movements at the Worlds End Highway/Emmaus Road intersection overlap unlike movements at the Worlds End Highway/Schulz Road intersection (refer Figure 13). As such, despite having an unsealed apron the Worlds End Highway/Schulz Road appears to offer sufficient space for transportation with some addition pavement to cater for the swept paths and the road seal extended along the local road to prevent drag out onto the Highway.

The CIRQA report does not identify a preferred haulage route for the construction phase and as such DIT requests that the applicant select a preferred haulage route prior to any construction activities occurring on site. As a minimum, the preferred intersection must be able to accommodate simultaneous two-way movements of a B-Double vehicle with additional pavement constructed to accommodate the swept paths with the new seal extending at full width a minimum of 20 meters along the local road.

The preferred intersection must be upgraded to the satisfaction of DIT with suitable pavements and any other infrastructure requirements (including drainage, headwalls, etc) being installed and or modified to cater for the B-Double movements. All road works deemed to be required to facilitate safe access must be designed and constructed to comply with Austroads Guides and Australian Standards and to the satisfaction of DIT, with all costs to be borne by the applicant. Furthermore, the developer will enter a ‘Developer Agreement’ with DIT to undertake the above works.

The above works are to be aligned to any future approval granted by the NHVR in terms of restricted access vehicles on the council maintained road network.

ADVICE

The Department for Infrastructure and Transport supports the development and provides the following conditions that should be applied to any approval:

1. Access to the development shall be gained via Bower Road and Mickan Road as shown on Green Gold Energy, Site Plan, Project No. APSP, Revision G dated 9 January 2024.

2. Prior to construction within the site, a Traffic Management Plan (TMP)', shall be prepared to the satisfaction of the Minister for Planning in consultation with the Commissioner of Highways and the Regional Council of Goyder that identifies the preferred haulage route. The TMP shall address matters including, but not limited to the following:

    a. A Traffic Management Plan (TMP) for each phase of construction of the development, including any road and access changes and any proposed upgrades and/or closures. The TMP shall also show all traffic devices to be utilised (including variable message signs) and any proposed traffic restrictions.

    b. The haulage route intersection with Worlds End Highway being upgraded to accommodate two-way movements of a B-Double vehicle with additional pavement constructed to accommodate the swept paths along with new seal extending at full width a minimum of 20 meters along the local road.

    c. Managing impacts to infrastructure within the road reserve.

    All access and traffic movements shall be in accordance with this plan.

3. All road works (e.g. additional pavement, drainage (trafficable headwalls), etc) deemed to be required must be designed and constructed to comply with Austroads Guides, Australian Standards and DIT Master Specifications. All costs to be borne by the applicant and the intersection shall be upgraded prior to components being transported to the site.

    NOTE: The applicant shall contact DIT Road Assets - South, Asset Manager, Mr Victor Ling (08) 7133 1969 or mobile 0467 784 657 (victor.ling@sa.gov.au) to obtain approval and discuss any technical issues regarding the required works. Furthermore, the developer shall enter a 'Developer Agreement' to undertake the above works.

4. Any infrastructure (e.g. road signs, drainage infrastructure, etc) within the road reserve that is demolished, altered, removed or damaged during the construction of the project shall be reinstated to the satisfaction of the relevant asset owner, with all costs being borne by the applicant.

5. Stormwater run-off shall be collected on-site and discharged without impacting the safety and integrity of the adjacent roads. Any alterations to the road drainage infrastructure required to facilitate this shall be at the applicant's expense.

The following note provides important information for the benefit of the applicant and is required to be included in any approval:

i. In the event that Restricted Access Vehicles (including oversize and overmass components) are proposed to be utilised, the applicant must ensure that all necessary approvals/permits are obtained from the National Heavy Vehicle Regulator (refer link: https://www.nhvr.gov.au

ii. The applicant shall notify DIT's Traffic Management Centre (TMC) – Roadworks on 1800 434 058 or email dit.roadworks@sa.gov.au to gain approval for any road works, or the implementation of a traffic management plan during the construction phase. Before any

construction works the contractor(s) shall complete a ‘Notification of Works’ form via the following link:
https://www.dit.sa.gov.au/contractor_documents/works_on_roads_by_other_organisations

Yours sincerely

MANAGER, TRANSPORT ASSESSMENT
for COMMISSIONER OF HIGHWAYS

South Australian
Country
Fire Service

cfs.sa.gov.au

Date:	9/05/2024
Our reference:	20240509-01jp
Your reference:	24003878

SA CFS Development Assessment Services
BUSHFIRE PLANNING HAZARD PROTECTION RESPONSE

Application	Crown Development (Energy Infrastructure Facility)
Development	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure.
Development Number	24003878
Development/Property Name	Australia Plains Solar Farm (the Project)
Location	LOT 315 Bower Rd Australia Plains and 91 Mickan Rd Australia Plains The subject site is located approximately 16.2 kilometres (km) north-east of the township of Eudunda in the Regional Council of Goyder
Owner	Bower Fortune Pty Ltd, Ms Amanda Jane Wright and Mr Shane Robert Hutchcraft
Applicant	Green Gold Energy Pty Ltd and Department for Energy and Mining

LEGISLATIVE FRAMEWORK

Instrument	The Planning and Design Code under the *Planning, Development and Infrastructure (General) Regulations 2017 – Schedule 9*
Overlay	Hazards (Bushfire – Regional) Overlay
Fire Authority/ Response Area	South Australian Country Fire Service (SACFS)

DECISION/SUMMARY

The South Australian Country Fire Service (SACFS) welcomes and supports development in regional and rural areas of South Australia. SACFS has no direct concerns with the proposal and provide these comments for your consideration.

Government of South Australia

Office Level 1, Emergency Services Headquarters “Kumatpi Trruku’, 37 Richmond Road, Keswick SA 5035
Phone (08) 8115 3372 **Fax** (08) 8115 3301
Post PO Box 2468 Adelaide SA 5000 **Email** das@cfs.sa.gov.au **ABN** 97 677 077 835 **DX** 666

This advice/comment is relevant to the following documents:

- Development Application Report (Revision 1)
- Native Vegetation Clearance Australian Plains Solar Project – Green Gold Energy 2 February 2024 Version 2
-
- DA 24003878 Addendum to Application Australia Plains Solar Facility

An officer of the SACFS has undertaken a review of the afore mentioned document(s) provided on the Plan SA portal, for the planning application.

SACFS has regard for the bushfire hazard(s) to and from the site, and any mitigation measures required to prevent spread of fire to the site, or the environment as a result of the activities within the site. SACFS provides the following comments:

Bushfire Hazard Overlay

The site is located within an area designated Hazards (Bushfire - Regional) Overlay.

The Desired Outcomes (DO) for this overlay identifies:

DO 1 Development, including land division responds to the relevant level of bushfire risk and is sited and designed to mitigate the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.

DO 2 To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger.

Fire Response Capability

The site is within the Gilbert Group Base – at Saddleworth Station CFS response area.

Land Use

Performance outcomes for Land Use do not apply in this hazard overlay.

Siting

The SACFS recommends establishing and maintaining an Asset Protection Zone (APZ) to create a setback/buffer to any infrastructure using mineral earth breaks, roadways and/or areas of managed vegetation to prevent or prohibit the spread of bushfires to and from the site, minimising the risk to life, and or damage to buildings and property and maintain a fuel reduced zone for safe movement of occupants and firefighters.

SACFS notes the current proposal does not meet this requirement.

SACFS recommends all buildings and infrastructure such as Substation, Inverter stations, BESS and Control Buildings should be located no less than 30 metres from the property boundaries or existing remnant vegetation being retained, for the purposes of maintaining an APZ.

See Access/Egress and Vegetation Management recommendations for more detail.

Access/Egress

SACFS notes the proposal does not demonstrate on the plans roads of adequate design to satisfy the desired outcomes of this hazard overlay.

Any future internal road networks should be designed to achieve compliance with the 'Roads' Performance Outcome relevant to the hazard overlay.

All access/egress roads on the project site:

- Perimeter roads with a minimum formed road width of 6 metres should be incorporated to achieve adequate separation between infrastructure and areas of bushfire hazard including areas of remnant vegetation being retained within the boundaries of the allotments to support safer access for the purposes of fire fighting or provide mineral earth breaks for passive protection from spread of fire to and from the site.
- Shall be constructed with a formed, compacted, self-draining, all-weather surface.
- Shall be a minimum width of 6 metres, if constructed less than 6m wide, shall incorporate passing bays with a minimum formed width of 6 metres (including the road or driveway width), and a minimum formed length of 17 metres. The passing bays should be constructed at 200 metre intervals along the driveway. Where it is necessary to provide adequate visibility, such as the nearest point to another passing bay, passing bays may be required at intervals of less than 200m.
- Shall be constructed with a minimum external radius of 12.5m for all road curves.
- Shall not exceed a gradient of 16 degrees (29%).
- Shall incorporate solid all-weather crossings over any water-course capable of supporting fire-fighting vehicles with a gross vehicle mass (GVM) of 21 tonnes.
- Vegetation overhanging the access road shall be pruned to achieve a minimum vehicular clearance of not less than 4 metres width and a vertical height clearance of 4 metres.
- Shall allow fire-fighting vehicles to safely enter and exit the site in a forward direction by incorporating a loop road around the site.
- All access gates to be readily accessible to attending fire service units, this maybe with the use of a Lockwood 003 type padlocks.

Note: Other fire safety measures pertaining to roads may be prescribed by the National Construction Code.

Vegetation Management (buildings and infrastructure such as Substation, Inverter stations, BESS and Control Buildings):

- Vegetation management shall be established and maintained within 30 metres of each Substation/Control Building or alike as follows:
    - The understorey plants within the APZ shall be maintained such that when considered overall a maximum coverage of 30% is attained, and so that the leaf area of shrubs is not continuous.
    - No understorey vegetation shall be established within 10m of the Substation/Control Building site (Understorey is defined as plants and bushes up to 2m in height).
    - Grasses within the zone shall be reduced to a maximum height of 10cm during the fire danger season (e.g. by grazing, slashing or chemical treatment)
    - The APZ shall be maintained to prevent the accumulation of dead vegetation during the fire danger season.

Water Supply

Whilst there is presence of reticulated water in the area, reticulated water supplies may be compromised during a bushfire event. Static fire water tanks for both bushfire, BESS and building fires will be required to assist in effective Fire Service intervention and suppression.

SACFS recommends Fire tanks (2 x 72,000L) to be made available to SA Fire Service Policy 14 requirements and include both large and small-bore suction outlets as per the policy and as follows:

- Access to the water supply shall be constructed of all-weather construction, with a minimum formed road surface width of 3 metres.
- Provision shall be made adjacent the water supply for a nominally level hardstand area (capable of supporting fire-fighting vehicles with a gross vehicle mass (GVM) of 21 tonnes) that is a distance equal to or less than 6 metres from the water supply outlet.
- The water supply is required to be available to all BESS system pod/containers within 90 metres of hose lay of the static fire water tank. If this cannot be achieved, then additional static fire water tanks or a dry hydrant system may be required.

Emergency Response Planning

The Bushfire Management Plan and the Emergency Management Plan will need to be established and reviewed and updated every 12 months by the company and/or its operators. Revised versions to be forwarded to the relevant SACFS Regional Office to use as a reference.

The Company and/or its operators will be required to engage on a regular basis with on-site training and site inductions for emergency service personnel.

BUILDING CONSIDERATIONS and BESS:

All class 2 – 9 buildings will need to comply with National Construction Code (NCC) and to include all the minimum *Deemed to satisfy* fire and life safety provisions.

Additional notes for Energy facilities or BESS:

- Access and working clearances for large emergency service vehicles to the "Electrical Transmission Area/ control room area" needs to be incorporated. This includes a reasonable clear and safe working environment.
- Servicing of the detection and suppression system within the racks will be maintained to the manufactures and to SA Ministerial Building Standard MBS 002 "Maintaining the performance of essential safety provisions" requirements and recorded.
- If a battery rack is required to be open at any time (including an emergency event), this will be done by the Company and/or its operator's staff and not the Fire Service.

SACFS, as the referral agency, reserves the right to request additional information and provide further comment, under the Planning Development and Infrastructure Act and Regulations, in particular, but not limited to Regulation (3) 45 during the Building Rules approval process.

Prepared By:	Signature:	Date:
Leah Bertholini **Manager DAS**	LBertholini	9/05/2024

Selleck, Fiona (DTI)

From:	Geisler, Sally (DTI)
Sent:	Tuesday, 18 June 2024 10:12 AM
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 Ben Schiller
Follow Up Flag:	Follow up
Flag Status:	Flagged

OFFICIAL

Hello Fiona

Please see below representation.

Kind regards

Sally

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Friday, June 14, 2024 4:20 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_proj
Submission Id	1374918
Submission Time	14 Jun 2024 4:19 pm
Submission IP Address	1.147.42.54

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Ben Schiller
Contact number:	0439354571
Email:	bschiller381@gmail.com
Postal address:	P.O. Box 277 eudunda sa 5374
Affected property:	Lot 54 gumvale rd Australia plains

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	we don't want our already poor roads destroyed, extra traffic, damage to the environment and disruption to native bird habitats, native fauna impacted as well as disruption to our peaceful rural community. You would also know that the development site is prone to flooding which if covered in solar panels and they come away in a big flood, would cause damage to fences and roads downstream. This will impact your land. Who knows what the long term affects could be on land used for agriculture, sheep, cropping etc?
What could be done to address your concerns?:	Move it to a different location
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

FilesUp: No file uploaded

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From:	DTI:SPC Reps
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 B. Shirley
Date:	Wednesday, 12 June 2024 9:23:14 AM

2

OFFICIAL

Hello Fiona

One for your attention and action

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Wednesday, June 12, 2024 7:38 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373919
Submission Time	12 Jun 2024 7:38 am
Submission IP Address	1.125.107.171

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Bridget Shirley
Contact number:	0885811024
Email:	bridgetgob@gmail.com
Postal address:	1009 Australia Plains Road, Australia Plains SA 5374
Affected property:	

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	I formally object & do not approve of: Development Number 24003878 Green Gold Energy Pty Ltd Department for Energy & Mining Subject Land Lot 315 Bower Rd Australia Plains SA 5374 91 Mickan Rd Australia Plains SA 5374 Australia Plains is a farming & residential area & this Green Gold Energy Pty Ltd proposed development will destroy our land, our peace & our environment.
What could be done to address your concerns?:	Stop Green Gold Energy Pty Ltd proposed development Development Number 24003878
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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OFFICIAL

PLANNING, DEVELOPMENT AND INFRASTRUCTURE ACT 2016
S131 – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Green Gold Energy Pty Ltd, sponsored by the Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure.
Zone / Policy Area:	Rural Zone
Subject Land:	Lot 315 Bower Rd, Australia Plains and 91 Mickan Rd, Australia Plains
Contact Officer:	Fiona Selleck
Phone Number:	08 7133 1754
Close Date:	14 June 2024

My Name: KATHRYN E. HANDKE My phone number: 0400714502

Primary method(s) of contact: Email: ckhandke@rbe.net.au
Postal Address: P.O. BOX 32
EUDUNDA SA Postcode: 5374

You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are: *(please tick one)*

- [x] owner of local property
- [ ] occupier of local property
- [ ] a representative of a company/other organisation affected by the proposal
- [ ] a private citizen

The address of the property affected is: AUSTRALIA PLAINS ROAD.
SEC. 184 186 HD BOWER, Postcode 5374

My interests are: *(please tick one)*

- [ ] I support the development
- [ ] I support the development with some concerns
- [x] I oppose the development

The specific aspects of the application to which I make comment on are:

I: *(please tick one)*

- [ ] wish to be heard in support of my submission
- [x] do not wish to be heard in support of my submission *(Please tick one)*

By: *(please tick one)*

- [ ] appearing personally
- [ ] being represented by the following person *(Please tick one)*

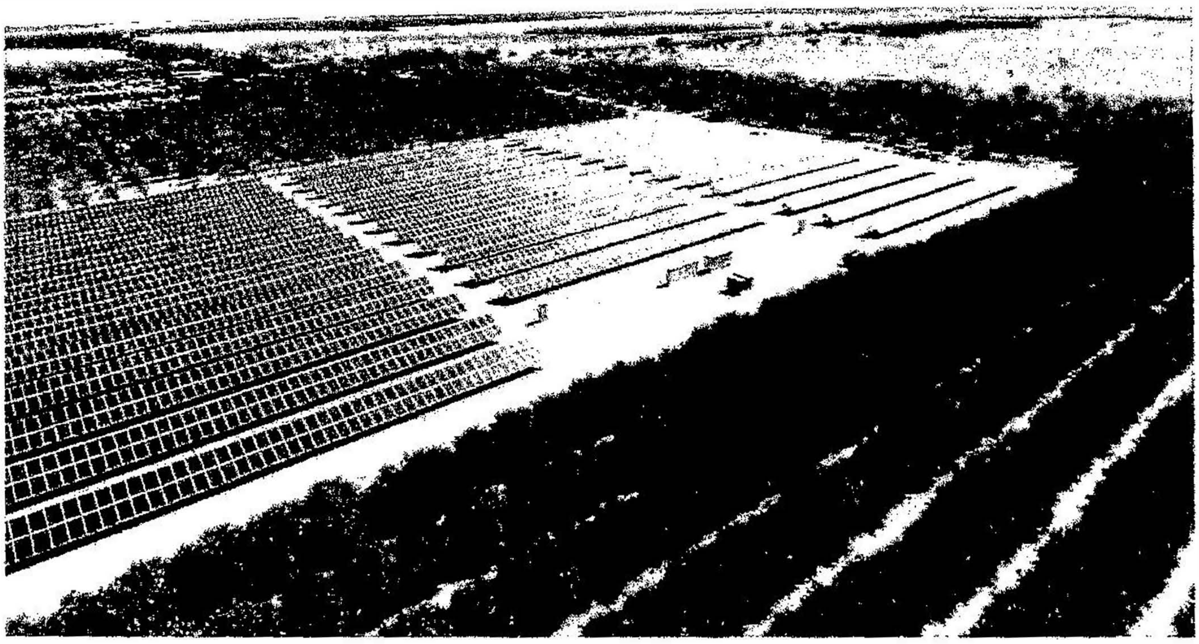
Signature: KEHandke

Date: 13-6-24

Return Address: State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 /or Email: **spcreps@sa.gov.au**

Australia Plains Solar Farm

Development Application Report (Revision 1)



Source: https://greengoldenergy.com.au/wp-content/uploads/2017/12/Aerial-1024x576.jpg

Submitted to:

Green Gold Energy
216 Glen Osmond Rd,
Fullarton
South Australia 5063

Prepared by:

Planning Aspects Pty Ltd
P O Box 968
Kensington Gardens
South Australia 5068

+61 418 856 580

22 January 2024

To Whom it concerns RE Development Number 24003878

I wish to oppose the above Development due to the following reasons.

I feel that as an adjoining property owner I had to be made aware of this development only a week ago by another local resident. I would have thought as adjoining property I would have received a written notification.

I do plan to sell my property in the future and this would have been sold under the heading of Lifestyle property. Who will buy with 400,000 solar panels next door. Solar panels look alien – just like wind towers.

Clearing of vegetation and natural scrub will affect water courses . Flooding is already prone along the creek which runs into my property. When a major flood comes along and that will happen, I can see solar panels being washed away into creeks and other properties surrounding this area.

This development is too close to residents. Roads with extra traffic will be damaged even more.)

Native animals and birds are going to be affected and with an enclosed fence, will struggle to find safe places with more land being taken away from their natural environment.

5

From: DTI:SPC Reps
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development
Date: Thursday, 13 June 2024 10:56:58 AM

OFFICIAL

Hello Fiona

Another one for you!4

Thanks

S

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Wednesday, June 12, 2024 5:02 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1374201
Submission Time	12 Jun 2024 5:02 pm
Submission IP Address	119.12.214.77

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	David Schutz
Contact number:	0428833946
Email:	schutz.transport@hotmail.com
Postal address:	8 Pine Ave Eudunda SA 5374
Affected property:	Section 60 and 61 HD Bower, Section 86 HD Bower

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	Damage to poorly maintained roads by heavy vehicles and contractors during construction, dust hazards on local roads, potential flooding and damage to fences downstream of the solar facility, unknown vehicles in the area, clearing of native vegetation and removal of ground cover will further contribute to erosion and damage to roads and fences during flood events. Effect of solar radiation on cropping and grazing pastures in the area. My land is directly opposite the planned area and my concern is my farming enterprise will be impacted. Fire risk is also a concern.
What could be done to address your concerns?:	I do not want a solar farm in the Australia Plains area. For the development not to go ahead and the land to continue to be used for grazing and agricultural as it has always been. The developers should find more appropriate sites well away from local residents and farms.
Other general comments:	I received no notification of the development, I should have been informed with a written letter notifying me of the application for development.
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

FilesUp:	No file uploaded
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PLANNING, DEVELOPMENT AND INFRASTRUCTURE ACT 2016
S131 – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Green Gold Energy Pty Ltd, sponsored by the Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure.
Zone / Policy Area:	Rural Zone
Subject Land:	Lot 315 Bower Rd, Australia Plains and 91 Mickan Rd, Australia Plains
Contact Officer:	Fiona Selleck
Phone Number:	08 7133 1754
Close Date:	14 June 2024

RECEIVED
07 JUN 2024
BY:

My Name: Desmond Murray Traeger My phone number: N/A.

Primary method(s) of contact: Email: N/A PO BOX

Postal Address: 225 EUDUNDA SOUTH AUSTRALIA. Postcode: 5374

You may be contacted via your nominated PRIMARY METHOD(S) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are: *(please tick one)*

- ☐ owner of local property
- ☑ occupier of local property AND OWNER..!! LIVING 20m AWAY NOT 160m!!!
- ☐ a representative of a company/other organisation affected by the proposal
- ☐ a private citizen

The address of the property affected is:

12 BALK ROAD, AUSTRALIA PLAINS. Postcode

My interests are: *(please tick one)*

- ☐ ~~I support the development~~
- ☐ ~~I support the development with some concerns~~
- ☑ I oppose the development

The specific aspects of the application to which I make comment on are: NO CONSULTATION EVER BY THIS COMPANY OR ANY GOVERNMENT AGENCY!! GOING TO BE BUILT ON A SEVERE FLOOD FLAT. HAVING TO LOOK AT SOLAR PANELS – MY PRIVACY – SECURITY – MY FAMILY LIVED ON ~~THIS~~ PROPERTY FOR 80 YEARS – ISOLATED/PRIVATE. NOW THIS WILL IMPACT EVERY

PLEASE TURN OVER!

I: *(please tick one)*

- ☑ wish to be heard in support of my submission
- ☐ do not wish to be heard in support of my submission *(Please tick one)*

By: *(please tick one)*

- ☑ appearing personally with an advocate.
- ☐ being represented by the following person *(Please tick one)*

Signature: D M Traeger

Date: 4/6/24

Return Address: State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 /or **Email:** spcreps@sa.gov.au

ASPECT OF MY LIFE! I OWN 370 ACRES OF LAND OPPOSITE THIS PROPOSAL. I DO NOT HAVE ELECTRICITY. I DO NOT HAVE WATER CONNECTED AND USE RAINWATER AND THIS WILL IMPACT MY WATER QUALITY. I SIT ON MY VERANDAH NOW — IN SILENCE — AND PEACE — WATCHING NATURE THE TREES, THE KANGAROOS, AND THIS PROPOSED DEVELOPMENT WILL TAKE ALL THIS AWAY — AN ABSOLUTE TOTAL EYESORE OF ENDLESS SOLAR PANELS WILL BE ALL I SEE, SURROUNDED BY A CYCLONE MESH BARBED WIRE FENCE, TOPPED WITH CCTV CAMERAS ON POLES!! NOW ENVISSAGE THAT! LOOKING FROM YOUR OWN VERANDAH, AT YOUR HOUSE! THERE IS NO WAY ANY POLITICIAN, COUNCILLER ANYONE! WOULD DESIRE THIS! NATIVE ANIMALS USE THAT SITE TO LIVE OR AS A THOUROUGHFARE, KANGAROOS, EMUS, ECHIDNA AND WOMBATS — CYCLONE FENCING WILL ELIMINATE THAT! IT IS VERY QUITE WHERE I LIVE, THE POWERLINE HUMMING IS ENOUGH, THIS SOLAR FARM WILL INCREASE NOISE DAY + NIGHT TO NO EXTENT!! JUST TO LET YOU KNOW THE GOYDER LINE WAS CHANGED IN BY MIKE RANN!! CYCLONE FENCING WILL CAUSE INCREASE IN FATALITIES FOR ANIMALS, THUS POSSIBLE HUMAN FATALITY!! BUT THE FACT I HAVE NEVER BEEN CONTACTED BY ANYONE IS ABYSMAL — I TOTALLY OBJECT TO THIS PROPOSED SOLAR FARM AT AUSTRALIA PLAINS.

