Table 5. The locations of bird survey sites.

Bird survey site	Easting	Northing
BS1	330315	6146999
BS2	328835	6146952
BS3	329038	6145345
BS4	330795	6145241
BS5	328907	6144780
BS6	326967	6144567
BS7	327926	6141193
BS8	327029	6140434
BS9	326383	6139957
BS10	328360	6140010
BS11	328641	6138011
BS12	329138	6136794
BS13	329290	6136211
BS14	330584	6136266

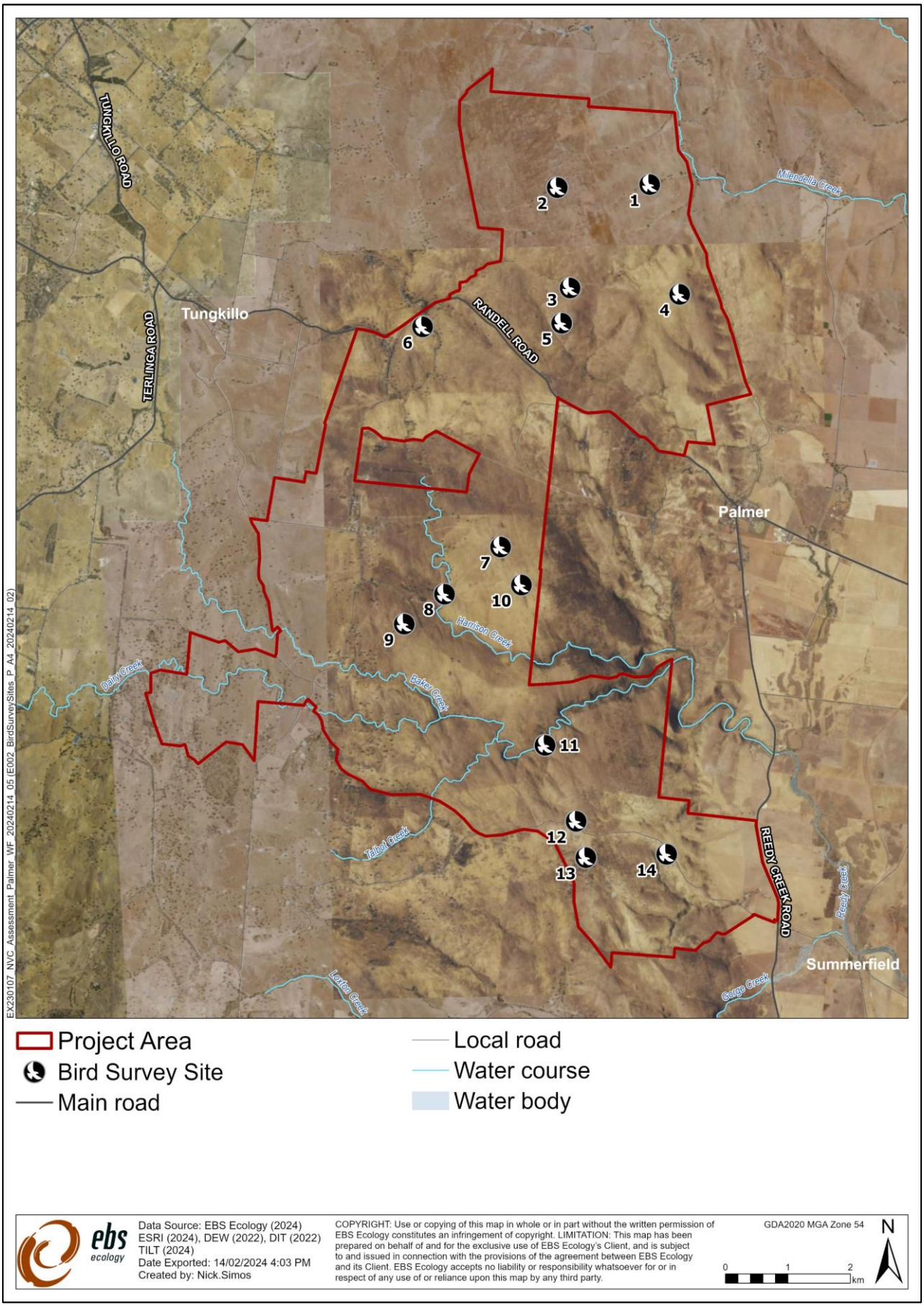


Figure 2. Location of the bird utilisation survey sites within the Varied Project Area.

3.3.2. Targeted Peregrine Falcon nest searches

In 2013, four Peregrine Falcon (*Falco peregrinus*) nests were identified during targeted surveys for nesting locations and their breeding status was investigated. Rocky crevices and ledges situated in gullies were searched as potential nest locations. In the October 2022 survey, known locations of Peregrine Falcon nests in the south of the Varied Project Area were revisited to determine the presence of breeding Peregrine Falcons. One pair of Peregrine Falcons were identified nesting within the Varied Project Area, near the location of previously identified nest sites. The location of Peregrine Falcon nests within the Varied Project Area are mapped in Figure 7.

In addition, in January 2023 suitable nesting habitat for Peregrine Falcons was initially defined via aerial imagery, after which field assessments were undertaken to ground truth the extent of suitable Peregrine Falcon nesting habitat based on known nesting preferences.

3.3.3. Opportunistic fauna

All native and exotic vertebrate fauna species opportunistically encountered during the field survey (directly observed, or tracks, scats, burrows, nests, and other signs of presence) were recorded across the Varied Project Area. Potential fauna refuge sites, such as hollows, rock crevices and creek lines were noted as an indication of availability of suitable habitat. Particular attention was given to identifying potential habitat for threatened species. For each opportunistic fauna observation, the species, number of individuals, GPS location, detection methodology (sight, sound, or sign) and habitat were recorded.

3.4. Limitations

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

BDBSA flora and fauna records were limited to a 5 km buffer around the Varied Project Area. The reliability of the BDBSA data ranges from 100 m to over 100 km. Fauna species, in particular birds, can traverse distances more than the 5 km search buffer, and therefore, additional species may occur.

Targeted surveys along the entire disturbance area have not been undertaken, as such, listed threatened plant species may occur in the design footprint.

The findings and conclusions expressed by EBS Ecology are based solely upon information in existence at the time of the assessment.

3.4.1. Spatial data limitations

All spatial data has been captured or converted to the following coordinate reference system.

Datum: Geocentric Datum of Australia 2020 (GDA2020).

Projection: Map Grid of Australia 2020 (MGA2020), Zone 54.

All location coordinates listed in this report are expressed using this system. Spatial data converted from other coordinate reference systems may have accuracy limitations.

4. ASSESSMENT OUTCOMES

4.1. Vegetation assessment

4.1.1. General description of the vegetation, the site and matters of significance

Vegetation association summary

Thirteen broad vegetation associations were identified across the survey area; four were associated with Area B and 10 vegetation associations were present within Area C (Table 6). *Austrostipa* sp. grassland and *Eucalyptus* spp. woodland were the most dominant vegetation associations across the Varied Project Area. These were determined by undertaking BAM surveys across the Varied Project Area to determine vegetation present across Areas B and C.

The location of the vegetation associations in Areas B and C, of the Varied Project Area, is mapped in Figure 3. Each of the vegetation associations is further described in Table 6 to Table 15.

Table 6. Vegetation associations identified within the Varied Project Area.

Ass. #	Vegetation association	Area		Clearance
		B	C	area (ha)
B2	*Austrostipa* sp. grassland with mixed exotic forbs and grasses	✓		143.69
B3	*Eucalyptus camaldulensis* creek line with *Cyperus gymnocaulos*	✓		0.957
B4	*Eucalyptus camaldulensis* and *Allocasuarina verticillata* open woodland over exotic grasses and forbs	✓		18.04
C1	*Lomandra effusa* with *Austrostipa* sp. grassland and exotic mixed exotics		✓	0
C2	*Austrostipa* sp. grassland with mixed exotic forbs and grasses		✓	157.60
C3	*Eucalyptus camaldulensis* over *Cyperus gymnocaulos*		✓	2.14
C4	*Eucalyptus camaldulensis* woodland over *Acacia pycnantha* shrubland and *Austrostipa* sp.		✓	2.35
C5	*Eucalyptus fasciculosa* open woodland over *Austrostipa* sp.		✓	15.36
C6	*Eucalyptus fasciculosa* open woodland with *Dodonaea viscosa* and *Acacia euthycarpa* shrubland over *Austrostipa* sp.		✓	9.76
C7	*Xanthorrhoea quadrangulata* grassland with *Austrostipa* sp.		✓	0
C8	*Ficinia nodosa* with *Juncus subsecundus* and *Cyperus gymnocaulos* sedgeland		✓	1.03
C9	*Acacia euthycarpa* tall shrubland over *Austrostipa* sp.		✓	0
C10	*Eucalyptus odorata* mallee woodland over *Austrostipa* sp.		✓	0

The Varied Project Area encompasses parts of the Marne and Saunders catchments, with a number of ephemeral creek lines running through the area. These are considered tributaries of the River Murray and are included within the River Murray Protection Area (River Murray Act 2003). Surface and groundwater resources within the Varied Project Area fall

within the Marne Saunders and Eastern Mount Lofty Ranges Prescribed Water Resource Areas. Some small surface water bodies are within Area C, mostly within the lower section (DEW 2013b). Reedy Creek occurs within the Varied Project Area, in the eastern corner of Area C and Reedy Creek Swamp is located approximately 6-10 km east of Area C, which is located next to the River Murray.

4.1.2. Details of the vegetation associates proposed to be impacted

Table 7. Summary of VA B2.

<table>
<tr><td>Vegetation Association</td><td colspan="5">Austrostipa sp. grassland with mixed exotic forbs and grasses</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">MDBSA 9.1 Woodlands with an Open Grassy Understorey</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">The quality of grassland fluctuates throughout the Varied Project Area with many areas dominated by exotic grasses such as Bearded Oat. These areas largely contain embedding rock.</td></tr>
<tr><td colspan="2">Over storey</td><td colspan="2">Mid storey</td><td>Under storey</td></tr>
<tr><td colspan="2">n/a</td><td colspan="2">n/a</td><td>Austrostipa sp. (Spear-grass)
Avena barbata (Bearded Oat)
Arctotheca calendula (Cape Weed)
Cynara cardunculus ssp. flavescens (Artichoke Thistle)
Echium plantagineum (Salvation Jane)
Hordeum vulgare (Barley)
Marrubium vulgare (Horehound)</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">Grasslands may be used by some threatened species such as for foraging by Little Eagles and Peregrine Falcons.</td></tr>
<tr><td>Landscape context score</td><td>1.19</td><td>Vegetation Condition Score</td><td>2.53</td><td>Conservation significance score</td><td>1.10</td></tr>
<tr><td>Unit biodiversity Score</td><td>3.31</td><td>Area (ha)</td><td>143.6872</td><td>Total biodiversity Score</td><td>474.92</td></tr>
</table>

Table 8. Summary of VA B3.

Vegetation Association	*Eucalyptus camaldulensis* riparian very open woodland with *Cyperus gymnocaulos*				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description	Ephemeral creeks				
	Over storey		**Mid storey**		**Under storey**
	Eucalyptus camaldulensis (River Red Gum)		*Cyperus gymnocaulos* (Spiny Flat sedge) *Maireana aphylla* (Cottonbush)		*Austrostipa* sp. (Spear-grass) *Poa* sp. (Meadow-grass)
Threatened species or community	Tree lined creek lines may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail, raptors and Southern Bell Frog (when water is present). No threatened plant species have been observed within the creek lines. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.				
Landscape context score	1.19	**Vegetation Condition Score**	16.91	**Conservation significance score**	1.10
Unit biodiversity Score	22.14	**Area (ha)**	0.9565	**Total biodiversity Score**	21.18

Table 9. Summary of VA B4.

Vegetation Association	*Eucalyptus camaldulensis* and *Allocasuarina verticillata* very open woodland over exotic grasses and forbs.				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description	With embedded rock				
	Over storey		**Mid storey**		**Under storey**
	Allocasuarina verticillata (Drooping Sheoak) *Eucalyptus camaldulensis ssp*. (River Red Gum)		*Cyperus gymnocaulos* (Spiny Flat sedge)		*Austrostipa* sp. (Spear-grass) *Rumex* sp. (Dock)
Threatened species or community	Treed areas may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail and raptors. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.				
Landscape context score	1.19	**Vegetation Condition Score**	13.08	**Conservation significance score**	1.10
Unit biodiversity Score	17.12	**Area (ha)**	18.04	**Total biodiversity Score**	308.87

Table 10. Summary of VA C2.

<table>
<tr><td>Vegetation Association</td><td colspan="5">Austrostipa sp. grassland over mixed exotic forbs and grasses</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">MDBSA 9.1 Woodlands with an Open Grassy Understorey</td></tr>
<tr><td colspan="6"> </td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">Mixture of higher quality grasslands and poor quality (minimal species diversity) grasslands throughout Area C.</td></tr>
<tr><td colspan="2">Over storey</td><td colspan="2">Mid storey</td><td>Under storey</td></tr>
<tr><td colspan="2">n/a</td><td colspan="2">n/a</td><td>Austrostipa nitida (Balcarra Spear-grass)
Austrostipa scabra (Falcate-awn Spear-grass)
Rytidosperma sp. (Wallaby-grass)
Themeda triandra (Kangaroo Grass)
Bulbine bulbosa (Bulbine Lily)
Chloris sp. (Windmill Grass)
Enneapogon nigricans (Black-head Grass)
Lomandra effusa (Scented Mat-rush)
Arthropodium strictum (Chocolate lily)</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">Grasslands may be used by some threatened species such as for foraging by Little Eagles and Peregrine Falcons.</td></tr>
<tr><td>Landscape context score</td><td>1.19</td><td>Vegetation Condition Score</td><td>2.29</td><td>Conservation significance score</td><td>1.10</td></tr>
<tr><td>Unit biodiversity Score</td><td>3.99</td><td>Area (ha)</td><td>157.5961</td><td>Total biodiversity Score</td><td>629.195</td></tr>
</table>

Table 11. Summary of VA C3.

Vegetation Association	*Eucalyptus camaldulensis* over *Cyperus gymnocaulos*				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description	Ephemeral creeks				
	Over storey		**Mid storey**	**Under storey**	
	Eucalyptus camaldulensis ssp. (River Red Gum)			*Cyperus gymnocaulos* (Spiny Flat sedge) *Phragmites australis* (Common Reed)	
Threatened species or community	Tree lined creek lines may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail, raptors and Southern Bell Frog (when water is present). No threatened plant species have been observed within the creek lines. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.				
Landscape context score	1.19	**Vegetation Condition Score**	15.57	**Conservation significance score**	1.10
Unit biodiversity Score	20.38	**Area (ha)**	2.1425	**Total biodiversity Score**	43.66

Table 12. Summary of VA C4.

Vegetation Association	*Eucalyptus camaldulensis* woodland over *Acacia pycnantha* shrubland and *Austrostipa sp.*
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey





General description	**Over storey**	**Mid storey**	**Under storey**
	Eucalyptus camaldulensis ssp. (River Red Gum)	*Acacia pycnantha* (Golden Wattle)	*Acaena novae-zelandiae* (Biddy-biddy) *Arthropodium strictum* (Common Vanilla-lily) *Austrostipa puberula* (Fine-hairy Spear-grass) *Austrostipa sp.* (Spear-grass) *Bulbine bulbosa* (Bulbine-lily) *Calostemma purpureum* (Pink Garland-lily) *Drosera peltata str.* (Swamp Sundew) *Kennedia prostrata* (Scarlet Runner) *Lomandra collina* (Sand Mat-rush) *Vittadinia gracilis* (Woolly New Holland Daisy)
Threatened species or community	Tree areas may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail and raptors. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.		

Landscape context score	1.19	**Vegetation Condition Score**	32.65	**Conservation significance score**	1.10
Unit biodiversity Score	42.74	**Area (ha)**	2.354	**Total biodiversity Score**	100.62

Table 13. Summary of VA C5.

Vegetation Association	*Eucalyptus fasciculosa* very open woodland over *Austrostipa sp.*				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description					
	Over storey		**Mid storey**	**Under storey**	
	Eucalyptus fasciculosa (Pink Gum)		*Maireana aphylla* (Cotton-bush)	*Arthropodium sp.* (Vanilla-lily) *Austrostipa sp.* (Spear-grass) *Crassula alata var. alata* (Three-part Crassula) *Euphorbia drummondii* group (Spurge) *Iseilema sp.* (Flinder's-grass) *Oxalis perennans* (Native Sorrel) *Vittadinia blackii* (Narrow-leaf New Holland Daisy)	
Threatened species or community	*Eucalyptus fasciculosa* (Pink Gum) (State rare). Tree areas may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail and raptors. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.				
Landscape context score	1.19	**Vegetation Condition Score**	18.56	**Conservation significance score**	1.14
Unit biodiversity Score	25.18	**Area (ha)**	15.36	**Total biodiversity Score**	386.81

Table 14. Summary of VA C6.

Vegetation Association	*Eucalyptus fasciculosa* open woodland with *Bursaria spinosa* over exotic grasses.				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description					
	Over storey		**Mid storey**	**Under storey**	
	Acacia euthycarpa (Wallowa) *Eucalyptus fasciculosa* (Pink Gum)		*Dodonaea viscosa* ssp. (Sticky Hop-bush) *Enchylaena tomentosa* var. (Ruby Saltbush) *Olearia axillaris* (Coast Daisy-bush)	*Amyema miquelii* (Box Mistletoe) *Aristida behriana* (Brush Wire grass) *Arthropodium strictum* (Common Vanilla-lily) *Austrostipa* sp. (Spear-grass) *Cheilanthes austrotenuifolia* (Annual Rock-fern) *Convolvulus angustissimus* (Narrow-leaf Bindweed) *Drosera peltata str*. (Swamp Sundew) *Enneapogon nigricans* (Black-head Grass) *Eutaxia* sp. (Eutaxia) *Goodenia pusilliflora* (Small-flower Goodenia) *Rytidosperma* sp. (Wallaby-grass) *Scaevola* sp. (Fanflower) *Vittadinia cuneata* var. (Fuzzy New Holland Daisy) *Wahlenbergia* sp. (Native Bluebell)	
Threatened species or community	*Eucalyptus fasciculosa* (Pink Gum) (State rare). Tree areas may be used by a number of threatened fauna species including Southern Whiteface, Hooded Robin, Elegant Parrot, Diamond Firetail and raptors. Hollows in the remnant River Red Gums may be used by Common Brushtail Possums.				
Landscape context score	1.19	**Vegetation Condition Score**	1.91	**Conservation significance score**	1.14
Unit biodiversity Score	2.59	**Area (ha)**	9.757	**Total biodiversity Score**	85.83

Table 15. Summary of VA C8.

Vegetation Association	*Ficinia nodosa* with *Juncus subsecundus* and *Cyperus gymnocaulos* sedgeland				
Benchmark Community	MDBSA 9.1 Woodlands with an Open Grassy Understorey				
					
General description	Sedgeland and associated dams may provide habitat for the Southern Bell Frog.				
	Over storey		**Mid storey**	**Under storey**	
	n/a		*Cyperus* sp. (Flat-sedge) *Cyperus gymnocaulos* (Flat-Sedge) *Ficinia nodosa* (Knobby Club-rush) *Juncus* sp. (Rush)	*Aristida behriana* (Brush Wire grass) *Austrostipa nitida* (Balcarra Spear-grass) *Austrostipa* sp. (Spear-grass) *Cheilanthes austrotenuifolia* (Annual Rock-fern) *Convolvulus angustissimus* (Narrow-leaf Bindweed) *Cymbopogon ambiguous* (Lemon-grass) *Enneapogon nigricans* (Black-head Grass) *Rytidosperma* sp. (Wallaby-grass) *Vittadinia blackii* (Narrow-leaf New Holland Daisy) *Vittadinia cuneata* var. (Fuzzy New Holland Daisy)	
Threatened species or community	Sedgeland and associated dams may provide habitat for the Southern Bell Frog.				
Landscape context score	1.19	**Vegetation Condition Score**	25.19	**Conservation significance score**	1.10
Unit biodiversity Score	32.97	**Area (ha)**	1.03	**Total biodiversity Score**	34.12

4.1.3. Site map showing areas of proposed impact

Native vegetation under application and the proposed impact of the Project are shown on the map in Figure 3.

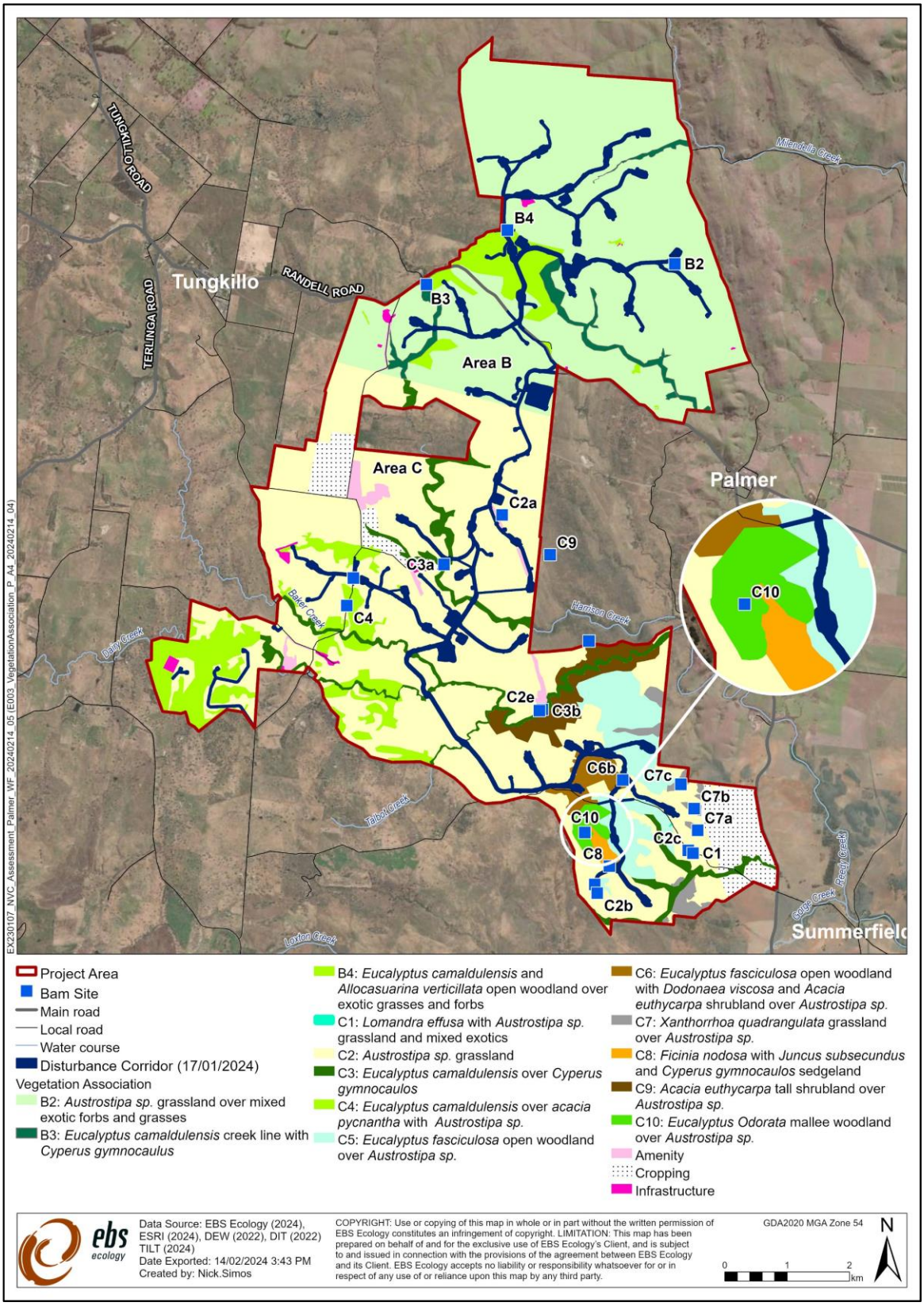


Figure 3. Native Vegetation under application and the proposed impact of the Project, separated by Area B and Area C. Project designs provided by proponent on 24 January 2024.