DES TRAEGER. D.M. [illegible]

From:	DTI:SPC Reps
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development
Date:	Thursday, 13 June 2024 10:56:38 AM

OFFICIAL

Hello Fiona

Another one for you!4

Thanks

S

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Wednesday, June 12, 2024 6:17 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1374233
Submission Time	12 Jun 2024 6:16 pm
Submission IP Address	1.124.18.37

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	J loffler
Contact number:	0418851118
Email:	neville.loffler@bigpond.com
Postal address:	po box 43
Affected property:	

Submission Details

I am:	a private citizen
I am - Other:	
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	
What could be done to address your concerns?:	
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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Selleck, Fiona (DTI)

From:	Geisler, Sally (DTI)
Sent:	Tuesday, 18 June 2024 10:10 AM
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 Jason Nietschke
Follow Up Flag:	Follow up
Flag Status:	Flagged

OFFICIAL

Hello Fiona

Please see below.

Kind regards

Sally

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Friday, June 14, 2024 10:20 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_proj
Submission Id	1374991
Submission Time	14 Jun 2024 10:19 pm
Submission IP Address	192.145.74.185

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Jason Nietschke
Contact number:	0400899669
Email:	jasonnietschke@gmail.com
Postal address:	Box 56 Koonunga 5373
Affected property:	0 Plains Rd Australia Plains

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	Yes as our property is across the road from the development. I strongly disagree with the development, as we don't want our already poor roads destroyed, extra traffic, damage to the environment and disruption to native bird habitats, native fauna impacted as well as disruption to our peaceful rural community. Who knows what long term affects could be on land used for agriculture, sheep cropping etc?
What could be done to address your concerns?:	Don't let it go ahead!
Other general comments:	The Chinese don't care for our environment or Australia so why should we support them?
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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From: Geisler, Sally (DTI)
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development
Date: Tuesday, 11 June 2024 8:17:03 AM

OFFICIAL

Hello Fiona

I hope you had a a lovely long weekend!

Please see below received in tot the SPC Reps inbox on 10 June 2024.

Thank you

S

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Monday, June 10, 2024 10:57 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373391
Submission Time	10 Jun 2024 10:57 am
Submission IP Address	119.12.218.214

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Kayla Lewis
Contact number:	0488228048
Email:	Elliso9@hotmail.com
Postal address:	PO Box 316 Eudunda
Affected property:	1140 Australia Plains Road Eudunda

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	This area is a farming area of many generations this is ruining the farming industries. Farmers are already doing it tough let alone having an eyesore to look at. Have this sort of eye sore where it affect 0 people where there is no population. The roads are going to get ruined the council never grades the roads as it is, the roads will become powder the will bring all the rocks up on the roads shower houses with dust and ruin our vehicles. Nobody wants this here except the people getting money in their pockets. DO NOT ALLOW THIS TO HAPPEN IN OUR SMALL COMMUNITY.
What could be done to address your concerns?:	TO NOT LET IT HAPPEN.
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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From: DTI:SPC Reps
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development 24003878 L & M Lewis
Date: Wednesday, 12 June 2024 9:28:22 AM
Attachments: Lewis-Objection-Aust-Plains-Solar-Farm.docx

OFFICIAL

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Tuesday, June 11, 2024 3:52 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373769
Submission Time	11 Jun 2024 3:52 pm
Submission IP Address	119.12.214.103

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Lynda and Martin Lewis
Contact number:	0885811546
Email:	ljlewis@skymesh.com.au
Postal address:	PO Box 310
Affected property:	Section 308 Hundred of English, 1170 Australia Plains Road

Submission Details

I am:	an occupier of local property
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding	

the proposed development?:	Please find attached list of concerns we have regarding the solar farm and our strong opposition to the development.
What could be done to address your concerns?:	We do not want a solar farm in our local rural area. For the development to not go ahead and the land in question continue to be used as grazing area in line with all other surrounding land use at this present time. For solar farm developers to make more appropriate choices for their development sites far away from local residents who will be subjected to the stress of having to live with this and its unknown effects for the long term.
Other general comments:	as above
PresentInPerson:	I wish to be heard in support of my representation
NominatedSpeaker:	Lynda Lewis

Supporting Documents

FilesUp:	Lewis-Objection-Aust-Plains-Solar-Farm.docx, type application/vnd.openxmlformats-officedocument.wordprocessingml.document, 19.7 KB
FilesUp:	No file uploaded
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FilesUp:	No file uploaded
FilesUp:	No file uploaded

Australia Plains Solar Farm

Concerns of The Lewis Family

1170 Australia Plains Road

Our family home and farming enterprise is located approximately 1000m, over the hill, from the proposed site of the solar farm development, particularly the substation/battery storage area as shown in the plans.

We have lived at our location for 24 years operating our farming enterprise and as an historic fourth generation farming family at Australia Plains did not expect that this type of development would take place in the area. Australia Plains is a quiet, rural setting and we want this to continue with no such developments to interfere with our rural lifestyle or that of our neighbouring land owners and residents.

We have had no notification of the development application, other than the brief notice placed in the Leader newspaper several weeks ago. Many people do not rely on newspapers so this method of notification is no longer effective and it should have been communicated to neighbouring landholders and residents in the area by a mailing at the very least. A community meeting would have been more appropriate where information regarding the development should have been conveyed to the public and any questions in regard to the impacts of the solar farm could have been answered face to face.

The following are our points of great concern and objection to the development application.

Close proximity to our residence, and the residences of neighbours, in particular the family across from Junction Road and the elderly gentleman living in his home across the road from the site on the north eastern end of the Bower road. Both are opposed to the development and have similar concerns to us. They will both be affected by the sight of the solar facility and are experiencing overwhelming feelings of distress as a result.

Visual impact, appearance, glare – can be seen from the road and other areas of our farm. This type of development is not sympathetic to the natural bushland surrounds and is totally “alien” in appearance.

Increase of vehicular traffic use of the “bush track” opposite our home to gain access to the south western side of the solar facility site. Random vehicles moving about the area, coming and going will not be appreciated by security conscious locals.

Fire risk- Hot northerly winds prevalent in summer. What protection would our home and farm have if a fire was to start due to a breakdown in the solar facility to the close north east of our property?

What are the Health risks to Humans and Livestock? Do the panels emmit radiation or an electromagnetic field around, if so at what distance? What Studies have been undertaken to prove safety (cancer, lung disease etc)? How can residents in the area be assured we will suffer no long term health issues from this development?

Heat sync effect on crops. Are adjoining agricultural crops/pastures going to be affected?

How will a large amount of solar panels affect the climate in the area?

Wildlife- A 2m high fence to be erected around perimeter – how will this and the infrastructure/construction impact on wildlife movement/kangaroos, emus & wombats on land, foraging range impacted for echidnas/goannas/bearded dragons/sleepy lizards/brown snakes/pygmy possums in the scrub & trees, how are birds impacted?

Wombats-currently active wombat burrows on the western edge of the site. How will these wombats be catered for? The fence will block their foraging range and disturbance to burrows will impact their homes.

Mallee Birds-in particular the white wing chough, or as we call them "jays", frequent the area, clearing of native vegetation will impact their territorial range and lessen available scrub area for breeding.

Removal of native tree scrub on the site is not acceptable. Land owners are not permitted to clear trees from their properties for the purpose of farming so why are solar farms allowed to fell trees? This will clearly further impact native bird species.

Sheep grazing -Glare from panels and the "look" of infrastructureie bright, shiny solar panels, will deter sheep from grazing in adjoining paddocks. Construction work will disturb lambing ewes and cause losses.

Biosecurity: COVID 19 and other animal diseases brought in by contractors which may pose a threat to farming enterprise. Where do contractors come from and where are they accommodated during construction?

No local jobs once construction is completed- all work undertaken by outside contractors. No advantage for long term employment in the local community/ no new families in the district/ no children attending local schools.

Road usage during construction will desecrate already poor roads which have not been maintained by the Regional Council of Goyder. Extra traffic caused by contractors during construction will create unknown hazards for locals on these poor roads. Dust will be a problem with high road usage and heavy vehicles. In times of heavy rainfall the roads will erode significantly if subjected to heavy use.

Heavy rainfall-it may not have been noted by the prospective developer that the north eastern end of the site in question has been historically flooded during events of heavy rainfall. Observation of the hugely eroded dry creek beds that lead into the property would be indicative of the large volume of water that has flowed across the site in years gone by.

Indigenous cultural considerations. While the plans state that there is no cultural significance to the land in question has this been confirmed by local indigenous representatives? Has a site walk taken place? This should be arranged before any decision is decided.

Interference with appliances/digital TV/mobile phone/internet/satellite?

Where are the panels/equipment/components manufactured – Australia?/OverSeas?

What is the composition of the panels and do they contain any toxic substances? Eg Arsenic?

Where does the generated power go to and will our electricity bills be any cheaper?

Disposal- What is the lifespan of the panels and how are they disposed of once they are no longer functional? Are they recycled?

What is the next stage in the development and will the neighbouring landowners and residents in the area be kept informed? We have not been communicated to in regard to the current development application and it is merely by chance that a relative has seen the Leader notification and alerted us to the situation.

In summary we are one of the closest residing neighbours to the land in question. We are not in favour of the solar farm going ahead and strongly object for the many reasons outlined above.

Signed:

Martin & Lynda Lewis (Section 308 Hundred of English, 1170 Australia Plains Road)

Toby & Kayla Lewis (1140 Australia Plains Road)

Nelson & Courtney Lewis (Lot 314 Australia Plains Road)

Selleck, Fiona (DTI)

From:	Geisler, Sally (DTI)
Sent:	Tuesday, 18 June 2024 10:14 AM
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 - Lynette Krempel
Follow Up Flag:	Follow up
Flag Status:	Flagged

OFFICIAL

Hello Fiona

Please see below.

Kind regards

Sally

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Friday, June 14, 2024 10:39 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_proj
Submission Id	1374701
Submission Time	14 Jun 2024 10:39 am
Submission IP Address	1.147.81.139

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Lynette Krempel
Contact number:	0402463695
Email:	lynbee1@gmail.com
Postal address:	PO Box 80 Eudunda SA 5374
Affected property:	961 Australia Plns Road Australia Plains

Submission Details

I am:	an occupier of local property
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	Yes. Firstly there has not been enough disclosure about this development,I had to find out from a neighbour. My husband and I bought this property to retire and build a new home in a quiet rural setting . We love the local bird population especially. I strongly oppose the development of local agricultural lands being used for such a development as solar panels. Who knows what this disruption will do to our native bird habitats and the native fauna. The long term affects on our peaceful rural community is disturbing. In a country the size of ours , there are a lot better places to build this type of development. I definitely feel my and my neighbours way of life would change too much.
What could be done to address your concerns?:	Do not build a solar panel development!
Other general comments:	Agricultural lands should not be used for anything else , they are our now and future food bowls
PresentInPerson:	I wish to be heard in support of my representation

NominatedSpeaker: Mrs Lynda Lewis

Supporting Documents

FilesUp: No file uploaded

FilesUp: No file uploaded

FilesUp: No file uploaded

FilesUp: No file uploaded

FilesUp: No file uploaded

13

From: Geisler, Sally (DTI)
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development 24003878 Michael Nash
Date: Thursday, 13 June 2024 10:57:30 AM
Attachments: inbound819040473587894345.pdf
inbound6723251207758478609.pdf

OFFICIAL

Hello Fiona

Another one for you!4

Thanks

S

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Thursday, June 13, 2024 8:35 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1374318
Submission Time	13 Jun 2024 8:34 am
Submission IP Address	193.115.108.187

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Michael Nash
Contact number:	0417992097
Email:	whatbugsyou@gmail.com
Postal address:	29 Jikara Dr Glen Osmond
Affected property:	Grasslands around Burra

Submission Details

I am:	other
I am - Other:	Researcher
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	Yes it threatens habitat for the pygmy blue tongue lizard that is an Endangered species, as classified by the International Union for Conservation of Nature (IUCN).
What could be done to address your concerns?:	Not change land management practices as specified by the pygmy blue tongue lizard management plan.
Other general comments:	
PresentInPerson:	I wish to be heard in support of my representation
NominatedSpeaker:	Michael Nash

Supporting Documents

FilesUp: inbound819040473587894345.pdf, type application/pdf, 669.6 KB
FilesUp: inbound6723251207758478609.pdf, type application/pdf, 538.6 KB
FilesUp: No file uploaded
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Recovery Plan for the

Pygmy Bluetongue Lizard

Tiliqua adelaidensis

2012

Government of South Australia

Australian Government

ISBN 978-0-9806503-9-6

This plan was prepared by the Department of Environment and Natural Resources in conjunction with Environmental and Biodiversity Services Pty Ltd.

Cite as:
Duffy, A., Pound, L. and How, T. (2012) *Recovery Plan for the Pygmy Bluetongue Lizard* Tiliqua adelaidensis. Department of Environment and Natural Resources, South Australia.

Copies of this recovery plan are available at:
http://www.environment.gov.au/biodiversity/threatened/recovery.html

Cover photograph:
Pygmy Bluetongue Lizard (*Tiliqua adelaidensis*) (photo by Mark Hutchinson)

Contents

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SUMMARY

This recovery plan has been prepared in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The effective life-span of this recovery plan is five years, after which its effectiveness and further goals will need to be reviewed.

Conservation Status

The Pygmy Bluetongue Lizard (*Tiliqua adelaidensis*) is listed as Endangered nationally under the EPBC Act, and Endangered in South Australia under Schedule 7 of the *National Parks and Wildlife Act 1972*.

The Pygmy Bluetongue Lizard is currently known from 31 small, isolated sites located on private agricultural land. Effective liaison and cooperative management with private landholders are therefore essential to the recovery of this species.

Vision

The long-term vision for the Pygmy Bluetongue Lizard Recovery Program is to achieve down-listing of *Tiliqua adelaidensis* to conservation dependent.

For this to occur, the Pygmy Bluetongue Lizard will need to be valued by an informed regional community; and that regional community will need to have an increased capacity to sustainably manage their unique lizard and its habitats within existing and improved regional planning and land management practices.

Five-Year Objectives

Overall Objective

To improve the long-term viability of Pygmy Bluetongue populations by:

- clarifying the extent, abundance and habitat requirements of the species;
- achieving long-term protection and enhancement of habitat through sustainable land management practices and adequate awareness.

Specific Objectives

Objective 1: Protect existing Pygmy Bluetongue populations and habitat.

Objective 2: Clarify distribution and abundance.

Objective 3: Maintain, enhance and increase the area and quality of suitable habitat for Pygmy Bluetongues at known populations.

Objective 4: Monitor populations to evaluate the effectiveness of management and to detect trends which may require a management response.

Objective 5: Fill critical knowledge gaps to help guide adaptive management and recovery of the species.

Objective 6: Continue to engage the community and form partnership to promote the significance and improved management requirements of the Pygmy Bluetongue Lizards.

Objective 7: Manage the recovery process through an effective recovery team.

Recovery Actions

Action 1.1 Ensure landholders and relevant agencies are aware of, and protect, known Pygmy Bluetongue populations and their habitat.

Action 1.2 Encourage private land conservation agreements and other measures to secure protection of Pygmy Bluetongue populations and habitat.

Action 1.3 Undertake threat and risk assessment of known Pygmy Bluetongue populations.

Action 2.1 Determine the extent and size of known Pygmy Bluetongue populations.

Action 2.2 Identify and map potential habitat.

Action 2.3 Search additional potential habitat for new populations.

Action 3.1 Work with landholders to implement *Best Practice Management Guidelines.*

Action 3.2 Implement measures to increase suitable Pygmy Bluetongue habitat at known populations.

Action 4.1 Continue to undertake (and refine as required) long-term population monitoring at selected sites.

Action 4.2 Maintain (and refine as required) systems for data collection and management.

Action 5.1 Prioritise, promote and conduct key research projects needed to guide improved recovery outcomes.

Action 5.2 Undertake land management trials to refine regimes required to improve habitat quality.

Action 5.3 Continue efforts to establish a captive breeding population.

Action 6.1 Promote community awareness and ownership of, and involvement in, the recovery of the Pygmy Bluetongue Lizards.

Action 6.2 Establish a network of local mentors and champions to help drive and promote improved recovery of Pygmy Bluetongue populations and engage the community in recovery activities.

Action 7.1 Maintain an effective recovery team which supports, guides and evaluates the implementation and outcomes of the recovery plan.

Part A: Introduction

The Pygmy Bluetongue Lizard (*Tiliqua adelaidensis*) had been considered extinct until it was rediscovered near Burra, South Australia, in 1992 (the first record for 33 years) (Armstrong & Reid 1993, Armstrong *et al*. 1993). At the time of its rediscovery, very little was known about the species. It had previously been known from only 20 museum specimens, mostly collected in the nineteenth century (Ehmann 1982, Shea 1992). Richard Schomburgk's remark *'kommt nur auf sandigem, steinigem terrain vor'* ('found only in sandy, stony terrain'; quoted by Peters, 1863) was the only published first-hand information available on its ecology.

The Pygmy Bluetongue Lizard has been subject to a recovery program since 1992. To date, a major focus of the recovery program has been research to determine the distribution, habitat, ecology and management requirements of the species. The recovery program has also focused on raising awareness of this species, and proving guidelines for land management based on the research findings.

Part B: Species Information

Description

The Pygmy Bluetongue Lizard is the smallest member of the genus *Tiliqua*, which consists of seven species of lizards commonly known as bluetongues. It is a moderate sized skink with short limbs, a relatively heavy body and large head, with a total length of less than 20 cm. Its colour varies from grey brown to orange brown, and may or may not include a series of black flecks along the back and flanks. Unlike other members of this genus, it has a pink tongue.

Conservation Status

The Pygmy Bluetongue Lizard is listed as Endangered nationally under the *Environment Protection and Biodiversity Conservation Act 1999*(EPBC Act), and Endangered in South Australia under Schedule 7 of the *National Parks and Wildlife Act 1972* (NPW Act). These classifications are consistent with IUCN (2001) criteria (EN B2ab(iii)).

The distribution of the species is severely fragmented. Pygmy Bluetongue Lizards are known from only 31 localities, all on privately owned agricultural land and most surrounded by cropped land or other unsuitable habitat. This species is therefore particularly vulnerable to the impacts of land management activities and/or stochastic events.

Recovery Opportunities

The Pygmy Bluetongue Lizard is currently listed as Endangered in South Australia on the basis of the following combination of IUCN (2001) criteria:

- area of occupancy less than 500 km^2; and
- severely fragmented; and
- observed and projected continuing decline in the area, extent and/or quality of habitat (criteria EN B2ab(iii)).

Given the modified agricultural landscape in which Pygmy Bluetongue Lizards now occur, it is unlikely that the restricted area of occupancy and the fragmentation of populations could be substantially reversed. However, there are research and management actions identified in this plan that will attempt to overcome past habitat modifications. The best opportunities for improving the conservation status of Pygmy Bluetongue Lizards in the short-term therefore lie in halting and preventing the decline of their native grassland habitat. This recovery plan aims to address this goal by outlining measures for improving habitat protection and, where feasible, for improving the quality and extent of habitat.

Part C: Distribution and Location

Distribution and Population Size

The Pygmy Bluetongue Lizard is endemic to South Australia. Very little information exists on the past distribution of Pygmy Bluetongue Lizards, with the few known localities extending from the Adelaide Plains to the North Mount Lofty Ranges (Ehmann 1982, Hutchinson 1992). Prior to the rediscovery of this species, only 20 specimens were known, half of which have no precise location data, while some have localities that may only be addresses of the consigners of the specimens (Armstrong *et al.* 1993). The relative abundance of Pygmy Bluetongue Lizards in European collections in the 19th century (11 of the 20 specimens) suggests that the species was formerly more common, and has undergone a marked decrease in distribution (Shea 1992).

The Pygmy Bluetongue Lizard is now known from 31 sites, ranging from Peterborough in the north to Kapunda in the south, and to the South Hummocks (north of Port Wakefield) in the west (Figure 1). All known populations are located on private land, most of which is used for sheep grazing. They are generally surrounded by unsuitable habitat, usually cropped agricultural land. However, the full extent of most populations has not yet been determined, and it is possible that some apparently isolated localities (e.g. Blyth, Auburn and Kapunda) may belong to larger, more contiguous populations (Schofield 2007).

The total population size of the Pygmy Bluetongue Lizard is uncertain. The population estimate of around 5000 lizards in the previous recovery plan (Milne *et al.* 2000) was based on 10 known populations, but since this time another 22 populations have been discovered (and one is presumed lost). Since 2005, annual counts have been undertaken within one hectare monitoring plots at nine populations, but the area of occupancy at each site, and the variation in habitat quality and lizard densities across these sites, is unclear. Developing a better understanding of the extent and size of Pygmy Bluetongue populations will be a high priority for this recovery plan.

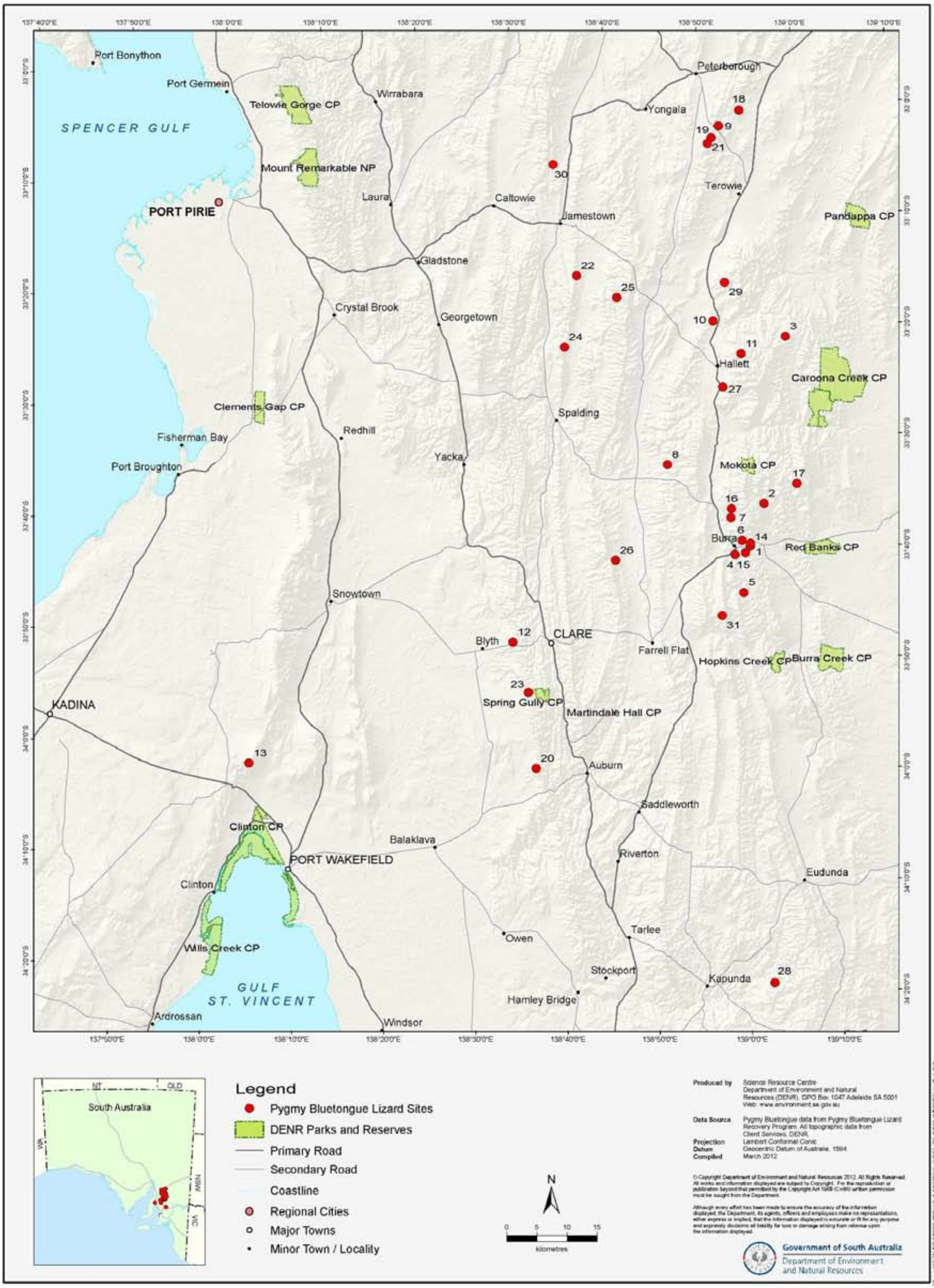

Figure 1. The locations of known populations of Pygmy Bluetongue Lizards (*Tiliqua adelaidensis*).