4.2. Threatened Ecological Communities

The database searches indicated that Five TEC might occur within the Search Area (see Table 6 page 21).

Vegetation in the Varied Project Area has been assessed against the definitions of each TEC identified in Table 16. The assessment found that one TEC occurs in the Varied Project Area:

- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia – Critically Endangered

However, the Project is avoiding clearance in this TEC, therefore no direct clearance will occur.

Table 16. Assessment for the presence of TECS in the Varied Project Area.

Threatened Ecological Community	Conservation Status	Definition	Assessment
Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (PBGW)	Critically Endangered	PBGW is restricted to SA and consists of an open to dense woodland dominated by *Eucalyptus odorata* and typically occurs with other tree species including *E. leucoxylon, E. microcarpa* or *E. porosa*. Canopy height comprises low trees, generally 5-10 m tall with an understorey comprised of diverse grasses and herbs including *Austrostipa* sp., *Lomandra* sp. and *Acacia pycnantha* (DEWHA 2008b; Turner 2012). This TEC can be categorised under three different condition classes (A, B and C), based on remnant patch size and native species diversity and composition. Class C does not make up the TEC but is of sufficient biodiversity value to target for restoration (DEWR 2007; Turner 2012).	Present – relevant vegetation present in the Varied Project Area, current designs will not have any infrastructure or WTG impacting on the vegetation.
Iron-grass Natural Temperate Grassland of South Australia (INTG)	Critically Endangered	INTG is endemic to SA and consists of tussock-forming perennial grasses, Iron-grasses (*Lomandra effusa* and/or *L. multiflora* ssp. *dura)* and a low presence (<10%) of trees and tall shrubs (DEWR 2007; Turner 2012). This TEC can be categorised under three different condition classes (A, B and C), based on patch size, native species diversity and composition, and tussock density. Class A and Class B, make up this TEC, while Class C does not make up the TEC but is of sufficient biodiversity value to target for	Absent – suitable vegetation present in the Varied Project Area, but the vegetation was assessed as C class Lomandra sp. grassland and as such is not considered the TEC.

Threatened Ecological Community	Conservation Status	Definition	Assessment
		restoration (DEWR 2007; Turner 2012, DEWHA 2008b).	
Mallee Bird Community (MBC) of the Murray Darling Depression Bioregion	Endangered	A fauna community found in the Murray Darling Depression (MDD) bioregion comprising an assemblage of 20 bird species that are dependent on the mallee vegetation that characterises the bioregion. Criteria for listing includes being within the MDD, containing at least 5 ha dominated by mallee habitats and at least 3 MBC bird species recorded within 20 km in the last 10 years (DAWE 2021a).	Absent – outside of the range of this TEC.
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Woodland communities where Buloke (*Allocasuarina luehmannii*) is the dominant or co-dominant tree species. Co-dominant species include *Callitris gracilis*, *Callitris glaucophylla*, *Eucalyptus largiflorens*, *Eucalyptus leucoxylon* ssp. *pruinosa* and *Eucalyptus microcarpa*. In SA, the community is only known from the Bordertown district (Cheal, Lucas, & Macaulay 2011).	Absent – no relevant vegetation present within the Varied Project Area.
Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions.	Critically Endangered	The dominant tree species is either *Eucalyptus porosa, Eucalyptus behriana* or *Eucalyptus dumosa* (depending on location). Other species of Eucalyptus commonly co-occur. The overstorey canopy is generally sparse or open (10-15%) and the mid and understorey also tend to be sparse. A low chenopod sub-shrub layer can be a key feature in this community as well as the dominance of tussock grasses in the ground layer (although this is drought dependent). In South Australia, this TEC occurs within the Murray Darling Depression and Naracoorte Coastal Plain IBRA bioregions.	Absent – outside of the range of this TEC.

4.3. Threatened species assessment

4.3.1. Threatened flora

EPBC Act

Nine (9) threatened flora species listed under the EPBC Act were identified by the PMST as potentially occurring within 5 km of the Varied Project Area (Table 17).

Of these, eight threatened flora species have been assessed as possibly occurring within the Varied Project Area:

- Menzel's Wattle (*Acacia menzelii*) (EPBC Act: Vulnerable; NPW Act: Vulnerable);
- Neat Wattle (*Acacia rhetinocarpa*) (EPBC Act: Vulnerable; NPW Act: Vulnerable);
- White-beauty Spider-orchid (*Caladenia argocalla*) (EPBC Act: Endangered; NPW Act: Endangered);
- Greencomb Spider-orchid (*Caladenia tensa*) (EPBC Act: Endangered);
- Trailing Hop-bush (*Dodonaea procumbens*) (EPBC Act: Vulnerable; NPW Act: Vulnerable);
- Clover Glycine (*Glycine latrobeana*) (EPB Act: Vulnerable; NPW Act: Vulnerable);
- Silver Daisy-bush (*Olearia pannosa* ssp. *pannosa*) (EPBC Act: Vulnerable; NPW Act: Vulnerable); and
- Pale Leek-orchid (*Prasophyllum pallidum*) (EPBC Act: Vulnerable; NPW Act: Rare).

The remaining species was assessed as unlikely to occur in the Varied Project Area due to the absence of suitable habitat (Table 17).

Database records of EPBC listed flora species are mapped in Figure 4.

The full flora likelihood assessment with the rational for the likelihood of occurrence in the Varied Project Area is provided in Appendix 3.

NPW Act

One threatened species was identified as occurring within the Varied Project Area:

- *Eucalyptus fasciculosa* (Pink Gum) (NPW: Rare).

An additional Fourteen (14) threatened flora species listed under the NPW Act (that are not listed under the EPBC Act) were identified by the BDBSA as potentially occurring within 5 km of the Varied Project Area (Table 17). Of these, three threatened flora species have been assessed as highly likely / likely to occur within the Varied Project Area:

- *Ptilotus erubescens* (Hairy-tails) (NPW: Rare);
- *Mentha diemenica* (Slender Mint) (NPW: Rare); and
- *Maireana rohrlachii* (Rohrlach's Bluebush) (NPW: Rare).

Nine (9) threatened flora species were assessed as possibly occurring and are shown in Table 17. The remaining three species were assessed as being unlikely to occur in the Varied Project Area due to the absence of suitable habitat and / or the Varied Project Area occurring outside of the known range of the species.

Database records of State listed flora species are mapped in Figure 4. The full likelihood assessment with the rationale for the likelihood of occurrence in the Varied Project Area is provided in Appendix 3.

Table 17. Likelihood of occurrence of threatened species identified in the desktop assessment. The data source and threat levels are described in the table footer.

Scientific Name	Common Name	Conservation status		Data Source	Last Sighting (year)	Likelihood of Occurrence in Varied Project Area
		EPBC Act	NPW Act			
Acacia iteaphylla	Flinders Ranges Wattle		R	2	2021	**Possible**
Acacia menzelii	Menzel's Wattle	VU	V	1,2	Likely to occur / 1980	**Possible**
Acacia rhetinocarpa	Neat Wattle	VU	V	1,2	Likely to occur / 1989	**Possible**
Austrostipa gibbosa	Swollen Spear-grass		R	2	2013	**Possible**
Austrostipa oligostachya	Fine-head Spear-grass		E	2	2010	**Possible**
Bothriochloa macra	Red-leg Grass		R	2	2022	**Possible**
Caladenia argocalla	White-beauty Spider-orchid	EN	E	1,2	Known to occur / 2022	**Possible**
Caladenia stellata	Star Spider-orchid		R	2	1995	**Unlikely**
Caladenia tensa	Greencomb Spider-orchid	EN		1	Known to occur	**Possible**
Centrolepis cephaloformis ssp. *cephaloformis*	Cushion Centrolepis		R	2	2010	**Unlikely**
Dianella longifolia var. *grandis*	Pale Flax-lily		R	2	2015	**Unlikely**
Dodonaea procumbens	Trailing Hop-bush	VU	V	1	Likely to occur	**Possible**
Eryngium ovinum	Blue Devil		V	2	2013	**Possible**
Eucalyptus fasciculosa	Pink Gum		R	2	2022	**Highly Likely / Known**
Glycine latrobeana	Clover Glycine	VU	V	1	Likely to occur	**Possible**
Hypericum japonicum	Matted St John's Wort		R	2	2017	**Possible**
Lachnagrostis robusta	Tall Blown-grass		R	2	2003	**Possible**
Maireana rohrlachii	Rohrlach's Bluebush		R	2	2022	**Highly likely / known**
Mentha diemenica	Slender Mint		R	3	2013	**Likely**
Olearia pannosa ssp. *pannosa*	Silver Daisy-bush	VU	V	1,2	Known to occur / 2007	**Possible**

Scientific Name	Common Name	Conservation status		Data Source	Last Sighting (year)	Likelihood of Occurrence in Varied Project Area
		EPBC Act	NPW Act			
Olearia passerinoides ssp. *glutescens*	Sticky Daisy-bush		R	2	2010	**Possible**
Prasophyllum pallidum	Pale Leek-orchid	VU	R	1,2	Likely to occur / 2022	**Possible**
Ptilotus erubescens	Hairy-tails		R	2	2010	**Likely**
Veronica derwentiana subsp. homalodonta	Mount Lofty Speedwell	CE	E	1	Likely to occur	**Unlikely**

Conservation status

EPBC Act: (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act** (*National Parks and Wildlife Act 1972*). **Conservation Codes**: **CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare. **ssp**.: the conservation status applies at the sub-species level. **Mi**: listed as migratory under the EPBC Act. **Ma**: listed as marine under the EPBC Act.

Source of Information

1. EPBC Act Protected Matters Report (DCCEEW 2023) – 5 km buffer applied to Varied Project Area.
2. Biological Database of South Australia data extract (DEW 2023a) (Recordset number DEWNRBDBSA230614-1) - 5 km buffer applied to Varied Project Area.
3. EBS Ecology (2014). Flora and Fauna Report. Report to Trust Power. EBS Ecology, Adelaide. – past field surveys undertaken by EBS nearby and in the Varied Project Area.