Habitat

Vegetation

The vegetation of all known sites is remnant native grassland or grassy woodland with a sparse over-storey of trees. Pygmy Bluetongue Lizards do not appear to be confined to a particular floristic community of native grassland, and have been recorded at sites dominated by species including spear grasses (*Austrostipa* spp.), wallaby grasses (*Austrodanthonia* spp.), bluebush (*Maireana* spp.), Brush Wire-grass *(Aristida behriana*) and iron-grasses (*Lomandra* spp.) (Hutchinson *et al.* 1994, Souter *et al.* 2007).

These vegetation types have been extensively cleared and fragmented. By 1995, native grasslands in South Australia had been reduced to around 0.3% of their original distribution (Hyde 1995).

The condition of grasslands in which Pygmy Bluetongue Lizards have been found is highly variable, ranging from grasslands that are highly degraded and dominated by exotic grasses to grasslands with a high diversity of native species. Vegetation cover ranges from moderate to sparse. Research to date indicates that Pygmy Bluetongue Lizards select burrows with a light or moderate level of surrounding grass cover in preference to areas with very little cover, and that the above-ground activity of lizards appears to be inhibited at burrows with no surrounding grass (Pettigrew & Bull 2011).

Shelter Sites

Pygmy Bluetongue Lizards use empty spider burrows, constructed by mygalomorph (trapdoor) and lycosid (wolf) spiders, as refuges, basking sites and as ambush points for hunting prey (Milne *et al.* 2003a). These spider holes are circular in cross section and up to about 20 mm in diameter. The average depth of holes is approximately 25 cm, ranging from 10 to 75 cm. Adult lizards favour the deeper holes which are made by mygalomorphs, and juvenile lizards prefer narrower burrows (Milne & Bull 2000). The lizards make no obvious external modifications to the holes, except for a slight bevelling of the edges, worn by their movement. The distinctive lids of the trapdoor spider holes may still be attached, enabling the hole builder to be identified. Data from around Burra indicate that one particular species, *Blakistonia aurea* (Idiopidae), is one of the more important hole builders (McCullough 2000).

A PhD study into the habitat requirements of Pygmy Bluetongue Lizards (Souter 2003) indicated that the abundance of the lizards within grasslands was dependent on the availability of deep spider burrows in well draining soils. Suitable lizard burrows were absent or scarce in areas that lacked native grassland or had a dense cover of introduced species.

Topography and Soil Type

Pygmy Bluetongue Lizards occur across a range of soil types, but are found in greater abundance at sites with more free-draining grey-brown or red calcareous soils, compared with sites of less free-draining red-brown earths. They are also found at sites with lithosol soils (sandy-type soil that has developed from the in-situ weathering of rock) (Souter 2003).

Soil which is either not deep enough or free-draining enough inhibits spiders from constructing suitable burrows, and therefore these areas lack habitat suitable for Pygmy Bluetongue Lizards. The lizards tend to be present in greatest densities on the lower slopes of hillsides, where the soil and consequently the spider burrows are deepest (Schofield 2006).

Climate

The region in which Pygmy Bluetongue Lizards occur has hot, dry summers and cool, moist winters, with mean annual rainfall ranging from 365 mm at Yongala to 632 mm at Clare (Bureau of Meteorology data 2010).

Habitat Critical to the Survival of the Species

Given the small total population size, the limited number of sites at which the Pygmy Bluetongue Lizard is known to occur, and the limited availability of suitable habitat, it is considered that all known habitat is critical to the survival of the species because:

- the habitat is required to maintain populations of other species essential to the Pygmy Bluetongue Lizard (e.g. wolf and trapdoor spiders which create spider holes);
- the habitat contains important Pygmy Bluetongue populations;
- the habitat is required to maintain genetic diversity, dispersal routes and population viability.

Any areas of native grassland or grassy woodland with a sparse overstorey which have not been previously ploughed and contain spider burrows may be capable of supporting Pygmy Bluetongue Lizards, particularly in areas with free-draining grey-brown or red calcareous soils or lithosol soils on the lower slopes of hillsides. Further surveys in such areas may identify new populations and additional habitat critical to the survival of the species.

Mapping of Habitat Critical to the Survival of the Species

It is considered that all currently occupied habitat of Pygmy Bluetongue Lizards (Figure 1) is critical to the survival of this species, as discussed above. As noted above, there may be additional habitat critical to the survival of the species which has not yet been surveyed or mapped.

Important Populations

All Pygmy Bluetongue populations are considered important due to the restricted and fragmented distribution of this species; hence all populations should be managed for the protection of this species. Significant genetic differentiation has been recorded between most of the studied populations (Rogers 1998, Smith 2006; Smith *et al.* 2009). Smith *et al.* (2009) sampled 229 Pygmy Bluetongue Lizards from six sites between Burra and Peterborough in the mid-north of South Australia (Sites 1, 2, 4, 6, 9 & 22 in Figure 1). They found that there was a distinct genetic structure among sample sites separated by only a few kilometres, including variations within small patches of continuous habitat, indicating a fine-scale pattern of isolation by distance in this species. They found no evidence of population bottlenecks in this species. Further research to clarify population size, extent and genetics will help to identify the largest populations (Action 2.1).

Part D: Biology and Ecology Relevant to Threatening Processes

Use of Burrows

Pygmy Bluetongue Lizards use burrows constructed by lycosid and mygalomorph spiders for shelter and as vantage points from which to stalk passing invertebrate prey (Milne *et al.* 2003a; Fellows *et al.* 2009). Only one adult lizard is found in each burrow. The lizards are extremely sensitive to both movement and noise, making it difficult to observe them basking outside their burrows unless approached extremely carefully.

Lizards bask with the back legs or tip of the tail remaining in the entrance of the burrow. From this position, the lizards can back rapidly into their burrows if disturbed. The hole dwelling behaviour of the Pygmy Bluetongue Lizards, initially an obstacle, has become a key factor facilitating its study. Use of an optic fiberscope permits direct observation of lizards in their burrows, and their sedentary nature enables regular monitoring of all animals in a given area.

Diet

Pygmy Bluetongue Lizards are omnivorous, feeding mainly on medium-sized arthropods which they capture by ambush. Examinations of Pygmy Bluetongue scats and stomach contents have recorded the remains of grasshoppers, ants, small spiders, beetles, snails, cockroaches and plant material (including *Dianella* seed, possible chenopod material, and several leaves and flowers of the introduced herb *Medicago*) (Ehmann 1982; Milne 1999; Fenner *et al.* 2007). Recent research suggests that Pygmy Bluetongue Lizards change their prey items opportunistically over spring and summer, with plant material incorporated in the diet to a greater extent as summer progresses (Fenner *et al.* 2007). Based on these dietary studies, it is suggested that Pygmy Bluetongue Lizards require a high abundance of arthropod prey, habitat where efficient prey capture is possible, and particular plant species which form part of their diet (Fenner *et al.* 2007).

Reproduction

Mating occurs in spring (October and November) (Hutchinson *et al.* 1994). Pitfall trapping has indicated that males are more active than females during spring, possibly because they are searching for mates at this time (Hutchinson *et al.* 1994). Females have been observed with newly born young from late January until late March, with the bulk of births taking place in February. Litter size ranges from one to four. At birth, Pygmy Bluetongue Lizards are approximately 45 mm snout-vent length (SVL) and weigh approximately 1.5 grams. Juveniles remain in the parental burrow for between one and twelve weeks, and then move out to smaller burrows of their own (Milne 1999; Milne *et al.* 2002).

By the start of spring (September), juveniles are between 60 and 70 mm SVL and weigh between four and eight grams. By the end of summer (February), at approximately one year of age, SVL is from 75 mm to 85 mm and weight from six to 10 grams. Males are capable of reproduction in the next spring season, and females may also reproduce at this age, although some females take another year to become reproductively active. Only females longer than 100 mm have been observed to have the maximum recorded four young, and it would take four years to reach this size according to current growth rate estimates.

It is estimated that fewer than 10 per cent of juveniles survive to adulthood (Milne 1999). In captivity, Pygmy Bluetongue Lizards are known to live to at least 18 years of age (M. Hutchinson, pers. comm.). Skeletochronological data from a small number of museum specimens show some wild individuals were at least eight years old when captured (S. Hudson, pers. comm.).

Part E: Known and Potential Threats

Identification of Threats

<u>Changed Land Use</u>

Changes in land use, particularly any changes that would permanently alter large or contiguous areas of habitat, are a major threat to Pygmy Bluetongue populations.

With only 31 known populations of this species remaining, the loss or reduced viability of even a single population would have significant implications for the long-term survival of this species.

Ploughing

Ploughing is a very significant threat as it will directly kill and displace both lizards and spiders, destroying their burrows. Ploughing will also break up the soil, making any burrows subsequently dug by spiders (which are likely to be very few) unstable and unsuitable for lizards. Even if a paddock is only ploughed once and left to regenerate naturally, the original lizard population will be lost.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.2 and 7.1

Ripping

Ripping is slightly less detrimental than ploughing, but would destroy lizards and their burrows in the direct path of the ripping lines. Ripping for new watering points may become more prevalent with the advent of paddock reconfiguration for rotational grazing.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.2 and 7.1

Inappropriate Grazing Regimes

While moderate grazing is generally compatible with the habitat requirements of Pygmy Bluetongue Lizards, heavy grazing by hard-hoofed stock is likely to be detrimental. Heavy grazing can be defined as that which may lead to destabilisation of the soil structure, causing the filling of burrows in the dry season, and the collapse of burrows in the wet season. Such heavy grazing may also increase exposure to predators and/or reduce the availability of prey. Increases to localised stocking densities through the installation of new water points will have similar impacts.

The complete removal of grazing at sites where Pygmy Bluetongue Lizards occur may also be a threatening process, if the current grazing regime is helping to maintain a suitable habitat structure. Removal of grazing may lead to increased weed growth and/or a reduction in inter-tussock spaces, which may impact on foraging and basking opportunities.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.2 and 7.1

Other Agricultural Development

In recent years there has been a trend towards new agricultural land uses in the region, e.g. establishment of saltbush pasture and viticulture. Any such changes involving soil disturbance, clearing or other habitat modification would be highly detrimental if they were to occur in areas occupied by Pygmy Bluetongue Lizards.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.2 and 7.1

Urban, Industrial and Infrastructure Development

Some Pygmy Bluetongue population sites, particularly those close to Burra, may be subject to future urban, industrial development. This may include the establishment of buildings, roads, wind farms and telecommunications infrastructure. Such development would disturb the native grassland and may directly destroy lizard burrows and the lizards themselves. One population near Burra is already believed to have been lost due to recent residential development (J. Schofield pers. comm.).

Wind farm developments are becoming increasingly common in the region. Turbines are typically installed on hill slopes and crests, which often are not optimal habitat for Pygmy Bluetongue Lizards. However, access roads, cabling and other associated infrastructure, which are often developed on flats and lower slopes, have the potential to cause further loss and fragmentation of Pygmy Bluetongue habitat. These include possible;

- weed invasion along roads and around infrastructure creating less suitable habitat;
- habitat fragmentation restricting movement for feeding and dispersal;
- changes to the hydrology from extra water run-off affecting the soil structure (burrow constructions by spiders) and vegetation compositions (denser ground cover); and
- shadow-flickering, vibration and noise from the turbine effecting the ability of the lizards to bask, feed and move around.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.1 and 7.1

<u>Weeds</u>

High and dense growth of wild oats and other weeds may reduce opportunities for Pygmy Bluetongue Lizards to bask, catch insects and find mates. Weeds may also render habitat unsuitable for burrowing spiders (Souter 2003).

Weed control may also be a threatening process if high-disturbance techniques are used or native plant species are affected (see *Part H: Management Practices* for information on appropriate weed control practices). Soil disturbance (e.g. ripping) may also promote weed establishment.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 5.2, 6.1 and 6.2

Pesticides

Insecticides and other pesticides are used in the region to control agricultural pests such as native locusts, grasshoppers and snails, including the introduced white snail (*Cernuella virgata*). These species are found at a number of Pygmy Bluetongue sites and can form a significant part of the lizards' diet.

Pesticide use may potentially impact on Pygmy Bluetongue Lizards either directly or indirectly. While the direct impacts of insecticides on Pygmy Bluetongue Lizards are unknown, insecticides are known to cause illness or death in some reptiles (Spur 1993, Khan & Hall 2005, Pauli *et. al.* 2010). Pelletised snail baits, which are often used in snail control, are also known to be very toxic to reptiles (Australian Pesticides & Veterinary Medicines Authority 2005).

Secondary impacts could include a reduction in the main food source of Pygmy Bluetongue Lizards, which could affect their survivorship or reproduction rates; or a reduction in burrowing spiders' abundance which may significantly reduce the availability of spider burrows which the Pygmy Bluetongue Lizards are dependent on for shelter sites. Cumulative secondary poisoning is also a potential risk.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 5.2, 6.1 and 6.2

Herbicides

As with insecticide use, there is no direct evidence of the impacts of herbicide use on Pygmy Bluetongue Lizards. However, herbicides are known to cause fertility problems for small vertebrates (Pauli *et. al.* 2010), and are a potential threat to Pygmy Bluetongue Lizards.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 5.2, 6.1 and 6.2

Inappropriate Fire Regimes

The effect of fire on Pygmy Bluetongue populations is not fully known. Fires were probably once a natural landscape process throughout the range of the Pygmy Bluetongue Lizard. However, given the small and isolated nature of the remaining Pygmy Bluetongue populations, fire could potentially have a significant impact.

It is likely that the impact of fire on Pygmy Bluetongue populations would depend largely on the timing and intensity of the fire. Fires that occur in spring, when males are active, or in late summer and early autumn, when juveniles are dispersing, could be particularly detrimental. Fires at other times of the year (mid-summer, late autumn, early spring) may be of less consequence, provided that they do not occur frequently or in conjunction with other adverse conditions or threats, although further research is required to clarify this (M. Bull, pers. comm.).

Monitoring was conducted before and after a Pygmy Bluetongue population site was burnt by accidental fire in December 2005 (Fenner & Bull 2007). The results of this study suggested that the lizards were able to take refuge from the fire in their deep burrows, as the fire did not kill adult lizards or affect the subsequent fecundity of females. While declines were initially observed in activity, foraging, body condition and juvenile survivorship following the fire, these effects were short-lived, with no adverse impacts observed in subsequent years (A. Fenner, pers. comm.).

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 3.1, 5.2, 6.1 and 6.2

<u>Habitat Fragmentation</u>

Large tracts of cultivated land separate most of the Pygmy Bluetongue sites. Due to the lizards' small size and reliance on spider burrows, they are unlikely to disperse across cultivated land. Small, isolated populations may suffer from inbreeding, and are vulnerable to local extinction from stochastic events. Genetic data confirm that dispersal between current populations is low (Smith 2006, Smith *et al.* 2009). Research and management actions identified in this plan will attempt to overcome past modification practices to create habitat linkages between subpopulations potentially including the use of artificial burrows and establishment of habitat in previously ploughed land.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1 and 6.2

<u>Planting</u> (tall trees and shrubs)

It is uncertain whether the native grasslands in the mid-north region of South Australia had a tree layer prior to European settlement. The most accepted scenario is that they have always been largely treeless, with a few scattered local occurrences of eucalypts and she-oaks (Jessup 1948).

Trees and shrubs alter the characteristics of the soil, litter and understorey plant community beneath their canopy. There are no records of Pygmy Bluetongue Lizards living under trees, even in areas adjacent to open grassland containing Pygmy Bluetongue Lizards. Experiments have shown that artificial burrows established under trees quickly fill with soil and debris (Souter 2003).

Trees may increase predation risks for the lizards by providing perches for birds to stalk the burrows (compared to only hovering birds in open grassland), and by reducing the level of sunlight at ground level, which may result in lizards having to move further away from their burrows to bask.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 5.2, 6.1 and 6.2

<u>Predators</u>

Both introduced and native predators are known to prey on the Pygmy Bluetongue Lizard. Domestic dogs have been known to take Pygmy Bluetongue Lizards, and foxes and cats are also potential predators. Known natural predators include Australian Kestrels and Eastern Brown Snakes (Hutchinson *et al.* 1994, Fenner *et al.* 2008a, M. Hutchinson pers. comm.).

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 3.1, 5.2, 6.1 and 6.2

<u>Fertilisers</u>

Fertilisers may have a negative impact on grasslands, by encouraging weed growth at the expense of native grasses, which may in turn affect the lizards.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 3.1, 5.2, 6.1 and 6.2

<u>Poaching</u>

Despite the large fines or jail terms associated with poaching and smuggling of threatened species, there is a risk that poachers could target these animals, as Australian reptiles are generally in demand.

Threat addressed in Actions 1.1, 1.2, 1.3, 2.1, 4.1, 5.2, 6.1 and 6.2

<u>Climate Change</u>

The *loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases* has been identified as a Key Threatening Process under the EPBC Act. The higher temperatures and altered rainfall regimes that are predicted under climate change scenarios could potentially impact on Pygmy Bluetongue Lizards, their prey and habitat.

While there is currently little knowledge of the effects of climatic conditions on Pygmy Bluetongue Lizards, monitoring surveys recorded significantly lower fecundity, lower grass cover and more bare earth in 2007 and 2008 than in 2006 (A. Fenner pers. comm., J. Schofield pers. comm.). These trends may be linked to the prolonged drought in the region.

Pygmy Bluetongue Lizards could be particularly vulnerable to climate change due to the isolation and small extent of the remaining populations and suitable habitat, as there are very limited opportunities for dispersal or translocation if the current area of occupancy becomes unsuitable.

Threat addressed in Actions 2.1, 2.2, 2.3, 3.2, 4.1, 5.2, 5.3 and 7.1

Areas Under Threat

The threats identified above are not limited to specific areas. Rather, all Pygmy Bluetongue habitats are considered to be potentially at risk from all of the threats highlighted above.

Populations Under Threat

All known Pygmy Bluetongue populations are small populations in paddocks within commercial farming properties in the mid-north of South Australia. One population has been placed under a Heritage Agreement and another is being managed solely for the protection of the Pygmy Bluetongue Lizards (Nature Foundation SA 2011) and is therefore protected from major habitat modification. Otherwise, all of the identified threats are currently considered to be relevant to all populations. Populations in the north of the species range may be more vulnerable to the effects of climate change due to the increased temperature gradient in that region.

As a complete threat assessment has not been conducted at all known populations, further investigation is required in order to identify the populations that are most at risk from particular threats (see Action 1.3).

Part F: Recovery Actions to Date

The Pygmy Bluetongue Lizard has been subject to a recovery plan since 2000 (Milne *et al.* 2000). This initial recovery plan focused on addressing key knowledge gaps, establishing community involvement in the conservation of this species, and establishing guidelines for the management of Pygmy Bluetongue habitat.

Searches for New Populations

Searches for new populations in recent years have identified 22 new sites, taking the total number of known Pygmy Bluetongue sites to 31.

Surveys to Establish Population Extent

Previously, there was little information available on the precise extent of each Pygmy Bluetongue population, with many populations known only from a single point datum. Recent surveys have improved knowledge on the area of occupancy at several Pygmy Bluetongue sites and have provided landholders with better information to guide property management, such as areas where potentially adverse farming practices should be avoided.

Establishment of Conservation Agreements with Landholders

There are two types of conservation agreements that landholders may enter into (see Part G: Management Practices):

- Heritage Agreements on land titles, which are permanent, legally binding and transfer to future owners of the land.
- The Sanctuary Scheme, which involves non-binding agreements designed to assist landholders to provide wildlife habitat on their property, even when the property is managed primarily for other purposes.

To date, one population has been protected via a Heritage Agreement, and three Sanctuaries have been declared. This has contributed to efforts against Performance Criterion 1 from the previous recovery plan of having '*6 secure sites containing a minimum of 3000 individuals.*'

In 2010, an 80ha grassland property north-east of Burra was purchased by Nature Foundation SA. The property is known as Tiliqua Reserve and is managed for the protection of the Pygmy Bluetongue Lizards (Nature Foundation SA 2011).

Commencement of Long-term Monitoring

A permanently marked one-hectare monitoring plot was established at site 1 (see Fig. 1) by Flinders University in 1994, with an additional eight permanent monitoring plots established in 2005 (sites 2, 3, 4, 6, 9, 11, 12 and 22 in Fig. 1) by the Department of Environment and Natural Resources (DENR). These monitoring sites were established to provide long-term data on the lizards' population structures and densities.

The monitoring involves the examination of suitable spider-holes (circular in cross section, 10 mm to 20 mm in diameter and at least 10 cm deep) in the one-hectare squares, using an optiscope (optic fiberscope) to determine the presence of Pygmy Bluetongue Lizards.

Searches are led by an experienced observer, with the assistance of novice volunteers. The surveys are undertaken in February-March, to coincide with the time of year with minimal ground cover. Refer to Appendix 1 for more details and data collected from 2005 to 2011. Trends between years are not necessarily absolute, given variation in observers; sampling time and vegetation cover (affecting detectability of lizard burrows) between years.

Pygmy Bluetongue numbers fluctuated between 2005 and 2011 (Appendix 1). Drought conditions during 2005 to 2009 may have affected the abundance of insects (i.e. food) and the abundance of spider burrows (i.e. shelter sites) which the lizards are dependent on (Sharp 2011), and this may reflect the fluctuating numbers of Pygmy Bluetongues observed. However, continued monitoring is required to better observe long-term population changes. In addition, part of an Australian Research Council (ARC) Linkage project under way at Flinders University (M. Bull pers. comm.) has a component to trial various monitoring techniques with monitors of varying ability to develop a better method of efficiently estimating lizard density.

Development of *Best Practice Management Guidelines*

The previous Pygmy Bluetongue Lizard Recovery Plan (Milne *et at.* 2000) identified a need to develop guidelines for the management of known habitat remnants. The *Pygmy Bluetongue Lizards: Best Practice Management Guidelines for Landholders* (Schofield 2006) have now been developed and distributed to landholders of some of the known Pygmy Bluetongue sites. This document describes ways to ameliorate known threats to Pygmy Bluetongue populations, and potentially increase lizard numbers and the quality and extent of habitat (see *Part H: Management Practices* for further detail).

Local government staff have also been contacted to raise their awareness of the potential impacts of land use change on Pygmy Bluetongue populations.

Research and Trials

Substantial progress has been made in filling some key knowledge gaps, which will help to guide recovery actions for this species.

Ecology and General Biology

Since 1992, studies have been undertaken to examine the behaviour, shelter site requirements, activity and movement patterns, life-history, diet, macrohabitat requirements, predators and parasites of Pygmy Bluetongue Lizards, and the ecology of wolf spiders (Milne 1999, McCullough 2000, Milne & Bull 2000, Milne *et al.* 2003a, Souter 2003, Souter *et al.* 2007, Fenner *et al.* 2007, Fenner *et al.* 2008b). Mark-recapture techniques were used to collect information on the basic demographic parameters of Pygmy Bluetongue Lizards, including reproductive output, growth rates, sexual development, longevity, population dynamics, mortality rates, body condition, and breeding patterns (Milne 1999). Annual natality, mortality and juvenile survival were estimated at one site (Milne 1999), and more recently, short-term population dynamics have been tracked at a second site (Fellows 2008).

Grazing Trials and Microhabitat Requirements

Grazing trials have been conducted through a collaborative project between DENR and the Mid North Grassland Working Group, to examine the potential effects of different grazing regimes on Pygmy Bluetongue burrows. There has been interest among landholders in switching to rotational grazing (which involves increased stock densities for short periods) in the mid-north region of South Australia, as it has been demonstrated to provide both productivity and conservation benefits. The grazing trials have determined that rotational grazing does not result in accelerated deterioration of spider burrows in comparison to traditional grazing regimes, and therefore appears to be compatible with the conservation of Pygmy Bluetongue Lizards (Sharp *et al.* 2010).

A PhD research project involving microhabitat manipulation associated with grazing found that heavy grazing management that results in the majority of vegetation being removed could have a negative impact on Pygmy Bluetongue Lizard recruitment and sustainability (Pettigrew & Bull 2011). Given the choice of good quality burrows with or without surrounding grasses, Pygmy Bluetongue Lizards will prefer the burrow with relatively sparse grass cover (Pettigrew & Bull 2011). This means that different grazing regimes within Pygmy Bluetongue habitat should be carefully monitored so that heavy grazing that removes much of the grass cover can be avoided (Pettigrew & Bull 2011).

Captive Breeding

Since the mid-1990s, a small captive population of Pygmy Bluetongue Lizards has been held at Adelaide Zoo (T. Morley pers comm.). Attempts to establish breeding in this population have been unsuccessful, possibly due to the aggressive and territorial behaviour exhibited by the lizards in captivity, and/or to unsuitable ambient conditions in the captive enclosure. There has also been uncertainty with regard to the age and fecundity of the individuals in the original captive population.

Research conducted on the fate and dispersal of juveniles in the wild (Fellows 2008) will assist in determining appropriate take rates for future supplementation of captive populations. An additional ARC Linkage project is currently underway at Flinders University (M. Bull pers comm.) to examine social and reproductive behaviour in captive populations; trial the use of larger, lower density, outdoor enclosures; and develop suitable strategies for the release of translocated lizards.

Artificial Burrows

Pygmy Bluetongue Lizards are known to use, and breed in, artificial burrows (Milne & Bull 2000, Milne *et al.* 2003b). Holes hammered in the ground using steel rods have been the most successful type. Trials in the use of artificial burrows at one population have suggested that they may enhance local lizard abundance and recruitment success, at sites with free draining soils, appropriate habitat, and limited availability of deep spider holes (Souter *et al.* 2004). To date there has been no evidence of adverse outcomes (e.g. negative social interactions) associated with the use of artificial burrows.

However, soil compaction through the artificial creation of burrows may be an issue at some sites where free draining burrows are required due to high water run-off. Further research is required to determine the long term success of artificial burrows across different soil types and land-form.

Genetics

Substantial progress has been made in genetic studies of Pygmy Bluetongue Lizards. Microsatellite markers have been developed and used to establish baseline genetic information, including genetic profiles of eleven populations (Smith *et al.* 2009, J. Scholfield, unpublished) at sites 1, 2, 3, 4, 6, 9, 11, 12, 13, 22 & 26 (Figure 1).

Information on DNA microsatellite allelic variation has suggested that there is a relatively high frequency of multiple matings (females mating with different males). High genetic diversity and low levels of inbreeding have been recorded within populations (Smith *et al.* 2009), and so intervention is not required to maintain genetically viable populations in the short term (M. Bull pers comm.).

Significant genetic differentiation has been recorded between most of the studied populations. Genetic differences have been greatest between the most geographically distant populations, with no genetic exchange between northern and southern populations (Rogers 1998, Smith 2006, J. Scholfield, unpublished). Research to date suggests there is no migration between geographically close populations, and limited dispersal within populations. It is therefore likely that naturally low dispersal rates, together with habitat fragmentation, are responsible for the genetic differentiation between populations (Smith 2006; Smith *et al.* 2009). This type of information will be valuable in evaluating the need, and developing protocols, for future management options such as relocation, reintroductions or supplementation of existing populations.

Community Engagement

The Pygmy Bluetongue Lizard Recovery Project has been extensively promoted through the media, and through liaison with landholders and community groups, including the local Biodiversity and Endangered Species Team (BEST) and the Burra Community School. This has helped to increase community awareness of, and involvement in, actions to help conserve the Pygmy Bluetongue Lizard. Contributions from community groups and landholders in activities such as monitoring and habitat protection have made an important contribution to the recovery effort. These have been important achievements against Performance Criterion 3 of the previous recovery plan of '*active participation by local people in species conservation*'.

Communication Strategy

A communication strategy has recently been developed to identify and prioritise communication activities and target stakeholders, to help support the objectives and actions of the recovery plan.

Part G: Objectives, Actions and Performance Criteria

Vision

The long-term vision for the Pygmy Bluetongue Lizard Recovery Program is to achieve down-listing of *Tiliqua adelaidensis* to conservation dependent.

For this to occur, the Pygmy Bluetongue Lizard will need to be valued by an informed regional community; and that regional community will need to have an increased capacity to sustainably manage their unique Lizard and its habitat within existing and improved regional planning and land management practices.

Ten-year Targets

- To have refined habitat predictors and indicators, and to have searched for Pygmy Bluetongue Lizards in known potential habitat.
- To have at least 75% of known populations protected and managed through the adoption of the *Best Practice Management Guidelines* by landholders.
- For land management practices at all known Pygmy Bluetongue sites to be sympathetic with Pygmy Bluetongue Lizard conservation requirements.
- To have determined the feasibility of reducing the fragmentation of populations, and increasing the area of occupancy.

Objectives of this Recovery Plan (Five-year Objectives)

<u>Overall Objective</u>

To improve the long-term viability of Pygmy Bluetongue populations by:

- clarifying the extent, abundance and habitat requirements of the species;
- achieving long-term protection and enhancement of habitat through sustainable land management practices and adequate awareness.

<u>Specific Objectives</u>

Objective 1: Protect existing Pygmy Bluetongue populations and habitat.

Objective 2: Clarify distribution and abundance.

Objective 3: Maintain, enhance and increase the area and quality of suitable habitat for Pygmy Bluetongues at known populations.

Objective 4: Monitor populations to evaluate the effectiveness of management and to detect trends which may require a management response.

Objective 5: Fill critical knowledge gaps to help guide adaptive management and recovery of the species.

Objective 6: Continue to engage the community and form partnership to promote the significance and improved management requirements of the Pygmy Bluetongue Lizards.

Objective 7: Manage the recovery process through an effective recovery team.

Objective 1: Protect existing Pygmy Bluetongue populations and habitat.

***Action 1.1* Ensure landholders and relevant agencies are aware of, and protect, known Pygmy Bluetongue populations and their habitat.**

In order to avoid inadvertent loss or degradation of Pygmy Bluetongue habitat or populations, it is important that landholders and relevant agencies are aware of the locations and management requirements of these sites. This is particularly important in areas that may be at risk of development, subdivision or changed land use. It is also important that the requirements of, or potential impacts to, Pygmy Bluetongue Lizards are adequately addressed in relevant policies and processes.

Methods

Engage in ongoing liaison with relevant authorities and landholders to encourage open communication and consideration of Pygmy Bluetongue populations, threats and habitat requirements, in processes such as property management planning, local government planning processes, change of land ownership and land use, and regional pest control activities.

Liaise with relevant authorities to ensure that potential impacts to Pygmy Bluetongue Lizards are routinely considered in the assessment of development proposals or the development of plans and policies that could impact on Pygmy Bluetongue Lizards. Provide maps of known Pygmy Bluetongue locations and of potential habitat.

Relevant organisations will include local councils (including planning and bushfire prevention staff), Primary Industries and Resources SA (PIRSA), the Northern and Yorke Natural Resource Management Board, and any other agencies or companies involved in infrastructure development, Environmental Impact Assessments, or agricultural extension in the region.

Specifically, ensure that relevant authorities are aware of, and have processes in place to ensure routine consideration of:

- the locations of known Pygmy Bluetongue populations;
- characteristics and known locations of potential Pygmy Bluetongue habitat;
- management and land-use activities that may impact on Pygmy Bluetongue populations;
- appropriate strategies to avoid and mitigate potential impacts to Pygmy Bluetongue populations; and
- the need to seek advice from DENR before approving any practices which may adversely impact on Pygmy Bluetongue Lizards.

Evaluate the effectiveness of current policies such as the insect control quarantines and buffer zones imposed by PIRSA, and encourage revision if required.

Disclosure of detailed information on the location of Pygmy Bluetongue populations should be restricted to landholders and agencies that require this information for protection of Pygmy Bluetongue habitat.

Action 1.2 **Encourage private land conservation agreements and other measures to secure protection of Pygmy Bluetongue populations and habitat.**

'Secure' protection of Pygmy Bluetongue habitat will not necessarily involve the formal protection of habitat in the public reserve system. If managed appropriately, agricultural grazing is often compatible with Pygmy Bluetongue Lizard conservation requirements, and in many cases it will be important to continue grazing management in order to maintain a suitable habitat structure.

Methods

Undertake further liaison with landholders to encourage the protection of Pygmy Bluetongue populations under conservation agreements (Stewardship Agreements, Heritage Agreements, Individual Property Management Plan) or adoption of *Best Practice Management Guidelines*, taking into account both conservation and primary production objectives. This can be done in conjunction with Action 3.1.

Consult with relevant government agencies and non-government organisations to investigate new approaches to facilitate the secure protection and appropriate ongoing management of habitat.

Action 1.3 **Undertake threat and risk assessment of known Pygmy Bluetongue populations.**

An assessment of threats and risks at each Pygmy Bluetongue population site will help to:

- identify and proactively address imminent threats which could cause further declines in population size, habitat extent or habitat quality; and
- ensure that recovery efforts are targeted to areas where they will be of most benefit.

Methods

Undertake a risk assessment of the current and potential threats, their likelihood and potential consequences based on site observations, discussions with land managers, and knowledge of local land use practices and trends. Use this information, in conjunction with an assessment of the relative importance of each population, to determine priority actions and priority areas for recovery efforts.

Objective 2: Clarify distribution and abundance.

Action 2.1 **Determine the extent and size of known Pygmy Bluetongue populations.**

To date, most estimates of population size at Pygmy Bluetongue sites have been derived from a single sample plot, extrapolated against the estimated area of suitable grassland habitat at each site. However, at most sites, the actual area of occupancy, spatial variation in abundance and total population size are unknown.

Further sampling effort across these sites will help to establish more accurate estimates of the size and extent of each population. This information will provide landholders with better information to guide farming practices, such as areas to avoid when applying herbicides or pesticides. Accurate baseline information on population extent and lizard abundance will also assist in measuring population trends, identifying threats, prioritising sites for management, and assessing the effectiveness of recovery actions.

Methods

Undertake area of occupancy surveys at all known sites, with the cooperation of landholders. Assess the abundance of lizards in both core and marginal habitat and calculate population estimates for each site. Encourage volunteer involvement in these surveys.

For each site, map the area of occupied habitat, and any unoccupied potential habitat, and store this information in a geospatial database.

***Action 2.2* Identify and map potential habitat.**

As virtually all suitable habitat for Pygmy Bluetongue Lizards occurs on private agricultural land, there are likely to be unsearched areas of potential habitat which may support additional populations. Pygmy Bluetongue Lizards tend to retreat to their burrows when disturbed, and may go undetected unless a targeted search is undertaken.

Methods

Establish appropriate methods for identifying and mapping potential habitat for undiscovered populations (or with the potential to support translocated populations in the future) or potential dispersal habitat. Methods may include interpretation of aerial photographs, GIS analysis, gleaning local knowledge and targeted field reconnaissance surveys. Use media reports and field days to encourage community members to report areas of potentially suitable habitat, and any potential sightings of the lizards.

***Action 2.3* Search additional potential habitat for new populations.**

Whilst some of the mid-north area has been surveyed in the past several years, further searches in potential habitat identified via Action 2.2 above may find new populations of Pygmy Bluetongue Lizards, thereby increasing the known extent of occurrence or area of occupancy of the species.

Due to the small number and isolated nature of currently known Pygmy Bluetongue populations, the discovery of any additional populations would be of high significance for the conservation and management of this species.

Methods

Liaise with landholders to arrange access to priority sites which are considered to be potential Pygmy Bluetongue habitat. Document habitat condition and undertake searches for the lizards using an optic fiberscope or other appropriate technique.

Keep thorough records of all areas that have been searched for Pygmy Bluetongue Lizards, and of any areas that may be suitable as future translocation sites. Ensure that the location of any new populations are documented in appropriate databases, and communicated to relevant landholders and land management agencies.

Objective 3: Maintain, enhance and increase the area and quality of suitable habitat for Pygmy Bluetongues at known populations.

Action 3.1* Work with landholders to implement *Best Practice Management Guidelines.

The *Pygmy Bluetongue Lizards: Best Practice Guidelines for Landholders* (Schofield 2006) provide landholders with land management recommendations for the conservation of the Pygmy Bluetongue Lizards, based on available information on the lizards' ecology and habitat requirements. Ongoing liaison with landholders will be required to maintain awareness of these issues, and encourage implementation of the guidelines.

Methods

Contact landholders and local government officers to discuss the guidelines and to offer advice and assistance in their implementation. Arrange site visits where possible.

At sites where access is permitted for survey or monitoring purposes, continue to provide regular feedback to landholders on the monitoring results and any management implications.

Encourage local councils to work cooperatively with the recovery team in identifying any changes (or potential changes) in land ownership or land management at Pygmy Bluetongue sites. Ensure that new landholders are made aware of the recovery program, threatening processes, and *Best Practice Management Guidelines*.

Update the guidelines as required, e.g. as new information to guide management becomes available, and redistribute to all relevant land managers.

***Action 3.2* Implement measures to increase suitable Pygmy Bluetongue habitat at known populations.**

Knowledge gained through the actions in this recovery plan (e.g. threat and risk assessments, grazing trials and research) will assist in identifying opportunities and priorities to increase suitable Pygmy Bluetongue habitat. Implementation of these measures will enhance the long-term viability and recovery of Pygmy Bluetongue populations.

Methods

Implement opportunities to increase the area and quality of habitat at priority sites, as identified through the threat and risk assessments, and the results of research and trials.

Examples of opportunities to increase habitat extent or quality may include adjustments to grazing management regimes, installation of artificial burrows or related recovery actions for the grassy habitats themselves.

Further research and trials over the life of this recovery plan (see actions 5.1 & 5.3) will assist in assessing the feasibility of translocation from captive or existing populations, in order to supplement populations or establish new populations. If translocation is found to be a feasible management option in future, protocols should be developed to guide the application and implementation of this technique.

Monitoring should be conducted to evaluate the effectiveness of any efforts to enhance Pygmy Bluetongue populations and habitats.

<u>Objective 4: Monitor populations to evaluate the effectiveness of management and to detect trends which may require a management response.</u>

Action 4.1 **Continue to undertake (and refine as required) long-term population monitoring at selected sites.**

Long-term monitoring of key Pygmy Bluetongue populations is required to evaluate the effectiveness of recovery actions, evaluate the impacts of land management regimes, and to detect trends which may require a management response.

A further understanding of temporal and spatial trends in population densities will assist in refining appropriate monitoring protocols.

<u>Methods</u>

Continue annual monitoring (in late Summer to Autumn) of population densities and population structure at the nine established monitoring sites.

For remaining sites not included in the annual monitoring program, conduct baseline surveys to measure population density and structure (part of Action 2.1).

Monitor and evaluate the effectiveness of recovery actions to protect, maintain, enhance or increase the quality of the habitat and to determine if any management response is required.

Refine monitoring procedures if required. Take into account knowledge of spatial and temporal distribution patterns, habitat use and population structure.

Conduct trials using various monitoring techniques with personnel of varying ability (expertise, training) to develop a better method of efficiently estimating lizard density.

Action 4.2 **Maintain (and refine as required) systems for data collection and management**

An effective data collection and management system is required to ensure that data relating to Pygmy Bluetongue populations and habitat is stored in a systematic manner, to facilitate efficient data analysis, priority setting and information sharing.

<u>Methods</u>

Maintain and update Biological Data Base of South Australia (BDBSA) to:

- provide systematic and comprehensive storage of monitoring data for Pygmy Bluetongue populations;
- provide clear documentation of the extent of habitat and/or populations that have been surveyed;
- record searched areas in which the lizards have not been recorded, in additional to areas where they have been located;
- assist in identifying potentially suitable habitat;

- assist in providing information in appropriate scales and formats to relevant land managers including landholders, local government and PIRSA; and
- allow analysis of population and distribution trends and effects of management and impacts.

<u>Objective 5: Fill critical knowledge gaps to help guide adaptive management and recovery of the species.</u>

Action 5.1 **Prioritise, promote and conduct key research projects needed to guide improved recovery outcomes.**

Research into the Pygmy Bluetongue Lizard to date has helped to improve knowledge of the habitat and management requirements of this species. Additional research to address key knowledge gaps will aid in further developing and refining management guidelines and recovery actions for this species.

<u>Methods</u>

Develop a research prospectus to identify critical knowledge gaps and priority research projects. Promote research needs and opportunities to South Australian research institutions, Natural Resources Management (NRM) boards and other relevant agencies. Facilitate implementation of priority projects.

Key areas for research may include:

- adult home range and dispersal;
- juvenile dispersal, survival and recruitment into adult populations;
- response to translocation;
- factors that influence reproductive success;
- impacts of pesticide and herbicide use, including on spiders;
- relationship between climatic fluctuations and survival and recruitment;
- response of Pygmy Bluetongue Lizards to altered land use;
- temporal variation in abundance and survivorship;
- mating system, social organisation and social interactions;
- selection pressures and their role in maintaining social systems;
- genetic structure of populations;
- the role of endemic and exotic parasites and pathogens;
- effects of different fire regimes on Pygmy Bluetongues and their habitat;
- time taken for Pygmy Bluetongues to re-occupy previously ploughed land;
- how to increase area of occupancy around existing populations surrounded by cropping land;
- interactions between the lizards and the spiders that build the burrows, and the ecology and habitat requirements of the spiders; and
- effects of different grazing regimes;

- impact on the movement, dispersal and survival of the Pygmy Bluetongue Lizards from wind farm development; and
- effects of shadow flickering and noise and vibration from wind turbine on the lizards ability to bask, feed and move around.

***Action 5.2* Undertake land management trials to refine regimes required to improve habitat quality.**

In order to refine and improve the *Pygmy Bluetongue Lizards: Best Practice Management Guidelines for Landholders* and develop a better understanding of optimal management regimes to improve habitat quality, further experimental manipulations and monitoring programs are required.

Methods

Continue microhabitat research and grazing trials to
- establish optimal microhabitat characteristics for Pygmy Bluetongue populations (including impacts on the abundance of prey and burrowing spiders);
- optimal grazing regimes to maintain these microhabitat characteristics; and
- establish trial to improve previously ploughed land to increase the area of occupancy of exiting populations and to link populations.

Continue to opportunistically monitor the effects of any unplanned wildfires at Pygmy Bluetongue sites. Evaluate the effects of experimental burns or wildfires in areas of similar habitat that are not occupied by Pygmy Bluetongue Lizards (e.g. Mokota Conservation Park) and evaluate the implications for Pygmy Bluetongue Lizards. Conduct a risk and needs assessment to determine whether prescribed experimental burn trials at sites occupied by Pygmy Bluetongue Lizards are a viable option.

***Action 5.3* Continue efforts to establish a captive breeding population.**

The establishment of a captive breeding population and the development of a husbandry manual will help safeguard against population declines in the wild by providing management contingencies should they be needed in future.

A captive breeding population may also provide opportunities for controlled studies of social interactions, which may provide insight into social behaviour in the wild, and thus help to inform future management strategies.

Methods

Continue to maintain a population of Pygmy Bluetongue Lizards in captivity. Apply the findings of relevant field research (e.g. research into social organisation, social aggression, genetics and diet) to the management of the captive population.

Conduct experimental trials (e.g. manipulating enclosure design, diet, burrows, cover, temperature, population densities and level of relatedness between individuals) in an attempt to establish breeding in captivity, and to determine the factors which are conducive to breeding success. Document findings in a husbandry manual for future reference.

Objective 6: Continue to engage the community and form partnership to promote the significance and improved management requirements of the Pygmy Bluetongue Lizards.

Action 6.1 **Promote community awareness and ownership of, and involvement in, the recovery of the Pygmy Bluetongue Lizards.**

As all Pygmy Bluetongue populations occur on private agricultural land, the awareness and involvement of landholders, local communities and relevant land management agencies is essential for the recovery of this species, through the behaviours they adopt and support.

Methods

In accordance with the Pygmy Bluetongue Lizard Communication Strategy, continue to foster the interest and ownership of the regional community in the Lizard as an iconic, locally endemic species. Encourage involvement of the community in implementing recovery actions, and continue to promote the recovery program and management issues in the media.

Encourage the reporting of suspicious behaviour at known lizard sites, such as digging by unknown people.

Action 6.2 **Establish a network of local mentors and champions to help drive and promote improved recovery of Pygmy Bluetongue populations and engage the community in recovery activities.**

Regional protection of threatened species must be community-driven and to ensure capacity building, land managers and individuals must have access to relevant training, extension services, and support networks.

Methods

Support interested locals with a passion for protecting and conserving the natural environment in their area to establish a network of mentors and champions, who can be there in their community, to promote, engage and build capacity of landowners, managers and interested people about the protection and management of the Pygmy Bluetongue Lizards. The network will have a range of people with knowledge/skills and interest for other threatened species and ecological communities including Iron-grass Natural Temperate Grassland, Peppermint Box Grassy Woodland, Spiny Daisy (*Acanthocladium dockeri*) and threatened orchids.

Objective 7: Manage the recovery process through an effective recovery team.

Action 7.1 **Maintain an effective recovery team which supports, guides and evaluates the implementation and outcomes of the recovery plan.**

An effective recovery team will assist in assessing progress, priorities and opportunities for the recovery program, and provide expertise and input as required to support the implementation of recovery actions.

Methods

Maintain representation from relevant government agencies, landholders, conservation groups, researchers and community groups on the recovery team. The recovery team should meet twice annually or as required to review priorities, progress and outcomes in relation to implementation of the recovery plan; and to assess and respond to emerging issues and opportunities.

Actions, Performance Criteria, Priorities and Responsibilities

Table 1 outlines performance criteria, responsibilities and level of priority for each action.