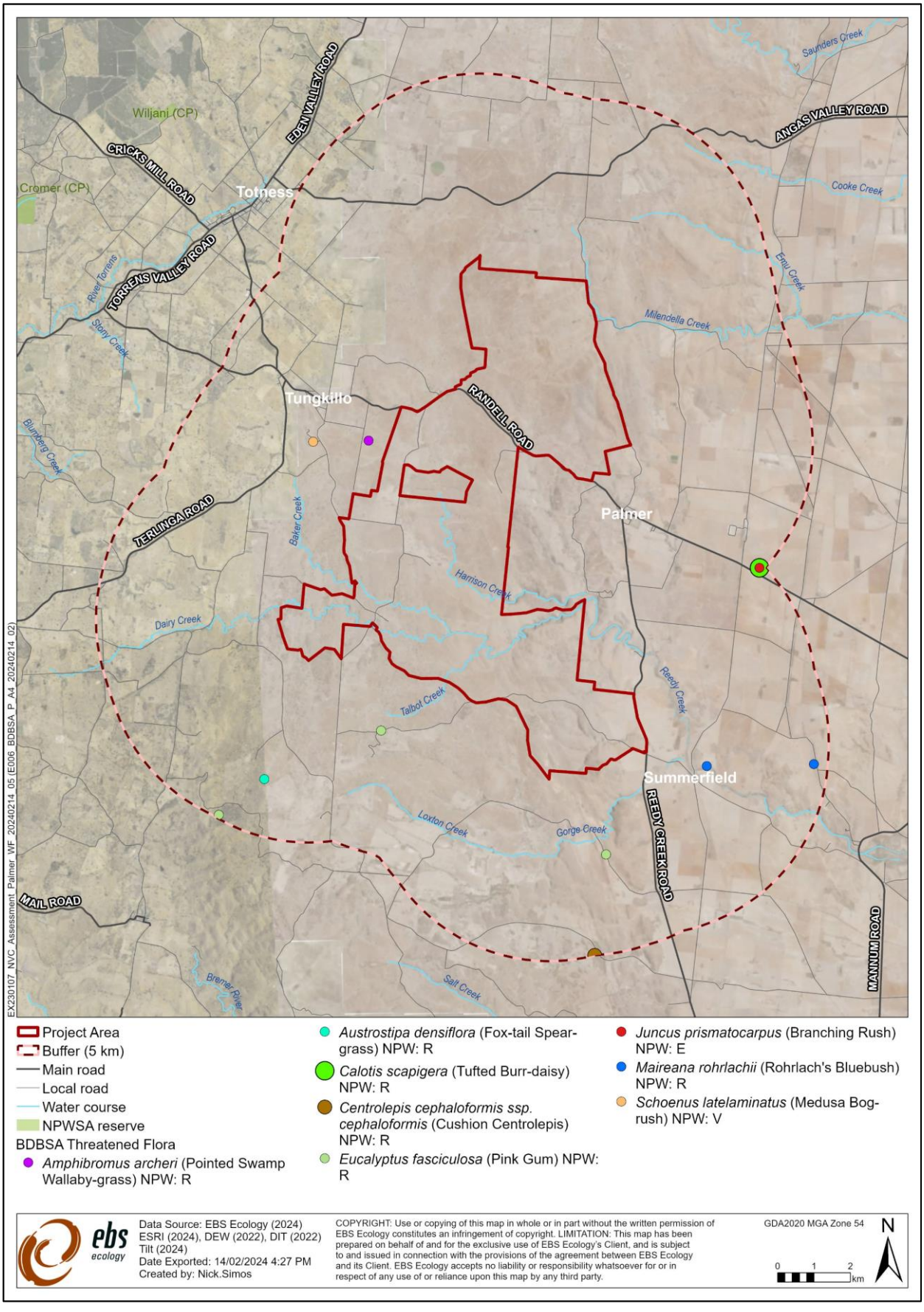


Figure 4. Nationally and State threatened flora identified within the Search Area (DEW 2023a).

4.3.2. Threatened fauna

Six threatened fauna species were recorded during the surveys that have been undertaken at PWF:

- White-bellied Cuckooshrike (*Coracina papuensis robusta*) (NPW Act: Rare) (observed in 2022);
- Peregrine Falcon (*Falco peregrinus)* (NPW Act: Rare) (observed in 2013 and 2023);
- White-winged Chough (*Corcorax melanorhamphos*) (NPW Act: Rare) (observed in 2013);
- Diamond Firetail (*Stagonopleura guttata*) (EPBC Act: Vulnerable; NPW Act: Vulnerable) (observed in 2013 and 2022/23);
- Southern Whiteface (*Aphelocephala leucopsis leucopsis*) (EPBC Act: Vulnerable) (observed in 2013 and 2022/23); and
- Elegant Parrot (*Neophema elegans elegans*) (NPW Act: Rare) (observed in 2013 and 2022/23).

In the 2022/2023 surveys two Diamond Firetails were observed in woodland in the south of the Varied Project Area and eight were observed in Bakers Gorge in the south. Southern Whiteface were observed throughout the Varied Project Area with 33 recorded during the BUS surveys in closed woodland, open woodland and grassland. Thirty-three Elegant Parrots were observed in woodlands, amenity plantations and grassland. One Peregrine Falcon was observed nesting in Bakers Gorge and one White-bellied Cuckooshrike was observed in the Peppermint Box woodland in the south of the Varied Project Area. White-winged Choughs were not observed in the Varied Project Area in the 2022/2023 surveys, but were observed in 2013 in woodland in the north of the Varied Project Area.

EPBC Act

Fifteen (15) threatened fauna species listed under the EPBC Act were identified by the PMST as potentially occurring within the Search Area (Table 18).

In addition to the above, two EPBC Act threatened species not observed on site were assessed as likely / highly likely to occur in the Varied Project Area, based on recent records and suitable habitat:

- Hooded Robin (*Melanodryas cucullata cucullata*) (EPBC Act: Endangered; NPW Act: Rare); and
- Grey-headed Flying-fox (*Pteropus poliocephalus*) (EPBC Act: Vulnerable; NPW Act: Rare).

An additional 4 EPBC Act listed threatened fauna species were assessed as possibly occurring in the Varied Project Area:

- Grey Falcon (*Falco hypoleucos*) (EPBC Act: Vulnerable; NPW Act: Rare);
- Blue-winged Parrot (*Neophema chrysostoma*) (EPBC Act: Vulnerable; NPW Act: Vulnerable);
- Latham's Snipe (*Gallinago hardwickii*) (EPBC Act: Vulnerable and Migratory);
- Common Greenshank (Tringa nebularia) (EPBC Act: Endangered and Migratory).

One species was listed as migratory and assessed as possibly occurring within the Varied Project Area:

- Fork-tailed Swift (*Apus pacificus*) (EPBC Act: Migratory); and

The remaining six EPBC Act listed fauna species were assessed as unlikely to occur in the Varied Project Area due to the absence of suitable habitat or the Varied Project Area is outside of the species range.

The full fauna likelihood assessment with the rational for the likelihood of occurrence in the Varied Project Area is provided in Appendix 3.

NPW Act

An additional sixteen (16) threatened fauna species listed under the NPW Act were identified by the desktop as potentially occurring within the Search Area (Table 18).

Of these, four have been listed above and an additional five (5) threatened fauna species were assessed as known / highly likely / likely to occur based on recent records, observations, and suitable habitat within the Varied Project Area:

- Eastern Shriketit (*Falcunculus frontatus* spp. *frontatus*) (NPW Act: Rare);
- Little Eagle (*Hieraaetus morphnoides*) (NPW Act: Vulnerable);
- Jacky Winter (*Microeca fascinans fascinans*) (NPW Act: Rare);
- Painted Buttonquail (*Turnix varius* ssp. *varius*) (NPW Act: Rare); and
- Common Brushtail Possum (*Trichosurus vulpecula*) (NPW act: Rare).

An additional seven (7) State threatened fauna species were assessed as possibly occurring within the Varied Project Area (Table 18).

Database records of EPBC and NPW Act listed fauna species are mapped in Figure 5 and Figure 6.

Table 18. Likelihood of occurrence of threatened fauna species identified in the desktop assessment. The data source and threat levels are described in the table footer.

Scientific Name	Common Name	Conservation status		Data Source	Last Sighting (year)	Likelihood of Occurrence in Varied Project Area
		EPBC Act	NPW Act			
BIRDS						
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU		1,2,3	Known to occur / 2020 (EBS Record)	**Known / Highly likely**
Apus pacificus	Fork-tailed Swift	Mi (M)		1,2	Likely to occur / 2014	**Possible**

Scientific Name	Common Name	Conservation status		Data Source	Last Sighting (year)	Likelihood of Occurrence in Varied Project Area
		EPBC Act	NPW Act			
Botaurus poiciloptilus	Australasian Bittern	EN	E	1,2	Known to occur / 2004	**Unlikely**
Coracina papuensis robusta	White-bellied Cuckooshrike		R	3	2022 (EBS record)	**Highly likely/Known**
Corcorax melanorhamphos	White-winged Chough		R	2	2020	**Highly likely/Known**
Coturnix ypsilophora australis	Brown Quail		V	2	2013	**Possible**
Egretta garzetta nigripes	Little Egret		R	2	2010	**Possible**
Falco hypoleucos	Grey Falcon	VU	R	1,2	Known to occur / 1964	**Possible**
Falco peregrinus	Peregrine Falcon		R	2,3	2022 (EBS record)	**Highly likely/Known**
Falcunculus frontatus ssp. *frontatus*	Eastern Shriketit		R	2	2014	**Likely**
Gallinago hardwickii	Latham's Snipe	Mi (W)	R	1	Likely to occur	**Possible**
Grantiella picta	Painted Honeyeater	VU	R	1	Likely to occur	**Unlikely**
Hieraaetus morphnoides	Little Eagle		V	2	2005	**Likely**
Lophoictinia isura	Square-tailed Kite		E	2	2013	**Possible**
Melanodryas cucullata cucullata	Hooded Robin	EN	R	1,2	Known to occur / 2020	**Likely**
Melithreptus gularis	Black-chinned Honeyeater		V	2	2008	**Possible**
Microeca fascinans fascinans	Jacky Winter (MLR, SE)		R	2	2017	**Likely**
Myiagra cyanoleuca	Satin Flycatcher	Mi (T)	E	1	Likely to occur	**Unlikely**
Myiagra inquieta	Restless Flycatcher		R	2	2017	**Possible**
Neophema elegans elegans	Elegant Parrot		R	2,3	2023 (EBS Record)	**Highly likely/Known**
Neophema chrysostoma	Blue-winged Parrot	VU, Ma	V	1,2	Likely to occur / 1999	**Possible**
Petroica boodang boodang	Scarlet Robin		R	2	1999	**Possible**
Rostratula australis	Australian Painted Snipe	EN	E	1	Likely to occur	**Unlikely**
Stagonopleura guttata	Diamond Firetail	VU	V	1,2,3	Known to occur / 2022	**Highly Likely/Known**

Scientific Name	Common Name	Conservation status		Data Source	Last Sighting (year)	Likelihood of Occurrence in Varied Project Area
		EPBC Act	NPW Act			
					(EBS Record	
Tringa nebularia	Common Greenshank	EN, Mi		1	Likely to occur	**Possible**
Turnix varius ssp. *varius*	Painted Buttonquail		R	1,2	2017	**Likely**
Zanda funerea whiteae	Yellow-tailed Black Cockatoo		V	1,2	2000	**Possible**
Zoothera lunulata ssp. *halmaturina*	South Australian Bassian Thrush Southern FR, MLR, KI	EN	V	1,2	Likely to occur / 2012	**Unlikely**
MAMMALS						
Pteropus poliocephalus	Grey-headed Flying-fox	VU	R	1,2	Likely to occur / 2020	**Likely**
Trichosurus vulpecula	Common Brushtail Possum		R	1,2	2002	**Likely**
REPTILES						
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1	Likely to occur	**Unlikely**

Conservation status

EPBC Act: (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act** (*National Parks and Wildlife Act 1972*). **Conservation Codes**: **CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare. **Mi**: listed as migratory under the EPBC Act. **Ma**: listed as marine under the EPBC Act.