Table 1: List of the performance criteria, priorities and responsibilities for each action

Objective 1: Protect existing PBT populations and habitat.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
1.1	Ensure landowners and relevant agencies are aware of, and protect, known PBT populations and their habitat.	• Landholders at all known PBT sites communicated with and provided with relevant information about PBT and *Best Practice Management Guidelines* by Year 2 (with Action 3.1). • All relevant authorities provided with information on PBT populations and habitat where PBT is known to occur by Year 1. • No avoidable decline in PBT populations or degradation of habitat due to lack of awareness of locations or of appropriate management practices especially from locust control and infrastructure development (e.g. wind farm).	DENR, local councils, PIRSA, NRMB, CFS, Landholders	High
1.2	Encourage private land conservation agreements and other measures to secure protection of PBT populations and habitat.	• At least 50% of known populations managed under conservation agreements (Stewardship Agreements, Heritage Agreements, individual property management plans) or through adoption of *Best Practice Management Guidelines* by landholders by Year 5	DENR, NRMB, Landholders	High
1.3	Undertake threat and risk assessment of known PBT populations.	• Threats and risk assessment completed at all known population sites by Year 2. • Priority actions and priority areas for recovery efforts determined for all known PBT population sites by Year 2.	DENR, RT	High
Objective 2: Clarify distribution and abundance.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
2.1	Determine the extent and size of known PBT populations.	• Area of occupancy mapped for all known PBT sites by Year 5. • Sound population estimates obtained for all known PBT sites by Year 5.	DENR, NRMB, Research institutes	High
2.2	Identify and map potential habitat.	• Map of potential habitat produced by Year 3.	DENR, NRMB, Research institutes	High
2.3	Search additional potential habitat for new population.	• Searches conducted at 10 or more potential sites per year (identified from Action 2.2).	DENR, NRMB, Research institutes	High

Objective 3: Maintain, enhance and increase the area and quality of suitable habitat for Pygmy Bluetongues at known populations.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
3.1	Work with landholders to implement *Best Practice Management Guidelines*.	• Evidence of improved land management practices at 20% of known sites by Year 5 as a result of the guidelines and associated advice.	DENR, RT, NRMB, Landholders	High
3.2	Implement measures to increase suitable PBT habitat at known populations.	• Management options to increase occupied habitat assessed for priority PBT sites (from Action 1.3) by Year 5. • Measures to increase occupied habitat at 5 priority sites (from Action 1.3) implemented by Year 5.	DENR, RT, NRMB, MNGWG, Landholders	Medium
Objective 4: Monitor populations to evaluate the effectiveness of management and to detect trends which may require a management response.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
4.1	Continue to undertake (and refine as required) long-term population monitoring at selected sites.	• Monitoring at the 9 long-term monitoring sites completed annually. • At least 50% of PBT sites with active management (from Action 1.2 & 3.1) monitored annually to evaluate effectiveness of management actions and adapted as required. • Results of long-term monitoring reviewed annually. • Current monitoring methods evaluated and various other monitoring techniques trialled to develop a better method of efficiently estimating lizard density by Year 5.	DENR, RT, Research Institutions	High
4.2	Maintain (and refine as required) systems for data collection and management.	• BDBSA updated annually with PBT populations, extent of habitat and searched areas and the information provide to relevant authorities as required.	DENR	Medium
Objective 5: Fill critical knowledge gaps to help guide adaptive management and recovery of the species.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
5.1	Prioritise, promote and conduct key research projects needed to guide improved recovery outcomes.	• Research priorities identified (from main text of Action 5.1) and promoted to South Australian research institutions by Year 2. • At least 1 new research projects initiated in response to these priorities by Year 5.	DENR, RT, NRMB, Research Institutions,	Medium

5.2	Undertake land management trials to refine regimes required to improve habitat quality.	• Land management trial (e.g. grazing trials, fire) to improve habitat quality conducted on at least 5 sites by Year 5 (with Action 3.1 & 3.2). • Knowledge acquired from the results of land management trials used to refine and improve the *Best Practice Management Guidelines* by Year 5.	DENR, NRMB, MNGWG, Research Institutions	Medium
5.3	Continue efforts to establish a captive breeding population.	• Breeding in captivity achieved by Year 5 through the development of appropriate techniques, conditions and facilities. • Husbandry manual for captive breeding developed by Year 5.	Zoo, Research Institutions	Low
Objective 6: Continue to engage the community and form partnership to promote the significance and improved management requirements of the Pygmy Bluetongue Lizards.				
6.1	Promote community awareness and ownership of, and involvement in, the recovery of the PBT.	• Local community are kept informed of the recovery program through media articles, newsletters and community events. • Level of volunteer participation in monitoring and other recovery actions is maintained or increased from 2008 levels and reported on annually.	DENR, RT, NRMB	High
6.2	Establish a network of local mentors and champions to help drive and promote improved recovery of PBT populations and engage the community in recovery activities.	• A network of local mentors and champions established by Year 2. • Opportunities for interested volunteers to participate in on-ground recovery activities identified and promoted through networks including integration with other threatened species and communities activities including Iron-grass grassland, Peppermint Box Grassy Woodland, Spiny Daisy and Mount Lofty orchid recovery - ongoing.	DENR, RT, NRMB	Medium
Objective 7: Manage the recovery process through an effective recovery team.				
Action	**Summary Description**	**Performance Criteria**	**Responsibility**	**Priority**
7.1	Maintain an effective recovery team which supports, guides and evaluates the implementation and outcomes of the recovery plan.	• Recovery Team has appropriate representation from relevant stakeholders (Table 3). • Recovery Team meets twice annually to review progress and priorities. • Recovery team has reviewed and improved priority setting, planning and implementation of the recovery program annually.	DENR, RT	High

PBT – Pygmy Bluetongue Lizard; **DENR** – Department of Environment and Natural Resources (SA); **MNGWG** – Mid North Grassland Working Group; **NRMB** – Natural Resource Management boards; **PIRSA** – Primary Industry and Resources SA; **CFS** – Country Fire Service; **RT** – Recovery Team; **BDBSA** – Biological Data Base of South Australia

Recovery Program Evaluation

The recovery team will monitor progress in the implementation of recovery actions, and evaluate the effectiveness of recovery actions. Performance criteria have been established for each action to assist in this evaluation. Currently the recovery team includes representation from:

- Department of Environment and Natural Resources
- South Australian Museum
- Flinders University
- Zoos South Australia
- Goyder Council
- Landholders of Pygmy Bluetongue sites
- Mid North Grassland Working Group
- Nature Foundation

The success of the plan and future directions should be reviewed after five years by the recovery team or an external reviewer.

Part H: Management Practices

The *Pygmy Bluetongue Lizards: Best Practice Management Guidelines for Landholders* (Schofield 2006) have been developed to provide landholders with land management recommendations for the conservation of the Pygmy Bluetongue Lizard. Some of the major recommendations in relation to management practices are outlined below.

Grazing Regimes

Most sites that support Pygmy Bluetongue populations are currently grazed, most commonly by sheep. Continuing with this practice at moderate rates should not pose a threat to the survival of the Pygmy Bluetongue Lizard, and it is recommended that sites that are currently grazed should continue to be stocked (Schofield 2006). Moderate grazing may be beneficial for Pygmy Bluetongue habitat by maintaining a lighter cover of plant matter. It is thought that dense vegetation may reduce the visibility of, or access to prey, and may also reduce basking opportunities by shading the burrow entrance (Pettigrew & Bull 2011.) However, if a site is not currently grazed and lizard populations appear stable, the establishment of grazing may not be necessary (Schofield 2006).

If stocking rates are high, it is recommended that grazing be reduced to moderate levels (Schofield 2006). Very heavy grazing is not recommended as the hard hooves of sheep and cattle may break up the soil, causing lizard holes to collapse. Sparse vegetation cover as a result of heavy grazing may also support lower densities of invertebrate prey, and increase the vulnerability of the lizards to predation (Pettigrew & Bull 2011).

Rotational grazing involving short periods of high stocking (up to seven Dry Sheep Equivalent) appears to be compatible with the needs of Pygmy Bluetongue Lizards, as it does not cause accelerated loss of burrows (Sharp *et al.* 2010).

The placement of watering points on or near the lizard populations is not recommended because stock traffic will impact on the soil and may cause erosion or burrow collapse.

Insect Control Practices

Caution is needed when applying insecticide near Pygmy Bluetongue sites.

During locust plagues, PIRSA adopts an aerial locust spraying buffer zone around Pygmy Bluetongue populations. The current recommendations for aerial spraying near threatened species populations are to allow a downwind buffer zone of one kilometre from the threatened population or an upwind buffer zone of three to five kilometres. Boom or backpack spraying should not occur closer than 500m to the threatened species population.

A number of species of snails are known agricultural pests in the Northern and Yorke region, including the introduced White Snail (*Cernuella virgata*) which is found at a number of Pygmy Bluetongue sites, and can form a significant part of the lizards' diet. Snail control is often achieved through the use of pelletised snail baits, which are known to be very toxic to reptiles (Australian Pesticides & Veterinary Medicines Authority 2005) and are a potential threat to Pygmy Bluetongue Lizards. If snail control is required, non-toxic methods are encouraged. These methods may include stubble burning or summer grazing. Stubble burning should be avoided in spring and early autumn, when the lizards are most active above ground.

Weed Control

The adoption of a conservative grazing regime will help to prevent grassland degradation and minimise the risk of weed infestation. Rotational grazing at moderate levels may help to control weed growth.

Minimal disturbance weeding techniques should be used wherever possible (Robertson 1997). Herbicides have not been adequately tested for their side effects on reptiles, and have been known to affect fertility of small vertebrates (Pauli *et. al.* 2010). If herbicide use is required, it should be applied directly to the target plants rather than through broad-scale application.

Fire

It is likely, given the high incidence of fire in the Australian landscape and the lizards' habit of living in deep burrows, that they would be adapted to and protected from wildfire. However, wildfire is likely to pose some threat to the lizards' survival, as lizards caught out of their burrows may be killed by the fire (particularly males in the spring, and dispersing juveniles in late summer/early autumn). Therefore, burning of native grasslands in the region during these periods is not recommended.

Tree Planting

Tree planting should not be undertaken within known Pygmy Bluetongue populations. Any revegetation of grasslands that includes tree planting is discouraged and advice should be sought first. If undertaken, revegetation should be conducted with extreme caution and using minimal disturbance techniques, to reduce the adverse impacts on the grassland flora and fauna.

Fertilisers

The use of fertilisers is not recommended at Pygmy Bluetongue sites or where the effects of fertilisers may have an impact on populations or habitat, as fertilisers may encourage weed growth, which may in turn affect the lizards. Care should be taken when applying fertilisers to croplands, where run-off may flow into adjacent Pygmy Bluetongue habitat.

Avoidance of Management Practices That Will Directly Impact on Pygmy Bluetongue Habitat

The *Best Practice Management Guidelines* also raise awareness of, and discourage, management practices which are likely to have significant adverse impacts on Pygmy Bluetongue habitat, including ploughing, ripping, changed land use, or infrastructure development.

Infrastructure Development

This may include the establishment of buildings, roads, wind farms and telecommunications infrastructure. The placements of these infrastructures have the potential to directly effect Pygmy Bluetongue populations or cause further loss and fragmentation of Pygmy Bluetongue habitat.

Due to the difficulty of surveying for Pygmy Bluetongues (timing, technique, effects), it is recommended that the Pygmy Bluetongue Lizard Recovery Team and/or DENR be contacted during initial project planning. Discussion should include the possible impact to Pygmy Bluetongues, their habitats, methods for surveying and post development monitoring and alternative options for infrastructure placements to eliminate or minimise possible impacts.

Management Agreements and Incentives

<u>Heritage Agreements</u>

A Heritage Agreement is a permanent and legally binding agreement between the landholder and the South Australian Minister for Sustainability, Environment and Conservation, and is attached to the land title. A range of incentives are available to landowners who enter into these agreements, including technical advice, financial assistance for the management of the land, rate rebates, and fencing assistance if required. Heritage Agreements do not usually allow any form of production on the protected area of the land, as they aim to preserve native vegetation and any associated fauna. However, specific clauses can be written in, for example if grazing significantly increases the biodiversity value of the native grasslands, then a certain level of grazing may be permitted.

<u>Sanctuary Scheme</u>

The Sanctuary Scheme is a voluntary scheme administered by the DENR which encourages and assists landholders to provide habitats for wildlife on their property. Under this scheme, an agreement which recognises the conservation value of the land and the landholder's commitment to managing the land for conservation, can be signed by the landholder and the South Australian Minister for Sustainability, Environment and Conservation. The Minister then declares the land to be a Sanctuary under the NPW Act by notice in the Gazette. The agreement is not attached to the title of the property, and may be revoked by the landholder by writing to the Minister. The holder of a Sanctuary Agreement may be more likely to receive funds from various funding bodies, to assist in activities that will protect or enhance habitat values for wildlife.

Part I: Duration, Estimated Costs and Benefits

Duration and Estimated Costs

This recovery plan has been prepared in accordance with the EPBC Act. The effective life-span of this recovery plan is five years, after which its effectiveness and further goals will need to be reviewed. Table 2 outline the estimated costs of implementing the identified actions for the duration of the Recovery Plan.

Table 2. Duration and Estimated costs of recovery actions.

Action	Summary Description	Priority	Cost Estimate ($)					
			Year 1	Year 2	Year 3	Year 4	Year 5	**TOTAL**
1.1	Landowner aware of and protect known populations and habitat	High	2,000	2,000	2,000	2,000	2,000	**10,000**
1.2	Private conservation agreements	High	1,000	1,000	1,000	1,000	1,000	**5,000**
1.3	Threat and risk assessments	High	1,000	1,000	1,000	1,000	1,000	**5,000**
2.1	Determine the extent and size of populations	High	40,000	40,000	40,000	40,000	40,000	**200,000**
2.2	Identify and map potential habitat	High	5,000	5,000	5,000	5,000	5,000	**25,000**
2.3	Search for new populations	High	10,000	10,000	10,000	10,000	10,000	**50,000**
3.1	Implement *Best Practice Management Guideline*	High	500	500	500	500	500	**2,500**
3.2	Implement measures to increase suitable habitat	Medium	2,000	2,000	2,000	2,000	2,000	**10,000**
4.1	Long-term population monitoring	High	20,000	20,000	20,000	20,000	20,000	**100,000**
4.2	Data collection and management	Medium	500	500	500	500	500	**2,500**
5.1	Research projects	Medium	80,000	80,000	80,000	80,000	80,000	**400,000**
5.2	Land management trials	Medium	20,000	20,000	20,000	20,000	20,000	**100,000**
5.3	Captive breeding program	Low	15,000	15,000	15,000	15,000	15,000	**75,000**
6.1	Community awareness, ownership, involvement	High	2,000	2,000	2,000	2,000	2,000	**10,000**
6.2	A network of local mentors and champions	Medium	20,000	20,000	20,000	20,000	20,000	**100,000**
7.1	Maintain an effective recovery team	High	500	500	500	500	500	**2,500**
	TOTAL		**219,500**	**219,500**	**219,500**	**219,500**	**219,500**	**1,097,500**

Affected Interests

The community groups and statutory organisations presented in Table 3 have been identified as current and potential stakeholders in the management of Pygmy Bluetongue Lizards.

Table 3. Current and potential stakeholders in the management of Pygmy Bluetongue Lizards.

National Stakeholders
Australian Department of Sustainability, Environment, Water, Population and Communities
World Wide Fund for Nature(WWF) Australia
General Public

State Stakeholders
SA Department of Environment and Natural Resources
Nature Foundation SA
Primary Industries and Resources SA
South Australian Museum
Zoos South Australia
Flinders University, South Australia
SA Herpetology Group
Native Vegetation Council
General Public

Regional Stakeholders
Northern and Yorke Agricultural District NRM Board
South Australian Murray-Darling Basin NRM Board
NRM Regional Facilitators
Burra Community School
Private Landholders
Friends of Burra Parks
Biodiversity and Endangered Species Team
Mid-North Grasslands Working Group
Regional Council of Goyder
District Council of Peterborough
Clare and Gilbert Valleys Council
Wakefield Regional Council
District Council of Barunga West
Country Fire Service (CFS)

Role and Interests of Indigenous People

The Aboriginal Partnerships Section of SA Department of Environment and Natural Resources undertook indigenous consultation for this plan in September 2009. No specific comments were made regarding this species and the recovery plan.

This recovery plan will be adopted and released subject to any Native Title rights and interests that may continue in relation to the land and/or waters. Nothing in the plan is intended to affect Native Title. The Commonwealth *Native Title Act 1993* should be considered before undertaking any future acts that might affect Native Title.

Benefits to Other Species and Ecological Communities

Implementation of this recovery plan will also benefit a range of other species and communities that share a common distribution with Pygmy Bluetongue Lizards. Threatened grassland species which will benefit from the actions in this plan include the Plains Wanderer (*Pedionomus torquatus*) (Vulnerable nationally and Endangered in South Australia) and Diamond Firetail (*Stagonopleura guttata*) (Vulnerable in South Australia).

Actions addressed as part of this recovery plan will also assist in the conservation of Iron-grass (*Lomandra effusa/ L. multiflora* subsp. *dura*) Natural Temperate Grassland of South Australia, which is listed as a critically endangered ecological community under the EPBC Act. This community is one of the habitats where Pygmy Bluetongue Lizards are found.

No negative biodiversity impacts are anticipated from the implementation of this plan.

Social and Economic Impacts

The implementation of this recovery plan is unlikely to cause significant adverse social and/or economic impacts. Most of the recommended recovery actions are compatible with productive land management, and may in fact help to increase the capacity of native grasslands for primary production.

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We would also like to recognise the efforts of all past project officers and members of the Pygmy Bluetongue Recovery Team.

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Appendix 1: Long-term Monitoring Methodology

Aim: To gather data on the Pygmy Bluetongue's population structure and density at selected sites over time.

Method: Examine all suitable spider-holes using an optiscope (opti fiberscope) to determine the presence of Pygmy Bluetongue Lizards in a one-hectare square plot. Suitable spider-holes are circular in cross section and 10 to 20 mm in diameter and greater than 10 cm deep.

To observe the inside of the spider-hole, gently push the tip of the optiscope tube down the burrow until an occupant, or the bottom of the burrow is observed. The hole dwelling behaviour of the Pygmy Bluetongue Lizards, is a key factor facilitating its monitoring. Use of an optiscope permits direct observation of lizards in their burrows, and their sedentary nature enables regular monitoring of all animals in a given area.

Location: Permanently marked one-hectare square plots established at population sites 1, 2, 3, 4, 6, 9, 11, 12 & 22 (Figure 1).

Timing: Monitoring to be conducted annually in February-March, to coincide with the time of year with minimal ground cover making it easier to spot the spider-holes.

Observer: Monitoring should be conducted by an experienced observer, with assistance from volunteers. To increase the number of experienced observers, volunteers should be trained over a number of surveys (or until competent) by an experienced person.

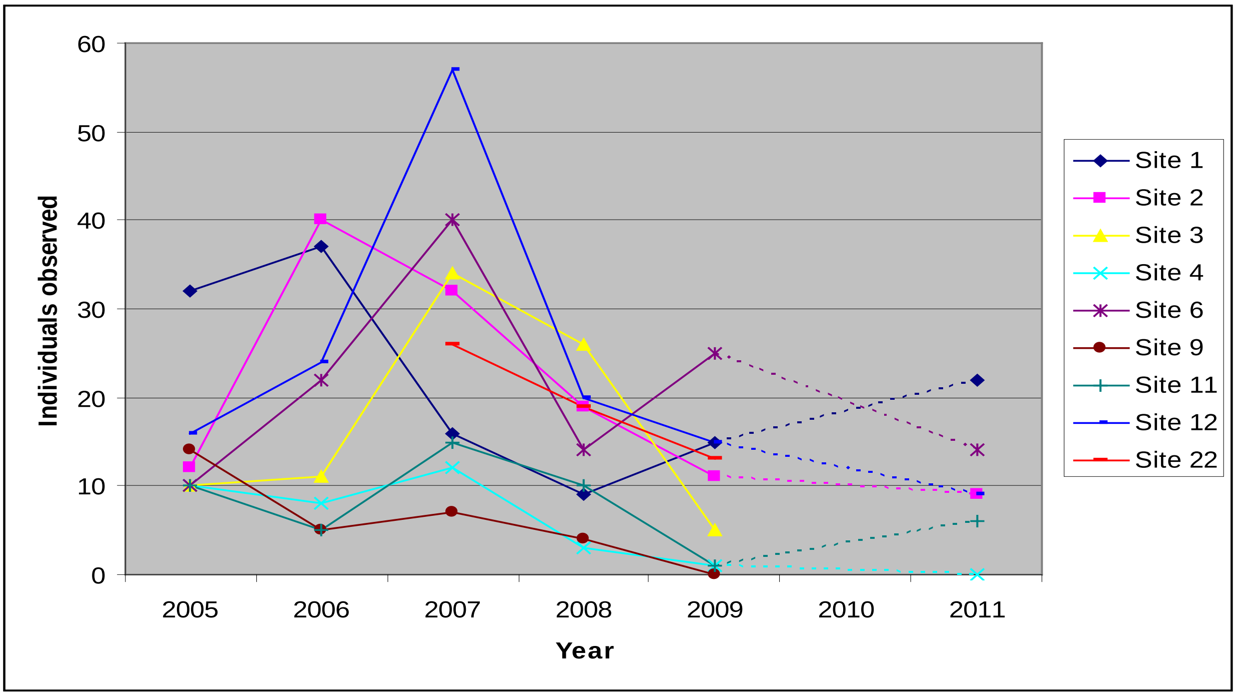
All nine sites (except Site 22 in 2005 and 2006) were monitored between 2005 and 2009. Only sites 1, 2, 4, 6, 11 and 12 were monitored in 2011 due to time and funding constraints. In 2010, a new survey method was trialled using a percentage density count and the data are not included here as comparison could not be made between the two methods.

The number of Pygmy Bluetongue Lizards was observed to fluctuate at all sites since 2005. Pygmy Bluetongue populations will fluctuate over time depending on the abundance of insects (i.e. food) and the abundance of spider burrows (i.e. shelter sites) (Sharp 2011). Drought conditions during 2005 to 2009 may have been responsible for the observed fluctuation, rather than failure of recovery actions. Other reasons may include a lag period between when abundant resources are available and when increase in lizard numbers is detected, lizards may move around considerably from year to year or changes to grazing management of the monitoring paddocks (Sharp 2011). There is a need to continue monitoring in the long-term to better observe the population trends over time.

DENR long-term monitoring data for 2005-20011.

	2005	2006	2007	2008	2009	2011
Site 1	32	37	16	9	15	22
Site 2	12	40	32	19	11	9
Site 3	10	11	34	26	5	-
Site 4	10	8	12	3	1	0
Site 6	10	22	40	14	25	14
Site 9	14	5	7	4	0	-
Site 11	10	5	15	10	1	6
Site 12	16	24	57	20	15	9
Site 22	-	-	26	19	13	-

- Site not surveyed.



Australian Government

Department of Climate Change, Energy, the Environment and Water

Conservation Advice for *Tiliqua adelaidensis* (pygmy blue-tongue lizard)

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 31 August 2023.

This document provides a foundation for conservation action and further planning.

Tiliqua adelaidensis (pygmy blue-tongue lizard) © Copyright, Wilson S. (2010) (from the Department of the Environment online image database)

Conservation status

Tiliqua adelaidensis (pygmy blue-tongue lizard) is listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) effective from 16 July 2000.

The species is eligible for listing under the EPBC Act as on 16 July 2000 it was listed as Endangered under Schedule 1 of the preceding Act, the *Endangered Species Protection Act* 1992 (Cwth).

The main factors that make the species eligible for listing under the EPBC Act in the Endangered category is its limited Area of Occupancy (AOO) estimated to be less than 500 km^2, severely fragmented occurrence, and continuing declines in AOO, the area, extent and/or quality of habitat, the number of locations or subpopulations and the number of mature individuals.

The species was assessed as Endangered under the IUCN Red List, eligible under Criterion B2ab (ii, iii, iv & v) (attributes of geographic range) (Fenner A, Hutchinson M, McDonald P & Robertson P (2018)). The species was also assessed as Endangered under *The Action Plan for Australian Lizards and Snakes 2017* (Chapple et al. 2019).

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threats Database.

Species information

Taxonomy

Conventionally accepted as *Tiliqua adelaidensis* (Peters, 1863).

Description

The pygmy blue-tongue lizard (*Tiliqua adelaidensis*, hereafter pygmy blue-tongue) is an inconspicuous moderate-sized short-legged skink with a relatively heavy body and a large head. The species grows to a maximum length of 20 cm, with an average snout to vent length of 9.5 cm (Milne 1999). The pygmy blue-tongue is the smallest member of the genus *Tiliqua*, which consists of 7 species of blue-tongue lizards. Unlike other members of this genus, the pygmy blue-tongue has a pink tongue. On average, adult males are shorter in body length and have wider heads than females (Hutchinson et al. 1994). Colouration varies from grey-brown to orange brown, with a cream underside. The pygmy blue-tongue may feature a series of black flecks along the back and flanks (description from Hutchinson et al. 1994; Duffy et al. 2012; Cogger 2014).

Despite being originally described in 1863, very little was known about the pygmy blue-tongue until recently. The species was considered extinct until 1992 after 33 years of no sightings. Its rediscovery, in the remains of a brown snake near Burra, 160 km north of Adelaide (Armstrong & Reid 1992, Armstrong et al. 1993), triggered a marked increase in research into the species.

Distribution

The pygmy blue-tongue is endemic to the mid-north region of South Australia (SA). The distribution of the species historically extended from the southern suburbs of Adelaide to Mannanarie, a town 220 km to the north (Ehmann 1982). The species may have been widespread across this area prior to the undertaking of intensive agricultural activities in areas that supported the species habitat (Bull & Hutchinson 2018). Currently, the species appears to be extinct in the southern part of its former range, which suggests the loss of approximately 40% of its distribution range (Bull & Hutchinson 2018). The current distribution of the pygmy blue-tongue extends from Peterborough in the north, to Bagot Well and Kapunda in the south and to the South Hummocks in the west (north of Port Wakefield) (Dufy et al. 2012).

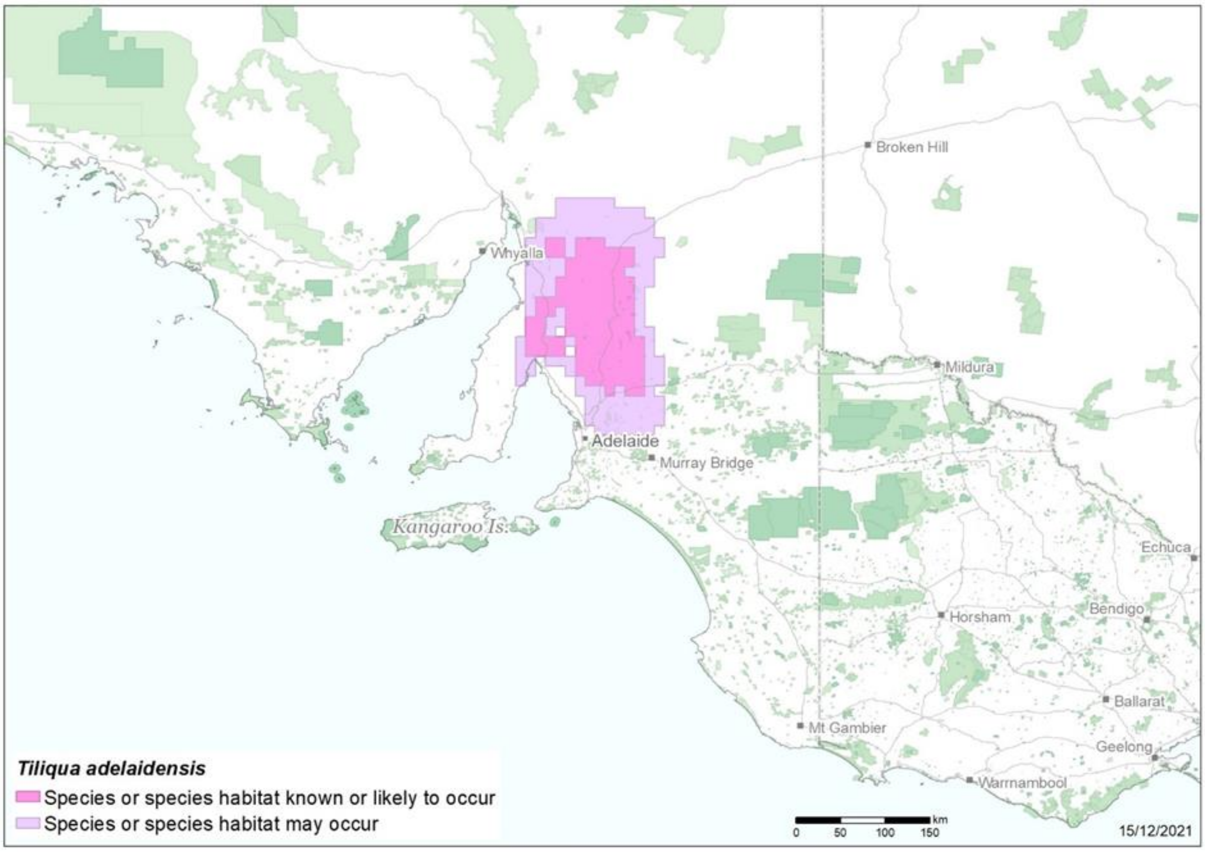
There is no current estimate available for the national population size of the pygmy blue-tongue, however there is a decreasing population trend (Fenner et al. 2018). A national population estimate of approximately 5 000 individuals made in 2000 was based on 10 known subpopulations (Milne et al. 2000), however more than 20 further subpopulations have since been discovered (Duffy et al. 2012; Clayton et al. 2020a).

The species occurs in approximately 37 disjunct sites (Clayton et al. 2020a). Most of these sites are not protected under formal agreements (Duffy et al.2012). One site has been placed under a Heritage Agreement and another, an 85-hectare site 10 km north-east of Burra named Tiliqua Nature Reserve, has been purchased by the Nature Foundation and is being managed solely for the protection of the species (Nature Foundation 2021). Given there is no connectivity between most of the pygmy blue-tongue sites, they are considered separate subpopulations. However, the full extent of all scattered pygmy blue-tongue subpopulations has not yet been determined, and it is possible that three or four localities which appear isolated (such as, Blyth, Auburn and Kapunda) may belong to larger, more contiguous metapopulations with 1000 or more individuals (Schofield 2007, Bull & Hutchinson 2018).

Several subpopulations of the species have been lost or have suffered considerable losses due to development, habitat loss, inappropriate grazing regimes and/or suspected inviable subpopulation sizes (A. Fenner pers. comm 2017 cited in Fenner et al. 2018; A Fenner 2021. pers comm 8 October). Limited monitoring of the sites outside of Burra, Kapunda and Jamestown has occurred since 2009, and as such the status of various subpopulations is unknown, however prior to 2009 there was a downward trend in numbers of individuals across most subpopulations (A Fenner 2021. pers comm 8 October).

Currently, the Extent of Occurrence (EOO) of the species is estimated at 7000 km^2 (Delean et al. 2013) and its AOO is estimated at less than 500 km^2 (Fenner et al. 2018). Climate modelling and species distribution modelling of a range of future climate scenarios suggest that the species' range may contract in the north (Fordham et al. 2012; Delean et al. 2013).

Map 1 Modelled current distribution of pygmy blue-tongue lizard



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.

Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything contained herein.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the habitat or geographic feature that represents to recent observed locations of the species (known to occur) or habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The Traditional Owners of the land in which the pygmy blue-tongue occurs are the Kaurna, Nukunu, Narungga and Ngadjuri people. No cultural stories that may have been associated with the pygmy blue-tongue remain (Ngadjuri elder Vince Copley Jnr 2016. pers comm, cited in Clayton et al. 2020a). An action in this Conservation Advice is targeted at better understanding the cultural significance of the pygmy blue-tongue to the Ngadjuri people to promote engagement of Indigenous Australians in on-ground action and knowledge building for the species.

Relevant biology and ecology

Life history

Diet

Pygmy blue-tongues feed primarily on grasshoppers along with other invertebrates (ants, small spiders, beetles, snails and cockroaches) and soft plant material (including *Dianella* seed and the introduced herb *Medicago*) (Ehmann 1982; Milne 1999; Fenner et al. 2007; Ebrahimi & Bull 2012a). Plant material is incorporated in their diet to a greater extent as summer progresses, suggesting that the pygmy blue-tongue changes its diet opportunistically over spring and summer (Fenner et al. 2007).

Reproduction

Pygmy blue-tongues are long-lived viviparous lizards with an estimated lifespan of 9 years in the wild and 18 years in captivity (Milne 1999; M. Hutchinson 2012. pers comm, cited in Duffy et al. 2012). The species is slow to sexually mature, has a low reproductive rate and low juvenile survival rates. It is estimated that fewer than 10% of juveniles survive to adulthood (Milne 1999).

Mating occurs in spring during October and November (Hutchinson et al. 1994). The pygmy blue-tongue mating system is polygynous (females accept multiple mating's from different males) (Schofield et al. 2014). Mate choice appears to be influenced only by spatial proximity and is indiscriminate with respect to partner relatedness (Schofield et al. 2014). However, multiple paternity arising from polygyny contributes to high rates of genetic mixing within pygmy blue-tongue populations (Schofield et al. 2014).

Females have been observed with newly born young from late January until late March, with the bulk of births taking place in February (Milne 1999) - although the timing of births has anecdotally been earlier in the last few years (Clayton et al. 2020a). Litter size ranges between 1–4 and juveniles remain in the parental burrow for between 1–12 weeks before dispersing to smaller burrows of their own (Milne 1999; Milne & Bull 2002). Males are capable of reproduction in the spring season of their second year, and females may also reproduce at this age, although some females take another year to become reproductively active (Duffy et al. 2012).

Since the mid-1990s, a small captive subpopulation of pygmy blue-tongue lizards has been held at Adelaide Zoo (T. Morley pers comm. cited in Duffy et al. 2012). Attempts to establish breeding in this population were unsuccessful, potentially due to unsuitable conditions in captivity or to the aggressive and territorial behaviour exhibited by the lizards in captivity (Duffy et al. 2012).

In 2016, a captive subpopulation of pygmy blue-tongues at Monarto Zoological Park, SA successfully reproduced ex situ (Bull & Hutchinson 2018). Investigations are underway to determine how to best encourage ex situ reproduction and prepare captive bred individuals for reintroduction. Given the risks associated with behavioural adaptations to captivity and lower genetic diversity in captive bred individuals, wild-wild translocations are considered a greater priority for the species' persistence.

Sheltering

The pygmy blue-tongue has unusual ecology given it inhabits vertical burrows dug by spiders, which only persist in untilled areas of open grassland. It inhabits the burrows from mygalomorph (trapdoor) and lycosid (wolf) spiders (Milne et al. 2003) and can also use mouse burrows if burrow entrance diameters are similar to those of spider burrows (Ebrahimi et al. 2012). Data from areas near Burra indicate that one species of spider, *Blakistonia aurea* (a species of trapdoor spider), is one of the more important burrow builders for the species (McCullough 2000).

The pygmy blue-tongue relies entirely on these burrows as refuges from high temperatures, predators and fires, as basking sites and as ambush points for hunting invertebrate prey (Milne et al. 2003; Fenner et al. 2007; Fellows et al. 2009). It has been assumed the species is not able to dig its own burrows and primarily avoids displacing resident spiders, instead inhabiting vacated burrows (Clayton 2018). Ebrahimi & Bull (2012b) found evidence that burrow making spiders may kill lizards who attempt to occupy their burrows.

The single-entrance spider burrows used by the pygmy blue-tongue are inconspicuous, circular in cross section and small (approximately 20–25 mm in diameter), given individuals select burrows with similar diameters to their head size (Milne & Bull 2000). The depth of these burrows ranges from 10 to 75 cm, with the species preferring deeper burrows greater than 20 cm in depth (Milne & Bull 2000), presumably to allow escape from digging predators and unfavourable climatic conditions. However, smaller burrows are occupied by younger individuals and are important for the persistence of the species (Milne & Bull 2000). Pygmy blue-tongues are extremely sensitive to both movement and noise, instantly retreating inside the burrow once perturbed, and as such it is difficult to observe them basking outside. The lizards make no obvious external modifications to the holes, except for a slight bevelling of the edges, worn by their movement (Duffy et al. 2012).

Good quality burrows are a limiting resource for pygmy blue-tongue populations (Fellows et al. 2009). A study by Nielsen (2017) found that burrow choices may be dependent on the availability of burrows and may not necessarily reflect the burrow preference of lizards (while burrows are generally found in areas with less vegetation cover, lizards select burrows in vegetated areas during the mating season). Individuals can stay in a chosen burrow for more than an entire 'activity' season (spring and summer) (Fenner & Bull 2011; Duffy et al. 2012; Bull et al. 2015; Bull & Hutchinson 2018). This implies that once a pygmy blue-tongue burrow is located, it can likely be relocated and monitored for pygmy blue-tongue activity

Pygmy blue-tongue lizards are also known to effectively utilise artificial burrows for shelter and reproduction (Milne 1999; Milne & Bull 2000, Souter 2003; Pettigrew & Bull 2011; Pettigrew & Bull 2014; Bull & Hutchinson 2018). Trials in the use of artificial burrows indicate they are an effective tool to assist translocation (with regards to establishing a new subpopulation and limiting dispersal of newly translocated individuals) and recruitment success at established sites (particularly around late summer and early autumn where neonates are dispersing from their parental burrow) (Souter et al. 2004; DEW 2021).

While artificial burrow installation is an effective method assisting with translocation and recruitment success, installing and maintaining artificial burrows is costly and time-consuming. Artificial burrows can also become unsuitable quite quickly if there are termites or debris onsite, or when they remain unoccupied, particularly if some form of grazing is present onsite. While they are effective in temporarily boosting population abundances and enabling subpopulation introductions, onsite burrow-making spiders are still considered important to the persistence of the species, given they provide constant supplies of new, suitable burrows for the lizards (Bull & Hutchinson 2018).

Ideally, artificial burrows should be used to supplement burrows at sites with existing natural burrows, where soil and drainage conditions are known to be suitable for the longevity and success of artificial burrows (J Clayton 2021. pers comm 20 July; DEW 2021). In addition, they should only be used as a short-term measure and in spider-occupied sites. Given burrow availability is a limiting resource for populations, the reliance of these lizards on interventions (the installation of artificial burrows) is not a sustainable option for population stability and growth (DEW 2021).

Dispersal behaviour

Pygmy blue-tongues exhibit limited dispersal (Schofield et al. 2013). They leave their burrows only for short distances to stalk prey (Ebrahimi & Bull 2012a), defecate (Ebrahimi et al. 2016), search for mates in the spring (Milne et al. 2003; Fellows 2008; Fenner & Bull 2011; Schofield et al. 2013) or upgrade to larger or more intact burrows (Fenner & Bull 2011a; Schofield et al. 2012). Pitfall trapping and microsatellite studies have shown that male pygmy blue-tongues are more mobile than females (Hutchinson et al. 1994; Schofield et al. 2013), and that neonates are the second-most captured age class after adults.

The success of dispersal is likely limited by the time taken to find a new burrow whilst avoiding predation and exposure to the elements (Schofield et al. 2013). The peak movement time for adults is in spring, during the mating season, whereas movement of neonates occurs in late summer and early autumn (Schofield et al. 2013). Female pygmy blue-tongues can move to a distance of up to 200 metres, however these longer distance movements are uncommon, and females more commonly move less than 20 metres (Milne 1999; Smith et al. 2009). The longer distance movements of male and juvenile pygmy blue-tongue are less understood (Milne 1999; Fellows 2008; Schofield et al. 2013). The rates of juvenile dispersal may be increased by territoriality and high density of resident adult lizards within the area (Schofield et al. 2013).

Social structuring

Pygmy blue-tongues occur in non-social colonies (Schofield et al. 2014). Estimates of natural population sizes indicate between 100-120 lizards occur per hectare (Clayton et al. 2020a). They display weak social structuring given they maintain resource areas and aggressively defend their burrow from conspecifics and use vomerolfactory cues to communicate burrow ownership (Fenner & Bull 2011; Schofield et al. 2013; Ebrahimi et al. 2016). Although they are predominantly solitary, with only one lizard occurring in each burrow, pygmy blue-tongues can share their burrows with snails and weevils (Clayton et al. 2020b), however remains of these taxa in pygmy blue-tongue scat indicate the pygmy blue-tongue may prey on their co-occurring burrow invertebrates (B. Derne 2016. pers comm, cited in Clayton et al. 2020b).

There is a low probability of interactions between pygmy blue-tongue and other co-existing lizard species due to their sedentary nature and differentiated niche use (Pelgrim et al. 2014; Ebrahimi et al. 2015a; Clive et al. 2020).

Genetics

There is limited gene flow between pygmy blue-tongue subpopulations (Smith et al. 2009; Fenner et al. 2018), leading to high levels of genetic differences between sites (Schofield et al. 2015b). Within subpopulations, the species has high levels of genetic diversity and significant genetic structuring at distances of 30 metres, suggesting that the species' low mobility may give rise to a finely clustered subpopulation structure, even within continuous habitat (Smith et al. 2009; Schofield et al. 2015a). Based on mitochondrial data, pygmy blue-tongue subpopulations could not be delineated into Evolutionarily Significant Units (ESUs) and instead Schofield et al. (2015b) suggests dividing subpopulations into more flexible conservation units to conserve genetic variability. Schofield et al. (2015b) identifies one northern and two southern flexible conservation units, however more work is required to understand the genetic population structure of the species.

Schofield et al. (2015a) suggested individual subpopulations are currently at low risk of loss of genetic diversity, given it is maintained within subpopulations by the localised polygynous mating strategy. However, subpopulation declines through which the genotypic range of potential partners is reduced, may lead to a greater risk of inbreeding for the pygmy blue-tongue where individual lizards will not actively avoid mating with highly related partners.

Parasites

Derne et al. (2019) described a new species of ectoparasitic mite, *Ophiomegistus michaeli*, which parasitises the pygmy blue-tongue. The adverse impacts of another species of mite, *O. natricis* (snake mite), on captive populations of other lizard species include anaemia, dermatitis, behavioural changes, and the transmission of pathogens (Wozniak & De Nardo 2000).

Further investigation into the host-parasite relationship between *O. michaeli* and the pygmy blue-tongue, particularly into the fitness cost of these parasites on the species, is required to optimise conservation strategies for the species (Cunningham 1996).

Habitat ecology

Sites supporting the pygmy blue-tongue are located predominantly on private agricultural land supporting remnant patches of native temperate grassland, occasionally featuring a sparse over-storey of trees. These sites have typically been historically used for sheep grazing. Pygmy blue-tongues require habitat supporting a high abundance of arthropod prey and perhaps the plant species which form part of their diet (Fenner et al. 2007). The condition of grasslands supporting the pygmy blue-tongue is highly variable, ranging from grasslands that are highly degraded and dominated by exotic grasses to grasslands with a high diversity of native species (Duffy et al. 2012).

Pygmy blue-tongues do not appear to be confined to a particular floristic community of native grassland and co-occur with various native grassland species including tussock grasses (*Austrostipa* spp. (spear grasses), *Rytidosperma* spp. (wallaby grasses), *Lomandra* spp. (iron-grasses) and *Aristida behriana* (brush wire grass)), endemic shrubs (*Cryptandra campanulata* (long-flower Cryptandra)) and perennial herbs (*Maireana* spp., notably *Maireana excavata* (bottle bluebrush) and *Ptilotus erubescens* (hairy tails)) (Hutchinson et al. 1994, Souter et al. 2007; Delean et al. 2013). Tussock grasses are important habitat attributes for the species, and local species have been planted in future translocation sites to enhance habitat areas (Clayton et al. 2020a).

Soil which is either not free-draining or deep enough inhibits spiders from constructing burrows which the lizard inhabits, and therefore areas with these soil conditions are unsuitable for pygmy blue-tongues. Importantly, pygmy blue-tongues require intact soil to persist within a site; they will not move into burrows in tilled fields even if the burrows are immediately adjacent to occupied native grassland patches (Souter 2003). Pygmy blue-tongues are found in greater abundance at sites with free-draining grey-brown or red calcareous soils (Duffy et al. 2012). They are also found at sites with lithosol soils (sandy-type soil derived from the in situ weathering of rock) (Souter 2004). The lizards tend to be present in greatest densities on the lower slopes of hillsides, where the soil, and consequently spider burrows, are deepest (Schofield 2006).

The species is scattered within areas of moderate rainfall (approximately 400 – 600 mm annually; Bull & Hutchinson 2018). There is evidence that variation in pygmy blue-tongue abundance across years may be correlated with climatic conditions, specifically rainfall. Low population abundances have been observed following years of low rainfall, and high abundances following years of high rainfall, noting young and adult lizards may respond differently to the same conditions (Bull & Hutchinson 2018).

Grazing regimes
Moderate grazing keeps grasslands open and with scattered bare areas. These are essential attributes of pygmy blue-tongue habitat, providing lizards access to direct sunlight which is important for basking and likely provides good visibility of predators and prey (Pettigrew & Bull 2014 Nielsen et al. 2017; Bull & Hutchinson 2018). However, overgrazing by large numbers of sheep, where all surrounding vegetation is removed and widespread sheep trampling occurs, has a detrimental effect on the species (Pettigrew & Bull 2011; Clayton & Bull 2015).

Nielsen and Bull (2017) found that pygmy blue-tongues occurring in moderately grazed paddocks produced significantly more yolk sacs (had a higher reproductive output) than those in hard-grazed paddocks. Individuals in moderately grazed paddocks also gave birth significantly earlier in the year than the latter, which is advantageous for young as they must establish their own burrows and accumulate enough energy reserves for the winter (Nielsen & Bull 2017). Another study by Nielsen & Bull (2020) showed that lizard body condition decreased with increasing grazing intensity within habitat areas. The detrimental effects of overgrazing on body condition and reproductive success may result from decreased abundance of invertebrate prey (Nielsen 2017), or increased predation due to decreased grass cover (Nielson & Bull 2017).

Insufficient grazing at sites where pygmy blue-tongues occur may also be detrimental to the species, as a moderate grazing regime may manage weed growth and create inter-tussock spaces enabling foraging and basking opportunities (Duffy et al. 2012).

Grazing trials conducted through a collaborative project between the South Australian Government Department of Environment and Natural Resources (DENR) and the Mid North Grassland Working Group determined that rotational grazing does not result in accelerated deterioration of burrows in comparison to traditional grazing regimes (Sharp et al. 2010; Duffy et al. 2012). Therefore, rotational grazing within pygmy blue-tongue sites appears to be compatible with the conservation of the species (Sharp et al.2010).

Translocation ecology

By 2100, it has been projected that, due to climate change, much of the current distribution range of the pygmy blue-tongue could be unsuitable for the species' future persistence (Fordham et al. 2012). Managed translocations of individuals to southern areas of the species' range will likely be important for the persistence of the species (Fordham et al. 2012; Delean 2013).

Various investigations into the optimisation of pygmy blue-tongue translocations have been undertaken. A study by Ebrahimi et al. (2015b) showed that translocation success may be increased by adjusting release conditions to modify behaviours, such as reducing the potential for dispersal from the site and predation at the site. Dispersal of translocated individuals from the recipient site was reduced when lizards had a greater availability of burrows, when burrows were more tightly clustered in areas of higher vegetation density, and when lizards were confined to the release area for a short time period (Ebrahimi et al. 2015b). Dispersal of translocated individuals from recipient sites was also reduced if the surrounding area was disturbed and if releases took place later in the activity season (Ebrahimi et al. 2015b). Ebrahimi & Bull (2012a) found that the provision of supplementary food at translocation sites in the early days of translocation resulted in higher rates of favourable behaviours (less time spent basking and lower rates of activity outside burrows, indicating the potential for lower dispersal and predation rates).

A study by Schofield et al. (2013) identified the potential advantage of primarily translocating juvenile females instead of adult males or females. The removal of adult females from a source subpopulation for translocation is likely to have adverse impacts on the source subpopulation's reproductive potential. The mobility of adult males indicates they are more prone to predation or face higher risks of dispersal (Schofield et al. 2013). Daniell et al. (2020) found that neonate pygmy blue-tongues actively explore their habitat, exiting burrows and basking more frequently than adults. Higher rates of activity and basking indicates neonates are at higher risk of predation and more likely to disperse from recipient sites and are therefore considered less suitable for translocation than adults (Daniell 2020).

Clive et al. (2020) investigated the impact of increasing pygmy blue-tongue population density at translocation sites on resident conspecifics and other co-existing lizard species. They found no evidence for a detrimental ecological impact on conspecifics or other lizard species (no decreased abundance or body condition) from augmented population size at the recipient site (Clive et al. 2020).

An Australian Research Council (ARC– LP190100071) funded project is underway at Flinders University to introduce individuals from natural and mixed subpopulations to a site currently unoccupied by the species. The purpose of this project is to identify any potential risks of future translocations relating to the introduction of lizards to an area not currently supporting the species. There is an associated translocation guideline in preparation for the pygmy blue-tongue (Clayton et al. 2020).

Habitat critical to survival

Given the small population size of the pygmy blue-tongue, its severely fragmented habitat and the limited availability of suitable habitat for the species, all known and future habitat is critical to the survival of the species.

This habitat includes the AOO of known populations, all areas of the species' historical occurrence and all areas of potential habitat (habitat areas with attributes necessary for the species' persistence) throughout its geographic and ecological range. Potential habitat in the south of the species' current range is particularly important to the persistence of the pygmy blue-tongue given the species' climatic envelope is expected to contract in the north of its distribution with climate change (Fordham et al. 2012).

All known, historical, and potential habitat for the pygmy blue-tongue provides suitable climatic, edaphic (soil condition) and biological attributes for the continued persistence of the species and is critical for future translocations, range extension, dispersal activities, the maintenance of genetic diversity and may support undiscovered populations.

Attributes of habitat critical to the survival of the species include:

- Spider burrows of suitable diameter and depth
- Open grassland with tussock grasses and inter tussock spaces allowing for basking and feeding
- Intact soil profiles with free draining grey-brown or red calcareous soils

Topographic features with a combination of the above attributes on the lower slopes of hillsides are habitat critical to the survival of the species.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word 'population' is used to refer to a subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

All pygmy blue-tongue populations are considered important due to the restricted and fragmented distribution of this species, as described in the Distribution section.

Threats

The majority of known pygmy blue-tongue sites have no formal protections from the key threats to the species. Direct habitat loss and fragmentation threaten the persistence of the species, given there have been significant declines in native grasslands in South Australia. In 1995, native grasslands had been reduced to around 0.3% of their original distribution in South Australia (Hyde 1995). Habitat alteration resulting from the intensification of agricultural activities in South Australia (the conversion of land previously used for sheep grazing to cropland) is also a major threat to the species (Nielsen 2017). Genetic consequences may arise from declining subpopulation sizes and from potential increases in the genetic divisions between pygmy blue-tongue subpopulations (Schofield et al. 2015).