Source of Information

1. EPBC Act Protected Matters Report (DCCEEW 2023) – 5 km buffer applied to Varied Project Area.
2. Biological Database of South Australia data extract (DEW 2023a) (Recordset number DEWNRBDBSA230614-1) - 5 km buffer applied to Varied Project Area.
3. Recorded during the field survey.

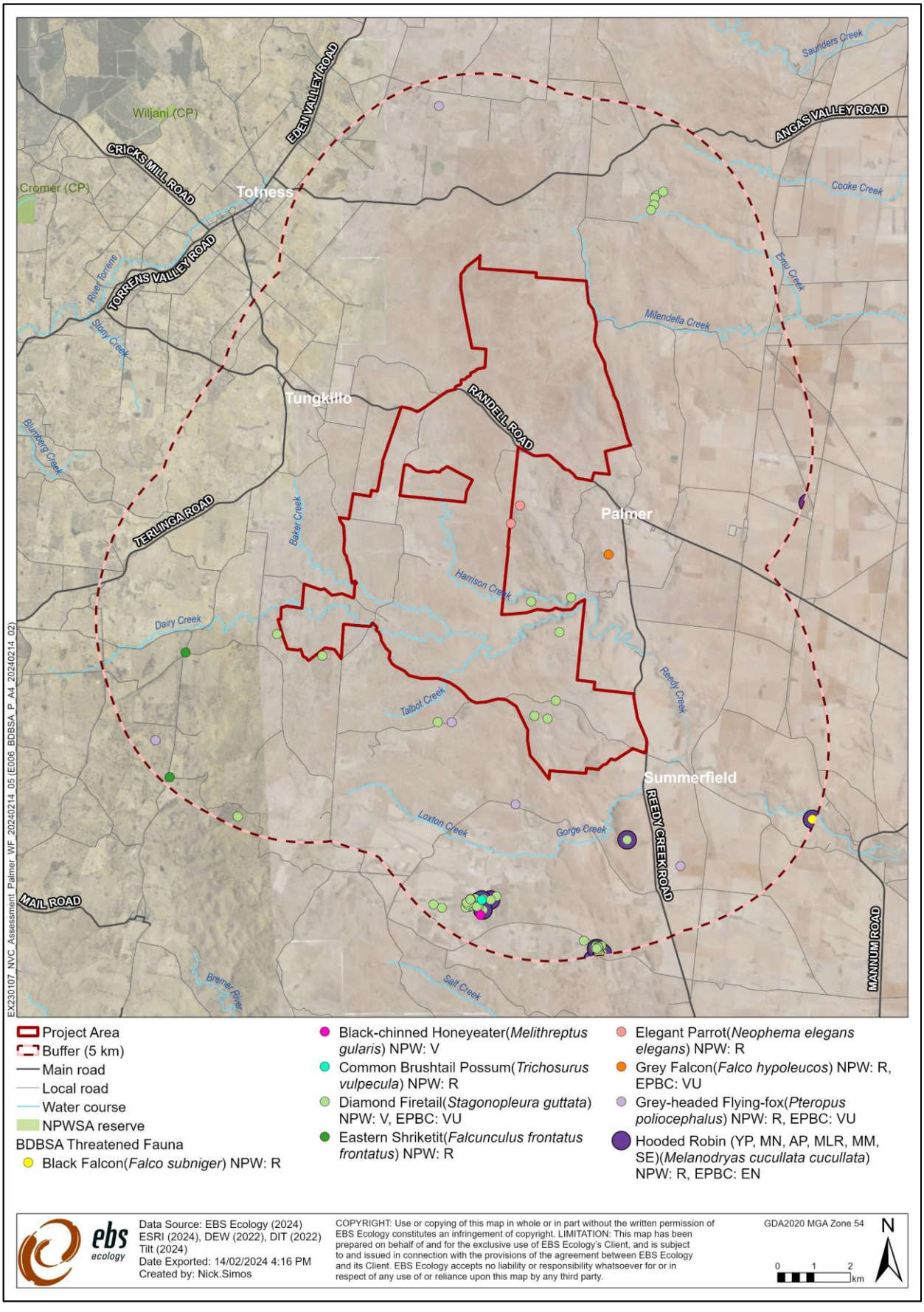


Figure 5. Nationally and State threatened fauna identified within 5 km of the Varied Project Area since 1995 (< 1 km reliability) (BDBSA Recordset number: DEWNRBDBSA230911-1) (DEW 2023a) (Map 1 of 3).

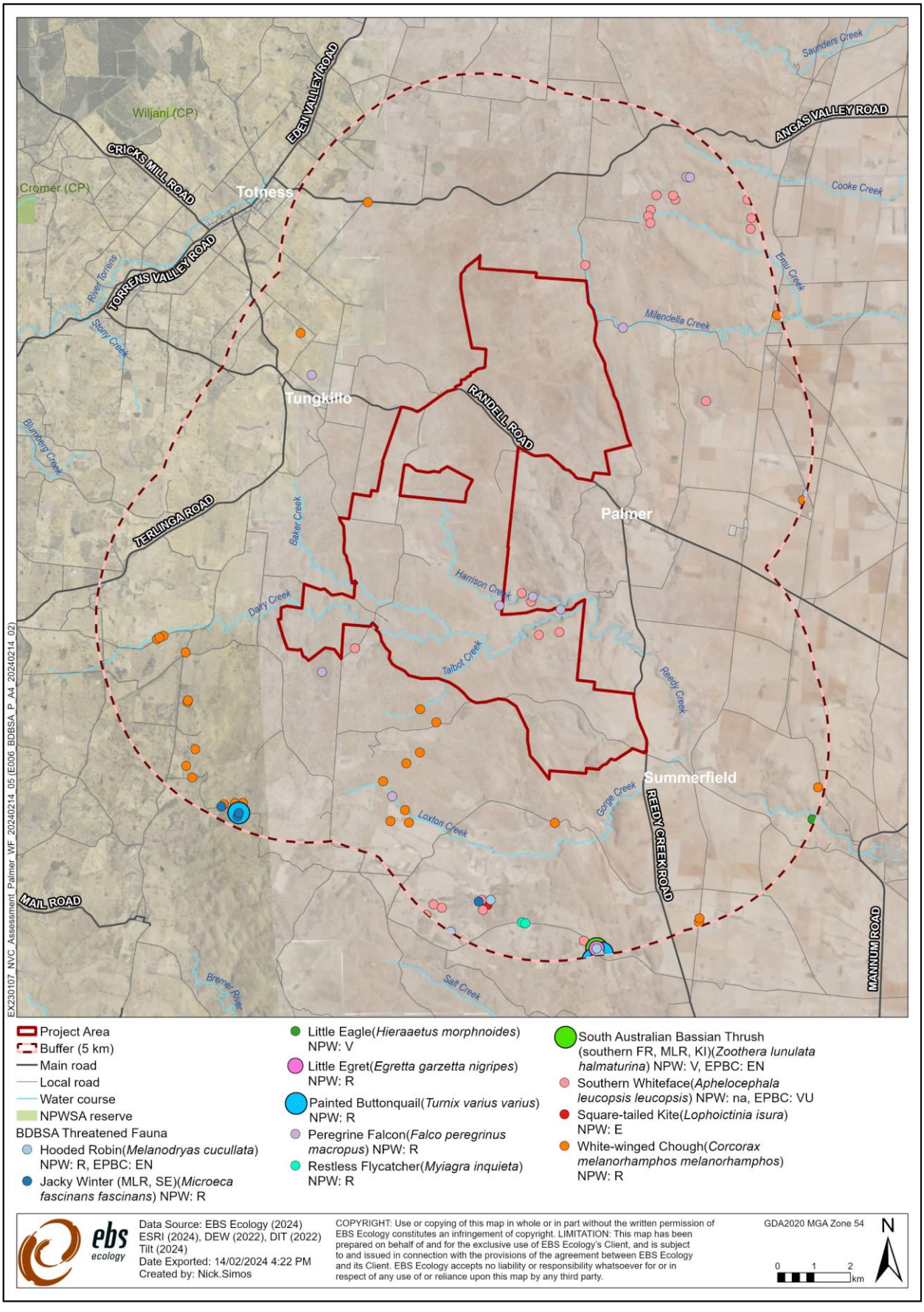


Figure 6. Nationally and State threatened fauna identified within 5 km of the Varied Project Area since 1995 (< 1 km reliability) (BDBSA Recordset number: DEWNRBDBSA230911-1) (DEW 2023a) (Map 2 of 3).

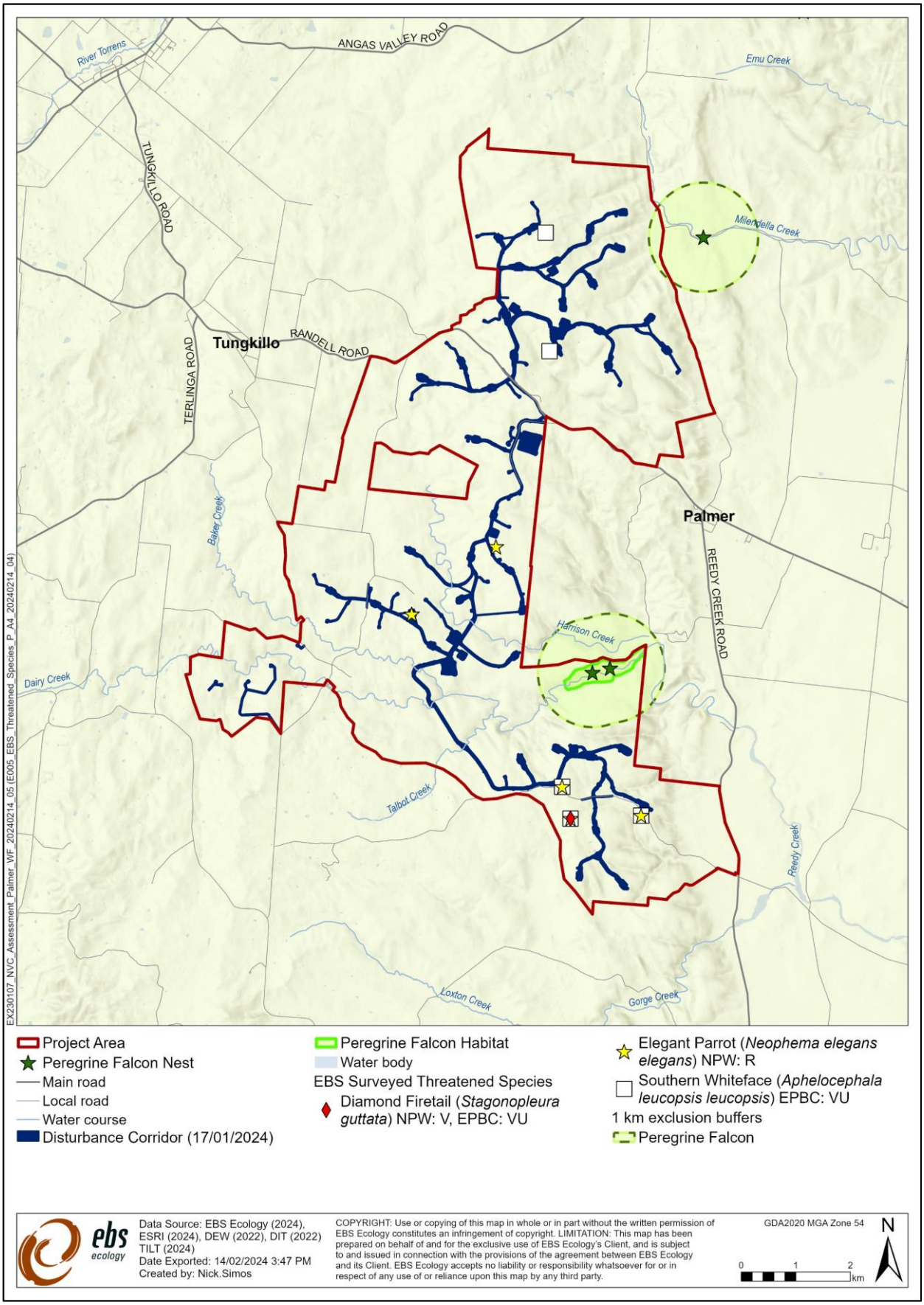


Figure 7. EBS records of threatened fauna species within the Varied Project Area and nesting habitat for Peregrine Falcons.