Reports of individual pygmy blue-tongues for sale internationally have demonstrated the risk of illegal export of the species. Illegally exported individuals were likely obtained from a subpopulation under scientific study (Clayton et al. 2020a). Given specimens have attracted high prices on the black market, international demand for this species may increase.

The migration of the pygmy blue-tongue's environmental envelope southwards due to a changing climate (Fordham et al. 2012), and the species' inability to disperse large distances, suggest that translocations of the species to favourable future habitat areas may be necessary for its persistence.

Table 1 Threats impacting pygmy blue-tongue lizard

Threats in Table 1 are noted in approximate order of highest to lowest impact, based on available evidence.

Threat	Status [a]	Evidence
Habitat loss and degradation		
Changed land use for agricultural activities	• Status: historical/current/ future • Confidence: observed • Consequence: catastrophic • Trend: increasing • Extent: across entire range	Changes in land use, particularly changes that permanently alter large or contiguous areas of habitat, are a key threat to pygmy blue-tongue populations (Duffy et al. 2012). Given the small number of subpopulations and the very restricted AOO of the species, the loss or reduced viability of even a single subpopulation could have significant implications for the long-term survival of this species. Tilling is a very significant threat to the species as it will directly kill and displace the lizards, their prey items, and their co-existing burrow-making spiders (Thorbek & Bilde, 2004; Stašiov et al. 2010; Duffy et al. 2012). Given persistent spider holes require hard-packed soil to persist, burrows quickly erode when soil is tilled. Even if a paddock is only tilled once and left to regenerate naturally, the original lizard population will be lost, and occupancy will be inhibited (Duffy et al. 2012). Ripping is slightly less detrimental than tilling if tracts of soil are left undisturbed but would destroy lizards and their burrows in the direct path of the ripping lines (Duffy et al. 2012). Ripping and tilling ultimately lead to habitat loss and may also promote weed establishment.
Inappropriate grazing regimes	• Status: historical/current/ future • Confidence: observed • Consequence: catastrophic • Trend: unknown • Extent: across entire range	Heavy grazing may lead to destabilisation of the soil structure, causing the filling of burrows in the dry season, and the collapse of burrows in the wet season (Duffy et al. 2012). While moderate grazing is generally compatible with habitat requirements of pygmy blue-tongues, heavy grazing by hard-hoofed stock is highly detrimental, increasing exposure to predators, reducing the availability of prey and affecting the habitat of co-existing burrow-making spiders (Pettigrew & Bull 2011; Duffy et al. 2012; Clayton & Bull 2015). The complete removal of grazing at sites where the pygmy blue-tongue occurs may also threaten local persistence of the species, if the current grazing regime is managing weed growth and creating inter-tussock spaces, which may impact on foraging, hiding, basking and mating opportunities (Duffy et al. 2012). Heritage agreements may prohibit grazing and reduce the overall fitness of pygmy blue-tongues onsite.

Threat	Status [a]	Evidence
Urban, industrial and infrastructure development	• Status: historical/current/ future • Confidence: observed • Consequence: major • Trend: increasing • Extent: across entire range	Pygmy blue-tongue population sites, particularly those close to Burra, are threatened by future urban, industrial development including the establishment of buildings, roads, wind farms and associated infrastructure, and telecommunications infrastructure. Such development may result in the excavation of pygmy blue-tongue habitat areas, the use of heavy machinery leading to the compaction of soil, and soil runoff from development sites into burrows (Duffy et al. 2012). Development can also cause changes to hydrology from extra water run-off which could impact the soil structure and vegetation compositions of pygmy blue-tongue habitat (Duffy et al. 2012). Three subpopulations near Burra are already believed to have been lost due to land use change, and a further two more are suspected to be extinct (Duffy et al. 2012, Fenner et al. 2018; Bull & Hutchinson 2018).
Pesticides	• Status: historical/current/ future • Confidence: inferred • Consequence: major • Trend: unknown • Extent: unknown	Insecticides and other pesticides are used to control agricultural pests such as native locusts, grasshoppers, and snails, including the introduced white snail (*Cernuella virgata*). These species are found at a number of pygmy blue-tongue sites and can form a significant part of the lizards' diet. Pesticide use may potentially impact on pygmy blue-tongues either directly or indirectly. While the direct impacts of insecticides on pygmy blue-tongue are unknown, insecticides are known to cause illness or death in some reptiles (Spur 1993, Khan & Hall 2005, Pauli et. al. 2010). Pelletised snail baits, which are often used in snail control, are also known to be very toxic to reptiles (Australian Pesticides & Veterinary Medicines Authority 2005). Secondary impacts could include a reduction in the main food source of pygmy blue-tongues, which could affect their survivorship or reproduction rates; or a reduction in burrowing spiders' abundance which may significantly reduce the availability of spider burrows which the pygmy blue-tongues are dependent on for shelter sites. Cumulative secondary poisoning is also a potential risk (Duffy et al. 2012).
Herbicides	• Status: historical/current/ future • Confidence: inferred • Consequence: major • Trend: unknown • Extent: unknown	As with insecticide use, there is no direct evidence of the impacts of herbicide use on pygmy blue-tongues. However, herbicides are known to cause fertility problems for small vertebrates (Pauli et. al. 2010) and may directly impact the species through illness or death. Secondary impacts could include a reduction in the plant food sources of the species, which may be particularly important in spring and summer, when plant material is incorporated in their diet to a greater extent (Fenner et al. 2007).

Threat	Status [a]	Evidence
Fertilisers	• Status: historical/current/ future • Confidence: inferred • Consequence: major • Trend: unknown • Extent: unknown	Fertilisers may have a negative impact on native grasslands habitat areas by encouraging invasive species at the expense of native grasses, as well as reducing availability of basking and foraging gaps. This may result in the degradation of the already highly limited and fragmented native grassland habitat for the species.
Climate change		
Predicted range shifts due to increased drying and warming	• Status: future • Confidence: inferred • Consequence: major • Trend: increasing • Extent: across part of its range	The loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases has been identified as a Key Threatening Process under the EPBC Act (TSSC 2001). The region where the pygmy blue-tongue occurs is expected to experience increased drying and warming due to climate change (Delean et al. 2013). Delean et al. (2013) used correlative species distribution models and plant-habitat models (in which the shifting distribution of pygmy blue-tongue habitat indicator species was modelled) to predict future pygmy blue-tongue range shifts due to changing climatic conditions. These models projected southward shifts in areas of potentially suitable native grassland habitat for the pygmy blue-tongue. However, suitable habitat may be limited in the south due to intensive land use legacies there. Pygmy blue-tongues are vulnerable to climate change due to the isolation and small extent of the remaining subpopulations and suitable habitat. However, the ecophysiological mechanisms of climate sensitivity (*sensu* Kearney & Porter 2009) have not been explored, and the species may have adaptive capacity, for example through changes in thermoregulatory behaviour. Nonetheless, the species has limited potential for dispersal from habitat that has become unsuitable, due to its poor dispersal ability.

Threat	Status [a]	Evidence
Illegal collection and trade		
Loss of individuals due to illegal trade	• Status: current/future • Confidence: observed • Consequence: moderate • Trend: increasing • Extent: unknown	The pygmy blue-tongue is listed in Appendix III under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The pygmy blue-tongue has a high commercial value among collectors due to its exceptional size and rarity. The species has not been permitted to be exported live from Australia commercially since at least 1982, and there have been no permits providing for the legal live export from Australia for non-commercial purposes since 2002 (Alhur et al. 2019). Although the volume of illegal trade may not be high, even moderate offtake levels may accelerate pygmy blue-tongue declines due to the threats they face, their low reproductive rate, small subpopulation sizes, habitat specialisation and limited distribution range. Illegal collecting of lizards is also likely to damage habitat by destroying burrows. The use of cameras onsite to monitor populations is considered a contributor to the risk of illegal collection of individuals, as it identifies known sites and potentially burrow locations. Population monitoring through the use of genetic typing is a safer alternative for the species.
Invasive species		
Weeds	• Status: historical/current/ future • Confidence: inferred • Consequence: major • Trend: unknown • Extent: unknown	High and dense growth of wild oats and other weeds may reduce inter-tussock spaces, thereby reducing opportunities for pygmy blue-tongues to bask, catch invertebrates and find mates. Weeds may also render habitat unsuitable for burrowing spiders (Souter 2003). Additionally, weed control may be a threatening process if high-disturbance techniques are implemented or native plant species are adversely impacted (Duffy et al. 2012).

Threat	Status [a]	Evidence
Fire regimes that cause declines in biodiversity [b]		
Increased frequency and severity of fires	• Status: historical/current/ future • Confidence: inferred • Consequence: moderate • Trend: unknown • Extent: unknown	Fire regimes that cause declines in biodiversity is listed as a key threatening process (KTP) under the EPBC Act (DAWE 2022). The effect of fire on pygmy blue-tongue populations is not fully known. Fires were probably once a natural landscape process throughout the range of the pygmy blue-tongue. However, given the small and isolated nature of the remaining pygmy blue-tongue subpopulations, fire could potentially have a significant impact (Duffy et al. 2012). It is likely that the impact of fire on pygmy blue-tongue subpopulations would depend largely on the timing and intensity of the fire. Fires that occur in spring, when males are active, or in late summer and early autumn, when juveniles are dispersing, could be detrimental. Fires at other times of the year (mid-summer, late autumn, early spring) may be of less consequence, if they do not occur frequently or in conjunction with other adverse conditions or threats, although further research is required to clarify this (M. Bull, pers. comm. cited in Duffy et al. 2012). The ability of the animals to detect fire and respond with evasive behaviour (such as, by retreating to burrows) are critical traits that require evaluation to improve understanding of fire effects (Nimmo et al. 2021). Monitoring was conducted before and after a pygmy blue-tongue subpopulation site was burnt by accidental fire in December 2005 (Fenner & Bull 2007). The results of this study suggested that the lizards were able to take refuge from the fire in their deep burrows, as the fire did not kill adult lizards or affect the subsequent fecundity of females. While declines were initially observed in activity, foraging, body condition and juvenile survivorship following the fire, these effects were short-lived, with no adverse impacts observed in subsequent years (A. Fenner, pers. comm. cited in Duffy et al. 2012).
Predation		
Predation by native and introduced species	• Status: historical/current/ future • Confidence: inferred • Consequence: moderate • Trend: unknown • Extent: unknown	Both introduced and native predators are known to prey on the pygmy blue-tongue. Domestic dogs have been known to prey on pygmy blue-tongue lizards (Duffy et al. 2021). Known natural predators include Australian kestrels and eastern brown snakes (Hutchinson et al. 1994, Fenner et al. 2008a, M. Hutchinson pers. comm.).

[a] Status—identifies the temporal nature of the threat

Confidence—identifies the nature of the evidence about the impact of the threat on the species

Consequence—identifies the severity of the threat

Trend—identifies the extent to which it will continue to operate on the species

Extent—identifies its spatial context in terms of the range of the species
[b] Fire regimes that cause declines in biodiversity include the full range of fire-related ecological processes that directly or indirectly cause persistent declines in the distribution, abundance, genetic diversity or function of a species or ecological community. 'Fire regime' refers to the frequency, intensity or severity, season, and types (aerial/subterranean) of successive fire events at a point in the landscape

Categories for consequences are defined as follows:
Not significant – no long-term effect on individuals or populations
Minor – individuals are adversely affected but no effect at population level
Moderate – population recovery stable or declining
Major – population decline is ongoing
Catastrophic – population trajectory close to extinction

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration. They are: the life stage they affect; the duration of the impact; the spatial extent, and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

Table 2 Pygmy blue-tongue lizard risk matrix

Likelihood	**Consequences**				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain			**Loss of individuals due to illegal trade**	**Urban, industrial and infrastructure development** **Predicted range shifts due to increased drying and warming**	**Changed land use for agricultural activities** **Inappropriate grazing regimes**
Likely		**Predation by native and introduced species**	**Weeds** **Fire regimes that cause declines in biodiversity**	**Pesticides** **Herbicides** **Fertilisers**	
Possible					
Unlikely					
Unknown					

Risk Matrix legend/Risk rating:

Low Risk	Moderate Risk	High Risk	Very High Risk

Priority actions have then been developed to manage the threat particularly where the risk was deemed to be 'very high' or 'high'. For those threats with an unknown or low risk outcome it may be more appropriate to identify further research or maintain a watching brief.

Conservation and recovery actions

Primary conservation objective

By 2033, the population size, Extent of Occupancy and area of secure habitat of the species have increased. New and existing subpopulations are supported by access to high-quality potential habitat and through the development and implementation of a successful translocation program.

Conservation and management priorities

The below conservation and management priorities are important for ensuring the pygmy blue-tongue's resilience throughout future climate change, especially habitat protection and restoration which may buffer against some climate change impacts. For example, restricted stock access and planting of native tussock grasses will help keep ground temperatures more stable.

Habitat loss and degradation

- Implement stewardship and protection of all known and potential habitat for the pygmy blue-tongue.
- No further loss, degradation and fragmentation of known or likely habitat due to land use change or development.
- No urban, industrial and infrastructure development within known and potential pygmy blue-tongue habitat areas.
- Avoid all major soil disturbance activities (for example, tilling) in all known and potential pygmy blue-tongue habitat.
- Avoid or carefully manage the use of chemicals (pesticides, herbicides and fertiliser) within all known and potential pygmy blue-tongue habitat.
- Continue to implement the development of artificial shelters in pygmy blue-tongue habitat areas where burrow availability is a limiting factor for the species, to act as temporary shelter sites and improve recruitment.
- Enhance pygmy blue-tongue habitat areas by planting local native tussock grasses where these grasses are sparse.
- Conserve burrow-making spiders (wolf and trapdoor spiders, particularly *B. aurea*) within pygmy blue-tongue habitat, given the importance of these spiders to the persistence of the species.
- Manage any disturbances to sites supporting the pygmy blue-tongue, including alterations to hydrology or soil, or chemical and nutrient pollution (such as from pesticides or herbicides).
- Manage access to known locations of the species to prevent accidental destruction of burrows by people or machinery (through fencing, signage, or other means).

- Implement an appropriate fire monitoring and management regime (see Fire section).

Climate change

- Use the correlative modelling developed Delean et al. (2013) and consider developing new ecophysiological models such as those outlined by Kearney and Porter (2009) to do the following:
  - locate and map existing habitat patches on which to focus conservation efforts;
  - identify and map future suitable habitat for the species; and
  - choose sites for assisted colonisation of the pygmy blue-tongue, using wild-wild methods and captive-bred individuals if appropriate (if genetic integrity is sufficient for population survival).
- Determine genetic differences and important genes in pygmy blue-tongues involved in resisting desiccation and withstanding dry conditions
- Establish monitoring sites to enable early detection of the impacts of climate change on the pygmy blue-tongue and its habitat.

Illegal collection and trade

- Continue and increase monitoring efforts of reptile trade within Australia and overseas to detect illegal traffic.
- Continue population enhancement through captive breeding and translocations to mitigate any adverse impacts from the loss of individuals due to illegal export.
- Continue building understanding of the population genetic structures and the distribution of genetic diversity of currently known subpopulations, to assist in identifying subpopulations and areas from which individuals have been illegally captured.
- Increase community awareness of the risk of illegal collection of the species.
- Avoid the use of camera monitoring methods at sites, unless essential (where they should be limited to suitably remote and secure sites), as this may enable the identification of sites and burrows by illegal collectors.

Invasive species (including threats from grazing, trampling, predation)

- Identify the key weed species that threaten the persistence of the pygmy blue-tongue and undertake weed control in habitat areas, including at adjacent sites, using appropriate methods and monitoring responses of the pygmy blue-tongue population. Consider the possible disturbance/overspray threats associated with the control method.
- Consult with local experts to implement the most appropriate physical or chemical weed control methods that will not have detrimental effects on the pygmy blue-tongue.
- Monitor weed infestations to determine if control strategies are effective. Regularly inspect roadside habitats during road maintenance for growth of new weeds and remove any invasive species.
- Implement suitable weed hygiene protocols when undertaking survey, monitoring and management activities, especially road maintenance, offroad vehicle use and access. Refer to the Arrive Clean, Leave Clean Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems (DoE 2015).

Fire

- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of the pygmy blue-tongue, degrade the habitat necessary to the species and do not increase impacts of predation.
- Physical damage to the habitat and individuals of the threatened species must be avoided during and after fire operations.
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to the pygmy blue-tongue.
- Undertake active weed control after fire management in areas of occupied and suitable habitat.

Impacts of domestic herbivores

- Ensure grazing regimes are aligned with pygmy blue-tongue habitat requirements (avoid both heavy grazing and under-grazing and implement moderate or rotational grazing regimes in all habitat areas).
- All heavy grazing activities should be ceased in pygmy blue-tongue habitat areas.
- Implement optimal grazing regimes required to improve habitat quality for the pygmy blue-tongue. Moderating sheep grazing, which has long been undertaken in habitat areas for pygmy blue-tongue, is essential to the maintenance of habitat attributes. If sheep or macropod grazing is undesirable, then other measures such as slashing or burning should be investigated as alternative measures but may need further research as to their effectiveness.

Breeding, translocation, and other ex situ recovery actions

- Continue efforts to develop an effective translocation plan for the pygmy blue-tongue, identifying potential risk mitigations and considerations for future translocations. The focus of this plan should be to move the species to areas which are likely to be within the species' future distribution, using wild-wild translocation, due to the risks associated with climate change. Ensure readiness and capacity for implementation is informed by ecophysiological modelling and monitoring thresholds.
- Identify, secure access to and enhance suitable recipient sites for pygmy blue-tongue translocations (for example, by planting local tussock grass species). Consider the contracting climatic envelope of the species with climate change (therefor, consider translocation to sites in the southern part of the species' range).
- Investigate and implement a successful translocation program to relocate declining populations to sites with high current habitat quality and favourable future climatic conditions.
- Continue efforts to maintain and increase the captive breeding program for the pygmy blue-tongue lizard at Monarto Zoological Park SA and other potential facilities, to ensure the persistence of genetic lineages of the species. A stud book should be implemented in captive breeding colonies.
- Subject to an improved understanding of local adaptation, investigate the potential to implement genetically-based assisted immigration to increase genetic mixing between

subpopulations (Schofield et al. 2015). If pygmy blue-tongue subpopulation densities become too low and the opportunities to avoid inbreeding diminish, then the addition of genetically different individuals might be appropriate to maintain genetic diversity among subpopulations.

- Monitor the success of translocations, considering the body condition of translocated individuals, survival and recruitment rates and if lizards from particular subpopulations fair better when translocated (Clayton et al. 2020a).
- Engage with landowners to achieve positive publicity around pygmy blue-tongue translocations (Clayton et al. 2020a).
- Determine the population genetic structure of known populations.

Stakeholder engagement/community engagement

- Determine objectives for any public engagement to improve management on private land and to ensure recent scientific knowledge is incorporated into public land management.
- Effective liaison and cooperative management with private landholders to ensure landholders and relevant agencies are aware of, and protect, known pygmy blue-tongue subpopulations and their habitat. This includes promotion and support for compatible grazing regimes on private property and the use of best practice management of land.
- Encourage private land conservation agreements and other measures to secure protection of pygmy blue-tongue subpopulations and habitat.
- Continue to engage and support stakeholders of the current pygmy blue-tongue Recovery Team for the conservation of the species. Continue engagement with other stakeholders including the South Australian Government, Flinders University, the South Australian Museum, Zoos SA, the Zoo and Aquarium Association of Australasia, community conservation groups, local community members and landowners and consulting companies.
- Continue to raise awareness of, and engagement in, the conservation of pygmy blue-tongues among stakeholders who are not heavily aware of, or involved in, the conservation process, such as community groups. Continued community engagement in the implementation of conservation actions can encourage local groups to take ownership of and become invested in the species' conservation.
- Improve understanding of the cultural significance of the pygmy blue-tongue lizard to the Kaurna, Nukunu, Narungga and Ngadjuri people.

Survey and monitoring priorities

- Continuously monitor pygmy blue-tongue subpopulations on a regular basis (annually at a minimum) to detect any changes in habitat quality or declines in population size, health and age structure. Monitoring should be designed to enable an assessment of:
  - population size, recruitment, and age-structure dynamics;
  - current EOO, AOO, population abundance and population trend/trajectory;
  - current habitat condition and ideal habitat condition (especially optimal grazing regimes);
  - onsite suitable burrow availability (the number of suitable empty burrows of the appropriate dimensions onsite), to give an indication of the maximum population size

(this may also give an indication of the existence of threats constraining population size);
  - levels of predation;
  - ongoing impacts of climate change on the species and its habitat;
  - success of management actions and the need to adapt them;
  - genetic diversity of subpopulations, especially translocated subpopulations;
  - effect on subpopulations of the removal of individuals for translocations;
  - success of ex situ captive breeding and translocation efforts.

- Carry out targeted surveys to identify all known and possible sites supporting the species, including any additional existing subpopulations of pygmy blue-tongue. Detection of the species might be enhanced by using a dog trained to detect the lizards (Nielsen et al. 2016).
- Survey sites identified as potential recipient sites for translocations, including ecological and bioclimatic information.
- Continue monitoring of translocated subpopulations or plan successful natural dispersal of translocated individuals, potentially to establish a self-sustaining population in the translocation area.
- Precise fire history records must be kept for the habitat and extant subpopulations (confirmed and suspected) of the pygmy blue-tongue.
- Monitor subpopulations for illegal capture of individuals through the use of genetic typing or other methods.

Information and research priorities

- Further investigate the genetics of the pygmy blue-tongue, including:
  - population genetic structure and the distribution of genetic diversity across subpopulations. This will enable the identification of separate subpopulations and of potential subpopulations in adjoining sites. It will also allow seized lizards to be traced to their source subpopulation.
  - methods to increase genetic diversity, such as captive bred introductions of genetically distinct individuals to various sites.
  - AOO requirements to maintain the current levels of genetic diversity in pygmy blue-tongue subpopulations and ensure that requirements are met at all sites.
- Further investigate the pygmy blue-tongues response to and interaction with climate change, including:
  - thermoregulatory responses of lizards to rising temperature extremes.
  - the vulnerability of the pygmy blue-tongue to climate change.
- Develop more mechanistic population models to refine predictions of pygmy blue-tongue range contraction with climate change. For example, link habitat suitability models with demographic models (Keith et al. 2008), incorporate thermoregulatory niches and behaviour of the reptiles and the drivers of habitat suitability for burrowing spider species which are important for the pygmy blue-tongues' persistence (particularly of *B. aurea*), as this may improve predictions of the future occurrence of the lizard (Delean et al. 2013; Kearney and Porter 2009).

- Improve understanding of aspects of pygmy blue-tongue ecology including:
  - the population dynamics and habitat requirements of burrowing spiders.
  - the potential for long-term success of artificial burrows across different soil and vegetation types.
  - the fitness costs and distribution of *O. michaeli*, the mite which parasitises the pygmy blue-tongue, on the lizard, and the implications of any costs on the translocation program for the species (such as, the cost of the prevention of mite spread).
- Investigate aspects of translocation and ex situ breeding ecology and biology, including:
  - methods to increase the long-term sustainability of translocations. For example, the potential to translocate burrow-making spiders (specifically *B. auera*) to new sites, to establish a healthy spider population prior to the translocation of lizards.
  - methods to increase the rates of successful ex situ reproduction and prepare captive bred individuals for reintroduction.
  - the potential to develop a strategy for captive-breeding-sourced translocations.

Links to relevant implementation documents

This Conservation Advice is developed to be able to subsequently inform other planning instruments such as a Bioregional Plan or a multi-entity Conservation Plan.

National Recovery Plan for the Iron-grass Natural Temperate Grassland of South Australia ecological community (2012)

National Recovery Plan for the Pygmy Blue-tongue Lizard *Tiliqua adelaidensis*. (2012).

100 Priority Species (2022)

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This publication is available at the SPRAT profile for *Tiliqua adelaidensis* (pygmy blue-tongue lizard)

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090, Canberra ACT 2601
Telephone 1800 920 528
Web dcceew.gov.au

Acknowledgements

This Conservation Advice was prepared in consultation with those states and territories who provided input, and we thank them for their contribution. In particular, thanks are given to South Australia’s DEW (Department for Environment and Water).