4.4. Cumulative impacts

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must consider the potential cumulative impact, both direct and indirect, that is reasonably likely to result from a proposed clearance activity.

Direct clearance

To calculate the impact to native vegetation, all infrastructure associated with PWF, including WTG sites, access tracks, cable routes and a construction compound has been mapped in Arc GIS and overlaid onto native vegetation association information. This includes all associated infrastructure and construction areas, such as turbine site hardstands, crane hardstands, stockpiles, batter slopes and construction compounds/laydown areas, which will require clearance of native vegetation.

Buffers have been applied within the design as described in Section 2.4.

Indirect clearance

Construction and operation of the Project has the potential to cause indirect impacts to native vegetation associated with construction machinery, dust, weeds, herbicide use, altered hydrology/stormwater drainage and potentially changes to local grazing regimes/levels. However, the construction contractor and wind farm operator will be required to implement a Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (respectively) to identify and document potential impacts to flora and fauna (and the environment in general) as well as the management measures that will be implemented to avoid, minimise, manage and mitigate these potential indirect impacts. In particular, as part of the CEMP, a *Flora and Fauna Management Plan* will be implemented to specifically address (avoid/minimise/manage/mitigate) potential impacts to flora and fauna.

4.5. Addressing the Mitigation Hierarchy

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must have regard to the mitigation hierarchy. The NVC will also consider, with the aim to minimize, impacts on biological diversity, soil, water and other natural resources, threatened species or ecological communities under the EPBC Act or listed species under the NPW Act.

a) Avoidance – outline measures taken to avoid clearance of native vegetation

All stages of the Project design have been undertaken considering vegetation mapping, TEC mapping and the known locations of threatened species populations. More than twenty iterations of project design have been undertaken, with many aimed at avoiding areas of high quality vegetation and known threatened flora and fauna. Whilst every effort has been made to avoid sensitive areas where possible, such as locating turbines outside of *Lomandra* spp.

grasslands and Peppermint Box grassy woodlands, engineering and landscape constraints mean that clearing of native vegetation cannot be completely avoided.

The size of the modern WTG's proposed for the PMWF require large proportionately sized hardstand and laydown areas to safely accommodate the storage, manoeuvring and assembly of the large WTG components.

b) Minimization – if clearance cannot be avoided, outline measures taken to minimize the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).

As far as is practicable, the development has been placed in areas with no native vegetation or avoided native vegetation in better condition or of higher conservation value. The majority of the clearance (301.28 ha) is located in the poorer quality grassland areas. The Varied Project Area has a long history of agriculture and the grassland and understorey is heavily degraded across the site. The best quality vegetation occurs in the gorges, which are being avoided. Good quality vegetation that has been avoided includes the following:

- TEC Iron-grass Natural Temperate Grassland of South Australia in good condition has been avoided.
- The TEC Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia has been avoided.
- Existing access tracks will be utilised wherever possible, noting the design and geometry requirements for the transportation of WTG components.

Where native vegetation cannot be avoided, Tilt will minimise impact to flora and fauna, including threatened species, and avoid over clearing by implementing their CEMP.

The Project will be referred under the EPBC Act for the following matters of national environmental significance:

- Diamond Firetail (*Stagonopleura guttata*) (EPBC Act: Vulnerable; NPW Act: Vulnerable);
- Southern Whiteface (*Aphelocephala leucopsis leucopsis*) (EPBC Act: Vulnerable); and
- Hooded Robin (*Melanodryas cucullata cucullata*) (EPBC Act: Endangered; NPW Act: Rare).

The Commonwealth Department of Climate Change, Energy, the Environment and Water may require further impact minimisation measures beyond the above. Once known, this information can be provided if required.

Where possible, existing tracks have been utilised, except for where deviations from the tracks will result in overall less clearance (given the size of the buffer currently on access tracks).

c) Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation.

The Project includes areas of both temporary and permanent vegetation clearance. Temporary clearance areas including standalone underground cabling (not co-located with access tracks), laydown areas and temporary construction compounds will be rehabilitated according to the strategies discussed in a CEMP.

Offset – any adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.

> *The NVC will only consider an offset once avoidance, minimization and restoration have been documented and fulfilled. The SEB Policy explains the biodiversity offsetting principles that must be met.*

The proponent will consider an on ground offset, however if this is not feasible the clearance will be offset via payment into the Native Vegetation Fund.

4.6. Principles of Clearance (Schedule 1, *Native Vegetation Act 1991*)

The Native Vegetation Council will consider Principles 1(b), 1(c) and 1(d) when assigning a level of Risk under Regulation 16 of the Native Vegetation Regulations. The Native Vegetation Council will consider all the Principles of clearance of the Act as relevant, when considering an application referred under the Planning, Development and Infrastructure Act 2016.

The clearance is assessed against the Principles of Clearance as set out in Table 19.

Table 19. Assessment against the Principles of Clearance.

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td rowspan="3">Principle 1(a) – it comprises a high level of diversity of plant species</td><td><u>Relevant information</u>
The following table summarises the number of plant species recorded (native and introduced for each vegetation association and the bushland plant diversity score.
<table>
<tr><th>Vegetation Association</th><th># Native</th><th># Introduced</th><th>Bushland Plant Diversity score</th></tr>
<tr><td>B2</td><td>1</td><td>15</td><td>2</td></tr>
<tr><td>B3</td><td>4</td><td>13</td><td>6</td></tr>
<tr><td>B4</td><td>4</td><td>12</td><td>8</td></tr>
<tr><td>C2</td><td>2</td><td>13</td><td>2</td></tr>
<tr><td>C3</td><td>3</td><td>11</td><td>4</td></tr>
<tr><td>C4</td><td>17</td><td>14</td><td>18</td></tr>
<tr><td>C5</td><td>7</td><td>14</td><td>8</td></tr>
<tr><td>C6</td><td>2</td><td>9</td><td>2</td></tr>
<tr><td>C8</td><td>11</td><td>19</td><td>14</td></tr>
</table></td></tr>
<tr><td><u>Assessment against the principles</u>
At Variance –
- C4
- C8</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC</u>

Where only a very small area of vegetation will be impacted relative to the amount of vegetation within the local vicinity (less than 0.25% of the native vegetation within a 5 km radius to be impacted) it may reduce the impact from ‘at variance’ to ‘not at variance’.

The total area of each VA in the Stage 1A Varied Project Area compared to impact is shown in Table 6 (Page 21).</td></tr>
<tr><td>Principle 1(b) – significance as a habitat for wildlife</td><td><u>Relevant information</u>
The following threatened species have been recorded or may use the vegetation under application:

EPBC Act
• Diamond Firetail - known</td></tr>
</table>

Principle of clearance	Considerations

- Southern Whiteface - known
- Hooded Robin – highly likely
- Grey-headed flying fox - likely

NPW Act

- White-bellied Cuckoo shrike - known
- Peregrine Falcon – known
- Elegant Parrot - known
- White-winged Chough - known
- Little Eagle - likely
- Jacky Winter - likely
- Painted Buttonquail - likely
- Common Brushtail Possum – likely
- Eastern Shriketit - likely

Generally, the extensive grasslands within the Varied Project Area have a low diversity of fauna, with mainly common species recorded during the surveys. Woodland trees provide hollows and shelter refuge for common species such as kangaroos and birds. Extensive rock outcrops occur on ridgetops, which are important habitat in an otherwise mostly cleared landscape.

An EPBC significant impact assessment has been undertaken for this Project which has assessed Diamond Firetail, Southern Whiteface and Hooded Robin as potentially being impacted by this Project. As such, a referral is being submitted for this Project.

Vegetation Association	Threatened Fauna Score	Unit biodiversity Score (UBS)
B2	0.1	3.25
B3	0.1	21.77
B4	0.1	16.83
C2	0.1	2.94
C3	0.1	20.04
C4	0.1	42.02
C5	0.1	24.76
C6	0.1	2.55
C8	0.1	32.42

Assessment against the principles

Seriously at Variance

- All

Moderating factors that may be considered by the NVC

Impact to the EPBC listed species listed above have been assessed against the *Matters of National Environmental Significance – Significant Impact Guidelines 1.1*. This assessment found that the Project may impact on Diamond Firetail, Southern Whiteface and Hooded Robin. As such

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td></td><td>the proponent is undertaking an EPBC referral. The proponent has endeavoured to minimise impacts to these threatened bird species by preferentially avoiding areas assessed as high quality (such as woodland and shrublands with intact understorey).

NPW Act listed fauna species have been considered during the design phase. For example, a 1 km WTG exclusion buffer placed around previously recorded Peregrine Falcon nest and potential nesting habitat (see Figure 7) has been implemented in the Projects design. Impacts to better quality woodlands and shrublands have been avoided or reduced where possible.

<u>Common species</u>
All fauna species recorded in the Varied Project Area during surveys are species that are commonly found in grasslands and woodlands. The Varied Project Area includes habitat features essential for maintaining local populations, such as hollow trees or wetlands, and a reduction in impacts to these have been considered during the design phase of the Project.
A 1 km WTG exclusion buffer has been placed around all known Wedge-tailed Eagle nests to mitigate possible impacts of rotor strike on this species.</td></tr>
<tr><td rowspan="2">Principle 1(c) – plants of a rare, vulnerable or endangered species</td><td><u>Relevant information</u>
One threatened flora species was identified as occurring within the Varied Project Area:
• Eucalyptus fasciculosa (Pink Gum) (NPW Act: Rare).
Three threatened flora species have been assessed as highly likely / likely to occur within the Varied Project Area:
• Ptilotus erubescens (Hairy-tails) (NPW Act: Rare);
• Mentha diemenica (Slender Mint) (NPW Act: Rare); and
• Maireana rohrlachii (Rohrlach's Bluebush) (NPW Act: Rare).
An additional nine threatened flora species were assessed as possibly occurring in the Varied Project Area.
Species listed as highly likely or likely to occur within the Varied Project Area have not been observed in the Varied Project Area, however the extent of the proposed clearance area has not been assessed.
<table>
<tr><th>Vegetation Association</th><th>Threatened Fauna Score</th></tr>
<tr><td>B2</td><td>0</td></tr>
<tr><td>B3</td><td>0</td></tr>
<tr><td>B4</td><td>0</td></tr>
<tr><td>C2</td><td>0</td></tr>
<tr><td>C3</td><td>0</td></tr>
<tr><td>C4</td><td>0.04</td></tr>
<tr><td>C5</td><td>0.04</td></tr>
<tr><td>C6</td><td>0</td></tr>
<tr><td>C8</td><td>0</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<tr><td><u>Assessment against the principles</u>
At Variance –
- C4 & C5</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>
n/a</td></tr>
<tr><td rowspan="3">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>
One TEC is present within the Varied Project Area, Peppermint Box Grassy Woodland, but this community is not being impacted by the Project. A CEMP will include detailed information about actions required to ensure no impacts occur to this TEC during construction.

Threatened Community Score - 0</td></tr>
<tr><td><u>Assessment against the principles</u>
Not at variance</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC</u>
n/a</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 Varied Project Area contains one IBRA Subregion (Fleurieu) and two associations (Eden Valley and Scotts Hill). The Fleurieu subregion has been heavily cleared for agriculture, generally with scattered patches of vegetation remaining in areas unsuitable for farming.

<table>
<tr><th>Subregion</th><th>Remnancy</th><th>Association</th><th>Remnancy</th></tr>
<tr><td rowspan="2">Fleurieu</td><td rowspan="2">12%</td><td>Eden Valley</td><td>6%</td></tr>
<tr><td>Scotts Hill</td><td>10%</td></tr>
</table>
Total Biodiversity Score – 3,790.03</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>
Impact significance

1) Impact on a tree species or vegetation community that has been selectively removed within the IBRA Association or IBRA Subregion and are therefore underrepresented in the vegetation that remains;
2) Impact on a remnant in relatively good condition, particularly if the vegetation within the IBRA Association or IBRA Subregion where vegetation has largely been degraded.

For the first criteria, the broader area has been heavily cleared of woodland for agriculture. The majority of the vegetation proposed for clearance is highly degraded grassland which is not underrepresented in the area. The woodlands proposed for clearance consist predominantly of spaced trees over poor quality understory. This is the predominant woodland vegetation type present in the area.
For the second criteria, remnant vegetation is in poor to moderate condition and areas of better quality remnant vegetation have been avoided where possible.</td></tr>
<tr><td rowspan="2">Principle 1(f) – it is growing in, or in association with, a</td><td><u>Relevant information</u>
The Project design crosses ephemeral creeks.</td></tr>
<tr><td><u>Assessment against the principles</u>
Seriously at Variance
- B3 and C3</td></tr>
</table>

Principle of clearance	Considerations
wetland environment	**Moderating factors that may be considered by the NVC** Clearance is considered to have a significant impact on the ecological character of a wetland if it is likely to result in: • areas of the wetland being destroyed or substantially modified • a substantial and measurable change in the hydrological regime of the wetland (e.g. a change in the volume, timing, duration and frequency of ground and surface water flows to and within the wetland) • the habitat or lifecycle of native species dependent upon the wetland being seriously affected • a substantial and measurable change in the physio-chemical status of the wetland (e.g. change in the level of salinity, pollutants or nutrients in the wetland, change in water temperature which may adversely impact on biodiversity) • the introduction of invasive species. Creek lines that are proposed to be impacted are highly modified. They have undergone historical clearance of trees and generally have large areas of eroded banks with scattered trees or patches of trees scattered along the route. The proponent has designed the infrastructure to ensure the water flows can continue in these creeks.
Principle 1(g) – it contributes significantly to the amenity of the area in which it is growing or is situated	**Relevant information** All vegetation is situated on private property. In a few areas, grassland and woodland vegetation occurs alongside public roads. These woodland areas, although some distance from any areas frequented by the public, are often situated on hillsides and ridge tops that are visible from the area's public road network. The wind farm development will be become a highly visible component of the landscape once complete, although remote from any areas accessible to the general public. Two WTG have already been deleted from the wind farm after concerns were raised about the proximity of the WTG to a local monastery.
	N/A
	Moderating factors that may be considered by the NVC In determining if clearance is at variance with the principles, the NVC will have regard to the Local Council's recommendations (if any) in relation to the application.

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.

4.7. Risk assessment

The *Guide for applications to clear native vegetation* (Native Vegetation Council, 2020b) sets out how the risk level of a clearance application is assessed. This is summarised in Table 20. The risk level of this clearance application is presented in Table 21. The table indicates that this is a Level 4 clearance.

Table 20. Risk assessment for native vegetation clearance applications in the agricultural regions of South Australia.

	Patches - clearance	**Trees - clearance**	**Escalating matters** Clearance assessment will be raised to the next level if;
Level 1	**0.05ha** or less	**5 trees** or less	The site contains a listed species or contains a threatened community under either the NP&W Act or EPBC Act Or Clearance of any trees of the specified circumference.
	And clearance does not involve **any** trees with a trunk circumference measured at 1m above the ground of (for multi stemmed trees, measure the largest trunk/stem): 50cm or more.		
Level 2	**>0.05 ha to 0.5ha**	**6 - 20 trees**	Clearance is seriously at variance with Principle of Clearance 1(b), 1(c) or 1(d).
Level 3	Total Biodiversity Score of less than or equal to **250**		Clearance is seriously at variance with Principle of Clearance 1(b), 1(c) or 1(d).
Level 4	Total Biodiversity Score of greater than **250**		

Table 21. Summary of the level of risk associated with the application.

Total clearance	No. of trees	-
	Area (ha)	350.93
	Total biodiversity Score	2085.25
Seriously at variance with principle 1(b), 1(c) or 1 (d)		1(b)
Risk assessment outcome		Level 4

5. CLEARANCE SUMMARY

Clearance summary tables for the clearance application are shown in Table 22 (native vegetation patches). 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 23 on page 57.

Table 22. 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
B	2	2	1	0	0.1	3.31	143.69	474.92	1			498.66	412,318.21	22,677.50
B	3	6	1	0	0.1	22.14	0.96	21.18	1			22.23	17,355.53	954.55
B	4	8	1	0	0.1	17.12	18.04	308.87	1			324.32	271,063.54	14,908.49
C	2	2	1	0	0.1	2.99	157.60	629.195	1			660.655	454188.46	24980.365
C	3	4	1	0	0.1	20.38	2.14	43.66	1			45.85	38,318.27	2,107.50
C	4	18	1	0	0.1	42.74	2.35	100.62	1			105.65	80,736.88	4,440.53
C	5	8	1	0.04	0.1	25.18	15.36	386.81	1			406.15	238,833.94	13,135.87
C	6	2	1	0.04	0.1	2.59	9.76	85.83	1			90.12	61,602.76	3,388.15
C	8	14	1	0	0.1	32.97	1.03	34.12	1			35.82	24,968.13	1,373.25
						Total	**350.93**	**2085.21**				**2189.46**	**$1,599,385.70**	**$87,96621**

Table 23. Summary of the total SEB obligations of the clearance.

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	3854.82	4047.59	$1,599,385.70	$87,966.21	$1,687,351.90
Economies of Scale Factor				0.5	
Rainfall (mm)				Varies across VAs	

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 required for the clearance of **350.93** ha of native vegetation with a Total Biodiversity Score of **2085.21** is **$1,687,351.90** which includes an administration fee of **$87,966.21.**

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8. APPENDICES

Appendix 1 - Flora species recorded by the field survey (2013 and 2022).

Scientific name	Common name	Conservation rating		Exotic
		EPBC	NPW	
Acacia euthycarpa	Wallowa			
Acacia paradoxa	Kangaroo Thorn			
Acacia pycnantha	Golden Wattle			
Acacia sp.	Wattle			
Acaena echinata	Sheep's Burr			
Acaena novae-zelandiae	Biddy-biddy			
Aira sp.	Hair-grass			Y
Aizoon pubescens	Coastal Galenia			Y
Allocasuarina verticillata	Drooping Sheoak			
Amyema miquelii	Box Mistletoe			
Arctotheca calendula	Cape Weed			Y
Aristida behriana	Brush Wire-grass			
Arthropodium sp.	Vanilla-lily			
Arthropodium strictum	Common Vanilla-lily			
Atriplex semibaccata	Berry Saltbush			
Austrostipa elegantissima	Feather Spear-grass			
Austrostipa nitida	Balcarra Spear-grass			
Austrostipa puberula	Fine-hairy Spear-grass			
Austrostipa scabra group	Falcate-awn Spear-grass			
Austrostipa scabra ssp.	Rough Spear-grass			
Austrostipa sp.	Spear-grass			
Avena barbata	Bearded Oat			Y
Brachychiton sp.				Y
Brachypodium distachyon	False Brome			Y
Brachyscome sp.	Native Daisy			
Briza maxima	Large Quaking-grass			Y
Briza minor	Lesser Quaking-grass			Y
Bromus diandrus	Great Brome			Y
Bromus rubens	Red Brome			Y
Bulbine bulbosa	Bulbine-lily			
Burchardia umbellata	Milkmaids			
Bursaria spinosa ssp. *spinosa*	Sweet Bursaria			
Caesia calliantha	Blue Grass-lily			
Calostemma purpureum	Pink Garland-lily			
Calostemma sp.	Garland-lily			
Cheilanthes austrotenuifolia	Annual Rock-fern			
Cheilanthes sp.	Rock-fern			
Chenopodium album	Fat Hen			

Scientific name	Common name	Conservation rating		Exotic
		EPBC	NPW	
Chloris truncata	Windmill Grass			
Chloris virgata	Feather-top Rhodes Grass			
Convolvulus angustissimus	Narrow-leaf Bindweed			
Correa sp.	Correa			
Crassula alata var. alata	Three-part Crassula			
Crassula sp.	Crassula/Stonecrop			
Cymbopogon ambiguus	Lemon-grass			
Cynara cardunculus ssp. *flavescens*	Artichoke Thistle			Y
Cyperus gymnocaulos	Spiny Flat-sedge			
Cyperus sp.	Flat-sedge			
Cyperus vaginatus	Stiff Flat-sedge			
Dactylis glomerata	Cocksfoot			Y
Disa bracteata	South African Weed Orchid			Y
Dodonaea viscosa ssp.	Sticky Hop-bush			
Drosera peltata	Pale Sundew			
Echium plantagineum	Salvation Jane			Y
Ehrharta calycina	Perennial Veldt Grass			Y
Einadia nutans ssp.	Climbing Saltbush			
Enchylaena tomentosa var. tomentosa	Ruby Saltbush			
Enneapogon nigricans	Black-head Grass			
Erodium botrys	Long Heron's-bill			Y
Eucalyptus camaldulensis ssp. *camaldulensis*	River Red Gum			
Eucalyptus fasciculosa	Pink Gum		R	
Eucalyptus odorata	Peppermint Box			
Euphorbia drummondii group				
Eutaxia microphylla	Common Eutaxia			
Ficinia nodosa	Knobby Club-rush			
Fumaria officinalis ssp. *officinalis*	Common Fumitory			Y
Fumaria sp.	Fumitory			Y
Geranium dissectum	Cut-leaf Geranium			
Glycine sp.	Glycine			
Gomphocarpus cancellatus	Broad-leaf Cotton-bush			Y
Gonocarpus elatus	Hill Raspwort			
Goodenia pusilliflora	Small-flower Goodenia			
Goodenia sp.	Goodenia			
Holcus lanatus	Yorkshire Fog			Y
Hordeum vulgare	Barley			Y
Hypochaeris glabra	Smooth Cat's Ear			Y