From:	DTI:SPC Reps
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 N & C Lewis
Date:	Wednesday, 12 June 2024 9:28:09 AM
Attachments:	Lewis-Objection-Aust-Plains-Solar-Farm2.docx

14

OFFICIAL

Hi Fiona

One for you

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Tuesday, June 11, 2024 4:15 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373787
Submission Time	11 Jun 2024 4:15 pm
Submission IP Address	119.12.214.108

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Nelson and Courtney Lewis
Contact number:	0402393957
Email:	nplewis96@gmail.com
Postal address:	61 Bruce Street Eudunda SA 5374
Affected property:	Sec 314 Hundred of English

Submission Details

I am:	an owner of local property
I am - Other:	

My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	As the closest neighboring landowners we are opposed to the solar farm. Please refer to the list of concerns attached which are those of ourselves and our family, as well as other residents and landowners at Australia Plains.
What could be done to address your concerns?:	We do not want a solar farm in our local area. For the development to not go ahead and the land adjoining mine to continue to be used as grazing land as it has been for many years. For solar farm developers to take their projects away from rural areas where people are living in close proximity and to establish these type of developments well away from peoples homes.
Other general comments:	We have future plans to build a home and live on the property so do not want to bring up our family next door to a solar farm! We are strongly opposed to it and have had ongoing stress as a result worrying about how this will affect our family, sheep and cropping of our land.
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

FilesUp:	Lewis-Objection-Aust-Plains-Solar-Farm2.docx, type application/vnd.openxmlformats-officedocument.wordprocessingml.document, 19.7 KB
FilesUp:	No file uploaded
FilesUp:	No file uploaded
FilesUp:	No file uploaded
FilesUp:	No file uploaded

Australia Plains Solar Farm

Concerns of The Lewis Family

1170 Australia Plains Road

Our family home and farming enterprise is located approximately 1000m, over the hill, from the proposed site of the solar farm development, particularly the substation/battery storage area as shown in the plans.

We have lived at our location for 24 years operating our farming enterprise and as an historic fourth generation farming family at Australia Plains did not expect that this type of development would take place in the area. Australia Plains is a quiet, rural setting and we want this to continue with no such developments to interfere with our rural lifestyle or that of our neighbouring land owners and residents.

We have had no notification of the development application, other than the brief notice placed in the Leader newspaper several weeks ago. Many people do not rely on newspapers so this method of notification is no longer effective and it should have been communicated to neighbouring landholders and residents in the area by a mailing at the very least. A community meeting would have been more appropriate where information regarding the development should have been conveyed to the public and any questions in regard to the impacts of the solar farm could have been answered face to face.

The following are our points of great concern and objection to the development application.

Close proximity to our residence, and the residences of neighbours, in particular the family across from Junction Road and the elderly gentleman living in his home across the road from the site on the north eastern end of the Bower road. Both are opposed to the development and have similar concerns to us. They will both be affected by the sight of the solar facility and are experiencing overwhelming feelings of distress as a result.

Visual impact, appearance, glare – can be seen from the road and other areas of our farm. This type of development is not sympathetic to the natural bushland surrounds and is totally “alien” in appearance.

Increase of vehicular traffic use of the “bush track” opposite our home to gain access to the south western side of the solar facility site. Random vehicles moving about the area, coming and going will not be appreciated by security conscious locals.

Fire risk- Hot northerly winds prevalent in summer. What protection would our home and farm have if a fire was to start due to a breakdown in the solar facility to the close north east of our property?

What are the Health risks to Humans and Livestock? Do the panels emmit radiation or an electromagnetic field around, if so at what distance? What Studies have been undertaken to prove safety (cancer, lung disease etc)? How can residents in the area be assured we will suffer no long term health issues from this development?

Heat sync effect on crops. Are adjoining agricultural crops/pastures going to be affected?

How will a large amount of solar panels affect the climate in the area?

Wildlife- A 2m high fence to be erected around perimeter – how will this and the infrastructure/construction impact on wildlife movement/kangaroos, emus & wombats on land, foraging range impacted for echidnas/goannas/bearded dragons/sleepy lizards/brown snakes/pygmy possums in the scrub & trees, how are birds impacted?

Wombats-currently active wombat burrows on the western edge of the site. How will these wombats be catered for? The fence will block their foraging range and disturbance to burrows will impact their homes.

Mallee Birds-in particular the white wing chough, or as we call them ”jays”, frequent the area, clearing of native vegetation will impact their territorial range and lessen available scrub area for breeding.

Removal of native tree scrub on the site is not acceptable. Land owners are not permitted to clear trees from their properties for the purpose of farming so why are solar farms allowed to fell trees? This will clearly further impact native bird species.

Sheep grazing -Glare from panels and the “look” of infrastructureie bright, shiny solar panels, will deter sheep from grazing in adjoining paddocks. Construction work will disturb lambing ewes and cause losses.

Biosecurity: COVID 19 and other animal diseases brought in by contractors which may pose a threat to farming enterprise. Where do contractors come from and where are they accommodated during construction?

No local jobs once construction is completed- all work undertaken by outside contractors. No advantage for long term employment in the local community/ no new families in the district/ no children attending local schools.

Road usage during construction will desecrate already poor roads which have not been maintained by the Regional Council of Goyder. Extra traffic caused by contractors during construction will create unknown hazards for locals on these poor roads. Dust will be a problem with high road usage and heavy vehicles. In times of heavy rainfall the roads will erode significantly if subjected to heavy use.

Heavy rainfall-it may not have been noted by the prospective developer that the north eastern end of the site in question has been historically flooded during events of heavy rainfall. Observation of the hugely eroded dry creek beds that lead into the property would be indicative of the large volume of water that has flowed across the site in years gone by.

Indigenous cultural considerations. While the plans state that there is no cultural significance to the land in question has this been confirmed by local indigenous representatives? Has a site walk taken place? This should be arranged before any decision is decided.

Interference with appliances/digital TV/mobile phone/internet/satellite?

Where are the panels/equipment/components manufactured – Australia?/OverSeas?

What is the composition of the panels and do they contain any toxic substances? Eg Arsenic?

Where does the generated power go to and will our electricity bills be any cheaper?

Disposal- What is the lifespan of the panels and how are they disposed of once they are no longer functional? Are they recycled?

What is the next stage in the development and will the neighbouring landowners and residents in the area be kept informed? We have not been communicated to in regard to the current development application and it is merely by chance that a relative has seen the Leader notification and alerted us to the situation.

In summary we are one of the closest residing neighbours to the land in question. We are not in favour of the solar farm going ahead and strongly object for the many reasons outlined above.

Signed:

Martin & Lynda Lewis (Section 308 Hundred of English, 1170 Australia Plains Road)

Toby & Kayla Lewis (1140 Australia Plains Road)

Nelson & Courtney Lewis (Lot 314 Australia Plains Road)

Selleck, Fiona (DTI)

From:	DTI:SPC Reps
Sent:	Friday, 14 June 2024 8:35 AM
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development 24003878 P & L Loffler
Follow Up Flag:	Flag for follow up
Flag Status:	Flagged

OFFICIAL

Hello Fiona

Please see below 😊

Thanks

S

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Friday, June 14, 2024 8:21 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_proje
Submission Id	1374640
Submission Time	14 Jun 2024 8:20 am
Submission IP Address	119.12.214.76

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Peter and Lorraine Loffler
Contact number:	0885811546
Email:	lyloffler43@gmail.com
Postal address:	30 Weigall Street Eudunda SA 5374
Affected property:	91 Mickan Rd Australia Plains Eudunda SA 5374

Submission Details

I am:	a private citizen
I am - Other:	
My position is:	I oppose the development
Do you have concerns regarding the proposed development?:	We are historic farmers of the Australia Plains area. Lorraine lived on a property up the road from the proposed site and attended the Australia Plains school. Her father owned their farm since the 1930's and her grandfather owned the Micken Road land at some time also. Lorraine remembers the Binder family who owned the the land and farmed there and remembers their farmhouse on the hillside adjoining Micken road. She remembers the government water tank making water available to droving stock travelling through to the Murray river. This is the heritage and the history of the district and needs to be respected and maintained for future generations. Lorraine and Peter are in their twilight years but strongly oppose the solar farm and fully support the opposition by their family who still live and farm on the original farmland at Australia Plains.
What could be done to address your concerns?:	Do not build a solar farm at Australia Plains. Take the project well away from where people live and farm. Show respect for history and the pioneering farmers of the area and do not desecrate the landscape with a solar farm.

Other general comments:	Very poorly communicated to landowners and residents in the area. If our daughter had not alerted adjoining landowners to the development application very few would have even known about it. A community meeting should have been held to let locals know of the intentions of the developers to make the application and to hear the opinions of neighbouring residents and landowners.
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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Penny Pratt MP
Member for Frome

State Commission Assessment Panel
GPO Box 1815
ADELAIDE 5001

spcreps@sa.gov.au

Dear Assessment Panel Members

I write in support of my constituent Mr Desmond Traeger who lives at 12 Black Road, Australia Plains and his concerns with the proposal of Green Gold Energy Pty Ltd to develop a solar farm comprising approximately 430,000 solar photovoltaic panels.

Mr Traeger has expressed to me his disappointment at the close proximity of the development to his home.

Specifically, he is concerned about the aesthetics, the potential lack of privacy, increased activity and noise and the security of his property.

He is also concerned that he did not have the opportunity to participate in a consultation process and advise of his objection earlier in the project planning stages.

I understand Mr Traeger has made a submission to the Panel and I would be most grateful if the Panel would hear Mr Traeger's concerns and take them into serious consideration.

If you would like any further information please do not hesitate to make contact.

Yours sincerely

Penny Pratt MP
Member for Frome

14 June 2024

From:	DTI:SPC Reps
To:	Selleck, Fiona (DTI)
Subject:	FW: Feedback submitted for Major Development
Date:	Friday, 17 May 2024 2:04:35 PM

OFFICIAL

Hi Fiona,

See below submission.

Regards,

Hayden

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Friday, May 17, 2024 11:32 AM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1366701
Submission Time	17 May 2024 11:31 am
Submission IP Address	1.147.77.160

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	peter schiller
Contact number:	0429604151
Email:	pschill22@hotmail.com
Postal address:	PO BOX 315, EUDUNDA, SOUTH AUSTRALIA, 5374
Affected property:	1362 Australia Plains rd Australia Plains

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	neutral
Do you have concerns regarding the proposed development?:	my land joins the proposed developement and i have not been contacted about the proposed solar farm which i should have been ,i was only made aware that this solar farm would join my property when signs went up yesterday i should have been contacted by mail .Also glare from the solar panels will make it dangerous for traffic on the nearby roads.
What could be done to address your concerns?:	a letter informing me of the proposed solar farm.
Other general comments:	solar farms and windfarms are making farming land more expensive by competing with farmers to buy or lease the land meaning farmers have to pay higher council rates ,so solar farms and windfarms should also pay council rates.
PresentInPerson:	I wish to be heard in support of my representation
NominatedSpeaker:	peter

Supporting Documents

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From: DTI:SPC Reps
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development 24003878 P. Schiller (2)
Date: Wednesday, 12 June 2024 9:25:11 AM

OFFICIAL

Hi Fiona

One for you

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Tuesday, June 11, 2024 9:06 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373888
Submission Time	11 Jun 2024 9:05 pm
Submission IP Address	1.147.10.79

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	peter schiller
Contact number:	0429604151
Email:	pschill222@gmail.com
Postal address:	PO BOX 315, EUDUNDA, SOUTH AUSTRALIA, 5374
Affected property:	1362 Australia Plains rd Australia Plains

Submission Details

I am:	an owner of local property
I am - Other:	
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	i oppose this developement because a large number of trees will be cleared to construct this solar farm .It covers up productive farming land stopping food production .There is a large floodway with a catchment from Eudunda to Robertstown which will have solar panels on it .It will make driving on nearby roads dangerous from the glare of the solar panels .the purchase of this land and other land for solar farms is driving up the value of nearby land meaning that council rates are pushed up .These companies are competing with farmers to buy the land .
What could be done to address your concerns?:	Green Gold energy can stop this developement and go else where with their solar farm and sell the land to locals.
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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From: DTI:SPC Reps
To: Selleck, Fiona (DTI)
Subject: FW: Feedback submitted for Major Development 24003878 S. Bitterworth
Date: Wednesday, 12 June 2024 9:25:24 AM

OFFICIAL

Hi Fiona

One for you

From: PlanSA - Submissions <noreply@plan.sa.gov.au>
Sent: Tuesday, June 11, 2024 7:10 PM
To: DTI:SPC Reps <spcreps@sa.gov.au>
Subject: Feedback submitted for Major Development

Form Information

Site Name	PlanSA
Site Id	578867
Page Standard Name	Impact assessed and Crown development submissions
Page Standard Id	921477
Url	https://plan.sa.gov.au/have_your_say/notified_developments/state_developments/major_projects_impact_assessed_submissions
Submission Id	1373854
Submission Time	11 Jun 2024 7:10 pm
Submission IP Address	118.67.56.180

Development Details

Applicant:	Green Gold Energy Pty Ltd Department for Energy and Mining
Development Number:	24003878
Nature of Development:	Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Subject Land:	**Lot 315 Bower Rd Australia Plains SA 5374** **91 Mickan Rd Australia Plains SA 5374** Development of a solar farm comprising approximately 430,000 solar photovoltaic (PV) panels with total export capacity of 200MW and associated infrastructure
Contact Officer:	Fiona Selleck
Phone Number:	(08) 7133 1754
Close Date:	14 Jun 2024

Contact Details

Name:	Shannon bitterworth
Contact number:	0434471268
Email:	Shannon.butterworth@sa.gov.au
Postal address:	P.O. Box 286 eudunda sa
Affected property:	

Submission Details

I am:	a private citizen
I am - Other:	
My position is:	I oppose the development

Do you have concerns regarding the proposed development?:	
What could be done to address your concerns?:	
Other general comments:	
PresentInPerson:	I do not wish to be heard in support of my representation
NominatedSpeaker:	

Supporting Documents

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Planning Aspects Pty Ltd
PO Box 986
Kensington Gardens SA 5068
0418 856 580
shanti.ditter@planningaspects.com
www.planningaspects.com
ABN 55 114 897 335

18 September 2024

Ms Fiona Selleck
Senior Planning Officer
Crown and Impact Assessment
Planning and Land Use Services
Department for Trade and Investment
83 Pirie Street
Adelaide SA 5000

Dear Fiona

Re: Crown Development Application 24003878 Australia Plains Solar Facility - Response to Representations

I refer to the twelve (12) separate representations received in respect of the proposed solar farm at Mickan Road, Australia Plains.

The main issues raised during the public notification period were:

- Visual impact
- Glare from solar panels and associated danger for road users
- The cost of land increasing resulting in high council rates
- Clearing of large number of trees
- Solar panels taking over productive land and impacting food production
- Potential for flooding
- Fire risk
- Lack of notification
- Miscellaneous including:
  - health risks to people and livestock
  - interference with appliances i.e. digital phone, satellite, internet
  - Effects on crops / local climate

On the basis of the concerns raised regarding visual impact and glare, Green Gold Energy has engaged the services of specialist consultants on these topics and they have concluded that there is limited impact on the visual quality of the locality, and limited opportunity for glint and glare to be generated from the facility. Notwithstanding this, the consultant has recommended incorporating measures into the environmental management plan (EMP) for the site to ameliorate any potential concerns for glint and glare specifically. The details of each assessment are included in Appendix A & B, with a summary provided below.

Visual Impact and Landscape Assessment
A visual impact and landscape assessment undertaken by Landskap has identified that the landscape character of the local area is highly modified. It is defined by dryland agriculture in the form of cropping and grazing with areas of mallee located along existing fence lines and within allotments.
It is also characterised by high-voltage overhead power lines and outbuildings that are associated with agriculture which are considered to interfere visually with the landscape.

Landskap have assessed the landscape character of the local area to be "… of relatively low scenic quality." On this basis they have concluded that the proposal will have a low visual impact on the locality due to the following:

"1. Publicly accessible views of the proposal are extremely limited and generally include:
- The roads immediately bordering the site, including Bower Road, Mickan Road and a short section of Australia Plains Road.
- Longer distance views are limited to short sections of Bower Road, west of the site, and Schulz Road, north of the site.

2. The local area has a good capacity to absorb infrastructure of the proposed nature, with flat to gently undulating topography and scattered stands of mallee eucalypts that restrict views.
3. Retention of existing areas of mallee eucalypts within the site and along the site boundary restrict views.
4. Proposed landscaping around the entire perimeter of the facility ensures that the facility will be screened from adjacent roads and private allotments. The proposed landscaping will add to the landscape amenity of the area and improve local biodiversity.
5. The local area is currently populated with high-voltage overhead power lines, approximately 50m high.
6. The proposed sub-station and BESS units are consolidated and well located to minimise their visual impact. They are located in the south-west corner of the project site, away from publicly accessible vantage points. The topography of the local area will limit their visibility from the south and west."
The local area generally comprises large allotments with scattered dwellings and outbuildings. Due to the low-density pattern of development within the local area, there are few dwellings adjacent to the project site. While a photographic survey was not undertaken from private properties, a desktop review is summarised below:

- 12 Back Road, Rocky Plain, located approximately 150m from the northern project site boundary is the closest dwelling. Based on photographic survey undertaken from Schulz Road, adjacent to the dwelling, the following are noted:
  - The northern portion of the proposal will be partially visible from the dwelling. Views will be significantly obstructed by existing vegetation adjacent the dwelling and along Bower Road, as well as proposed vegetation along the project site boundary.
  - Views to the southern portion of the proposal, including substation and BESS will be obstructed by existing topography and mallee stands within the project site.
- 1362 Australia Plains Road, Australia Plains, located 700m south of the southern boundary. Based on photographic survey undertaken from Junction Road, adjacent the dwelling, it is anticipated that the proposal will not be visible due to local topography and vegetation.
- 1170 Australia Plains Road, Australia Plains, located 2,000m south of the southern project site boundary. Based on photographic survey undertaken from Australia Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.

- 1140 Australia Plains Road, Australia Plains, located 2,150m south of the southern project site boundary. Based on photographic survey undertaken from Australia Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.
- 1041 Australia Plains Road, Australia Plains, located 2,250m south-west of the southern project site boundary. Based on photographic survey undertaken from Plains Road, it is anticipated that the proposal will not be visible due to local topography and vegetation.

Due to the local topography, Landskap have noted that some long-distance views to the proposal may be possible from private allotments to the east and north, however anticipate that these views will be significantly limited by the local topography, existing vegetation and proposed landscaping.
Supporting this assessment, Landskap have concluded that the local topography, existing vegetation, and proposed landscaping to the perimeter of the proposal would significantly limit the visual impact of the proposal to an acceptable level.

Landskap have concluded that "… the visual impact of the proposal will be low and will lessen over time. It is our opinion that it will not result in an unacceptable visibility that compromises the landscape character of the locality. The successful establishment of proposed landscaping will provide visual and landscape benefit to the local area."

Glint and Glare Assessment

Environmental Ethos was engaged by Green Gold Energy to undertake a glint and glare assessment of the proposal. The glint and glare impact modelling utilised the Solar Glare Hazard Analysis Tool (SGHAT 2024A) in conjunction with a viewshed analysis.

In summary, the points identified from the assessment include:

- no aviation facilities within 5km of the Project, and no railway infrastructure within 1km of the Project.
- Within 3km of the proposal, nine residential receivers were identified to have a potential line of sight to the proposal (based on the terrain model).
- The viewshed modelling identified the five (5) local roads as having potential line of sight to the proposal and an unformed road corridor.
- Glare modelling identified that under normal operation of the solar farm with a tracking/backtracking operation and a minimum limit of 5-degree resting angle (being the fixed angle at which the backtracking process starts and finishes during daylight hours), no potential glare hazard impacts were identified as affecting residential receivers within 3km of the subject site.
- Glare modelling identified no potential glare hazard affecting Bower Road, Back Road, and Australia Plains / Emmaus Roads.
- PV Array 5 (located to the east of the subject site) was identified as generating a small amount of glare that has the potential to affect Mickan Road and a very small amount of glare affecting Schulz Road, when the resting angle was set at 5 degrees. Adjustment to a 6 degrees resting angle eliminated potential glare in the modelling, therefore the mitigation measures for PV Array 5 includes the requirement to limit the resting angle of the tracking system to a minimum 6 degrees.
- Glare modelling identified potential glare affecting the unformed road corridor (Junction Road) generated by PV Arrays 3 and 5. As the Project will curtail access along the road corridor during the life of the Project, the potential glare identified in the modelling is unlikely to affect drivers of vehicles.
- Screen planting and the retention of areas of existing vegetation, and in particular when the screen planting has become established to a height and density sufficient to block line of site to the subject

site from Mickan Road and Schulz Road, the requirement to limit the resting angle of the tracking system for PV Array 5 to 6 degrees (minimum) would no longer be necessary.

On this basis Environmental Ethos has recommended that the Environmental Management Plan associated with the project should detail glare management measures required to mitigate impacts to sensitive receptors, regarding resting angles. It also recommends the monitoring of glare hazard potential for managing complaints, including rectification, for inclusion in the in the Project EMP.

Cost of Land

The subject of the increasing cost of land is a land economics consideration that generally cannot be dictated to by the planning approvals system.

Clearing of trees

The establishment of the solar farm will necessitate the removal of trees and vegetation. The proposal has been assessed by EBS ecology and the necessary approvals are being sought through the Native Vegetation Council for the removal.

Notwithstanding this, the proposal has been designed to maintain and keep as much of the existing vegetation as possible. It also includes the incorporation of additional screening vegetation of approximately 5 metres in width around the perimeter of the subject land.

Solar Panels on productive land

Whilst the solar array will be located within productive land, establishment of the panels will allow the subject land to be used for grazing of sheep. Whilst is will be given up from cropping, the use will not entirely sterilise the land from primary production.

Risk of Flooding

Development of the proposed solar farm will result in additional hard surfaces that have the potential to increase in water flows during rainfall events. To this end the proposal has incorporated a number of detention basins and swales throughout the site to mitigate the potential impact of flooding and erosion on the site. Full details of the proposed design and layout of the swales and detention basis is included in the Stormwater Assessment that was submitted as part of the development application.

Fire Risk

The proposal includes the installation of water tanks for fire-fighting purposes (with the precise number and location to be determined in liaison with the CFS). Installation of the solar array per se is not considered to exacerbate nor aggravate the likelihood for bushfire on the site. Installation of fire protection systems on the site will assist to reduce the effects of bushfire on the subject land.

Lack of Notification

The proposal involved a community open day in August 2020, where 38 people attended. At this event attendees were provided with information about the solar farm and the proponent and were shown a number of images of similarly-scaled solar farm developments to provide a reasonably accurate picture of what the proposed development would look like on completion.

The community event was held at a time when the subject site included Lot 309 Emmaus Road. Residents in close proximity to the southern boundary of this allotment attended the open day to register their opposition to the proposal, expressing concerns over the visual impact of the solar farm and its "incompatibility" within a predominantly rural / primary production setting. Remaining participants were generally supportive of the development on the condition that any adverse impacts would be carefully managed.

The application was subsequently placed on formal public notification under the provisions of the *Planning, Development and Infrastructure Act, 2016.* In addition, direct contact was made with a number of representors in an attempt to allay concerns.

Miscellaneous Issues

A number of miscellaneous matters have been raised by representors including:

- health risks to people and livestock
- interference with appliances i.e. digital phone, satellite, internet
- Effects on crops / local climate

There is no supporting evidence to support the assertion that a solar farm has the potential to impact any of the suggested matters.

Conclusion

The additional assessments undertaken to determine the impact of the proposed solar farm on the subject land have concluded that impacts on glint and glare in the locality can be appropriately managed with additional landscaping around the perimeter of the site and mitigating any further impacts with an Environmental Management Plan for the site.

The existing topography of the site and its spatial location together with its highly altered state has led Landscap to conclude that the development of the solar farm will have limited impacts on the visual amenity of the locality.

The planning assessment of the proposal under the provisions of the Planning and Design Code as it applies to the site supports the establishment of a solar farm as proposed. On this basis and with the further supporting evidence provided, it is recommended that the proposal be supported.

Should you have any further queries regarding the proposal, please do not hesitate to contact me on 0418856580.

Kind regards,

Shanti Ditter
Principal