Scientific name	Common name	Conservation rating		Exotic
		EPBC	NPW	
Hypochaeris radicata	Rough Cat's Ear			Y
Iseilema sp.	Flinder's-grass			
Juncus sp.	Rush			
Kennedia prostrata	Scarlet Runner			
Lagurus ovatus	Hare's Tail Grass			Y
Lepidium africanum	Common Peppercress			Y
Lolium sp.	Ryegrass			Y
Lomandra collina	Sand Mat-rush			
Lomandra effusa	Scented Mat-rush			
Lomandra multiflora ssp.	Many-flower Mat-rush			
Lycium ferocissimum	African Boxthorn			Y
Maireana sp.	Bluebush/Fissure-plant			
Marrubium vulgare	Horehound			Y
Medicago polymorpha var. polymorpha	Burr-medic			Y
Medicago sp.	Medic			Y
Moraea setifolia	Thread Iris			Y
Nicotiana glauca	Tree Tobacco			Y
Olea europaea ssp. *europaea*	Olive			Y
Olearia axillaris	Coast Daisy-bush			
Oxalis perennans	Native Sorrel			
Oxalis pes-caprae	Soursob			Y
Paronychia sp.	Whitlow			
Pelargonium peltatum	Ivy-leaf Pelargonium			
Petrorhagia dubia	Velvet Pink			Y
Phragmites australis	Common Reed			
Piptatherum miliaceum	Rice Millet			Y
Pittosporum angustifolium	Native Apricot			
Poa sp.	Meadow-grass/Tussock-grass			
Portulaca sp.	Purslane			
Ptilotus spathulatus	Pussy-tails			
Reichardia tingitana	False Sowthistle			Y
Romulea rosea var. *australis*	Common Onion-grass			Y
Rosa canina	Dog Rose			Y
Rumex acetosella	Sorrel			
Rumex crispus	Curled Dock			
Rumex sp.	Dock			
Rytidosperma caespitosum	Common Wallaby-grass			
Rytidosperma sp.	Wallaby-grass			
Salsola australis	Buckbush			

Scientific name	Common name	Conservation rating		Exotic
		EPBC	NPW	
Salvia verbenaca var.	Wild Sage			Y
Scaevola albida	Pale Fanflower			
Schinus molle	Pepper-tree			Y
Senecio sp.	Groundsel			
Sonchus oleraceus	Common Sow-thistle			Y
Themeda triandra	Kangaroo Grass			
Trifolium angustifolium	Narrow-leaf Clover			Y
Trifolium arvense var. *arvense*	Hare's-foot Clover			Y
Ulex europaeus	Gorse			Y
Urtica sp.	Stinging Nettle			Y
Vittadinia blackii	Narrow-leaf New Holland Daisy			
Vittadinia cuneata var.	Fuzzy New Holland Daisy			
Vittadinia gracilis	Woolly New Holland Daisy			
Vittadinia sp.	New Holland Daisy			
Wahlenbergia sp.	Native Bluebell			
Xanthorrhoea quadrangulata	Rock Grass-tree			

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 in the field survey.

Scientific Name	Common Name	Conservation Act	
		EPBC Act	NPW Act
AMPHIBIANS			
Limnodynastes dumerilii	Pobblebonk Frog		
Limnodynastes tasmaniensis	Spotted Marsh Frog		
Litoria ewingii	Brown Tree Frog		
AVES			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill		
Acanthiza reguloides	Buff-rumped Thornbill		
Accipiter cirrocephalus	Collared sparrowhawk		
Accipiter fasciatus fasciatus	Brown Goshawk		
Alauda arvensis	Eurasian skylark*		
Anas gracilis gracilis	Grey Teal		
Anas superciliosa	Pacific black duck		
Anthochaera carunculata	Red wattlebird		
Anthus australis	Australasian Pipit		
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU	
Aquila audax	Wedge-tailed eagle		
Artamus cinereus	Black-faced Woodswallow		
Artamus cyanopterus	Dusky Woodswallow		
Barnardius zonarius	Australian Ringneck		
Cacatua galerita	Sulphur-crested Cockatoo		
Cacatua sanguinea gymnopis	Little Corella		
Carduelis carduelis	European Goldfinch*		
Chenonetta jubata	Australian Wood Duck		
Cincloramphus cruralis	Brown Songlark		
Cincloramphus mathewsi	Rufous Songlark		
Climacteris picumnus picumnus	Brown Treecreeper		
Colluricincla harmonica	Grey Shrikethrush		
Coracina novaehollandiae	Black-faced Cuckoo-shrike		
Corvus coronoides	Australian Raven		
Corvus mellori	Little Raven		
Coturnix pectoralis	Stubble quail		
Dacelo novaeguineae	Laughing Kookaburra		
Daphoenositta chrysoptera	Varied sittella		
Dicaeum hirundinaceum hirundinaceum	Mistletoebird		
Egretta novaehollandiae	White-faced Heron		
Elanus axillaris	Black-shouldered Kite		
Eolophus roseicapilla	Galah		

Scientific Name	Common Name	Conservation Act	
		EPBC Act	NPW Act
Epthianura albifrons	White-fronted Chat		
Falco berigora	Brown Falcon		
Falco cenchroides	Nankeen Kestrel		
Falco peregrinus macropus	Peregrine Falcon		R
Geopelia striata	Peaceful Dove		
Glossopsitta concinna	Musk Lorikeet		
Glossopsitta porphyrocephala	Purple-crowned lorikeet		
Grallina cyanoleuca	Magpielark		
Gymnorhina tibicen	Australian Magpie		
Hirundo neoxena	Welcome swallow		
Lichenostomus virescens	Singing Honeyeater		
Malurus cyaneus leggei	Superb fairywren		
Malurus lamberti	Variegated fairywren		
Manorina flavigula	Yellow-throated miner		
Manorina melanocephala	Noisy miner		
Merops ornatus	Rainbow bee-eater		
Microcarbo melanoleucos melanoleucos	Little Pied Cormorant		
Mirafra javanica	Horsfield's Bushlark		
Neophema elegans elegans	Elegant Parrot		R
Ocyphaps lophotes	Crested Pigeon		
Pachycephala rufiventris rufiventris	Rufous Whistler		
Pardalotus punctatus	Spotted Pardalote		
Pardalotus striatus	Striated Pardalote		
Pelecanus conspicillatus	Australian Pelican		
Petrochelidon ariel	Fairy martin		
Petrochelidon nigricans	Tree martin		
Petroica goodenovii	Red-capped robin		
Phylidonyris novaehollandiae	New Holland Honeyeater		
Platycercus elegans	Crimson rosella		
Pomatostomus superciliosus	White-browed Babbler		
Psephotus haematonotus	Red-rumped parrot		
Ptilotula penicillata	White-plumed Honeyeater		
Rhipidura leucophrys	Willie Wagtail		
Smicrornis brevirostris	Weebill		
Stagonopleura guttata	Diamond Firetail	VU	V
Sturnus vulgaris	Common Starling*		
Tachybaptus novaehollandiae	Australasian Grebe		
Tadorna tadornoides	Australian Shelduck		
Vanellus miles	Masked Lapwing		
Vanellus tricolor	Banded Lapwing		

Scientific Name	Common Name	Conservation Act	
		EPBC Act	NPW Act
MAMMALS			
Capra hircus	Goat*		
Macropus fuliginosus	Western Grey Kangaroo		
Macropus robustus	Euro		
Oryctolagus cuniculus	European Rabbit*		
Phascolarctos cinereus	Koala		
Vulpes vulpes	Fox (Red Fox)*		
REPTILES			
Chelodina longicollis	Long-necked Turtle		
Ctenophorus decresii	Tawny Dragon		
Pogona Barbata	Eastern Bearded Dragon		
Pseudechis porphyriacus	Red-bellied Black Snake		
Pseudonaja textilis	Eastern Brown Snake		
Strophurus intermedius	Southern Spiny-tailed Gecko		
Tiliqua rugosa	Sleepy Lizard		

Conservation status
Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: VU/V: Vulnerable. R: Rare. * = introduced.
^species listed as observed in 2013 also include those recorded in Area A which has now been removed from the Varied Project Area. Survey methods are described in EBS Ecology 2014.

Appendix 3 – Likelihood of Occurrence Assessment

Table 24. Likelihood of occurrence of threatened species identified in the desktop assessment. The data source and threat levels are described in the table footer.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
PLANTS							
Acacia iteaphylla	Flinders Ranges Wattle		R		2021	Naturally occurs in the Flinders Ranges, across to the Gawler Ranges, and on the Eyre Peninsula. Naturalised beyond its native range in some parts of south-eastern and southern SA (SSCC 2018).	**Possible** - Recent records but no individuals identified during the field survey.
Acacia menzelii	Menzel's Wattle	VU	V	Known to occur	1980	Endemic to SA, the species is confined to localised areas around Monarto and Murray Bridge, Mount Lofty Ranges and Flinders Ranges (around Brachina). It occurs as scattered shrubs; either on roadsides, or in low open shrubby woodland on more rocky sites and found in open Eucalyptus scrub where associated species include *Eucalyptus socialis* (Beaked-red Mallee), *E. incrassata* (Ridge-fruited Mallee), *Callitris gracilis* (Southern Cypress Pine) and *E. odorata* (Peppermint Box) on calcareous loamy earths (DEWHA 2008a).	**Possible** - Suitable *E. odorata* habitat present but no individuals identified during the field surveys.
Acacia rhetinocarpa	Neat Wattle	VU	V	Known to occur	1989	Endemic to South Australia and found scattered in a few small areas near the east coast of EP, east coast of Yorke Peninsula, southern Mount Lofty Ranges and in the Murray region, growing in open scrub vegetation associated with *Eucalyptus gracilis*, *E. socialis* and *E. incrassata* on calcareous sand and loamy soil (SSCC 2018). Normally associated with *Eucalyptus spp*. such as *Eucalyptus dumosa* (DotE 2013b).	**Possible** – Older record and some habitat in the Varied Project Area is suitable, but no individuals identified during the field surveys.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
Austrostipa gibbosa	Swollen Spear-grass		R		2013	Occurs in the southern Flinders Ranges, Mount Lofty Ranges and the South-east in SA growing on rich loamy soil along creeks and seasonally wet areas in woodland and grassland (SSCC 2018).	**Possible** – recent records and some suitable habitat within the Varied Project Area.
Austrostipa oligostachya	Fine-head Spear-grass		E		2010	Found in the southern Mount Lofty Ranges and the upper South-east in South Australia, growing in ephemerally wet areas, along riverbanks and loamy flats in grassy woodland and grassland (SSCC 2018).	**Possible** – recent records, some suitable habitat in the Varied Project Area.
Bothriochloa macra	Red-leg Grass		R		2022	Mainly found in open grassy woodland communities and is often found in disturbed sites. More common in the SE of SA (SSCC 2018).	**Possible** – recent records and some suitable habitat within the Varied Project Area.
Caladenia argocalla	White-beauty Spider-orchid	EN	E	Known to occur	2022	Endemic to the Mount Lofty Ranges Region of SA. Occurs in intact grassy woodlands often with *E. leucoxylon* (South Australian Blue Gum) and *Allocasuarina verticillata* (Drooping Sheoak). Usually grows on a gentle slope with a southerly aspect and in clay loam soils. Flowering from late September to October (Quarmby 2010).	**Possible** - Blue gum woodland is present, and aspect ideal for this species. Recent records nearby. However, the area is highly degraded and contains a majority of exotic grassy species.
Caladenia stellata	Star Spider-orchid		R		1995	Grows in Callitris-dominated woodland in gravelly soils or red sandy loams (PlantNet 2023)	**Unlikely** – older record, minimal suitable habitat in Varied Project Area except in gorges which will not be impacted.
Caladenia tensa	Greencomb Spider-orchid	EN		Known to occur	No records	Aeolian sand deposits in Callitris, *E. leucoxylon* Woodland and *Melaleuca uncinata* mallee in Murray-Darling Depression bioregion. Winter active geophyte,	**Possible** - known from several disjunct populations within

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						with long narrow leaf emerging, followed by 1-2 flowers (TSSC 2016a).	reserves and conservation parks. Woodland and soil type present across Varied Project Area, however majority of site is highly disturbed and unlikely to have this species.
Centrolepis cephaloformis ssp. *cephaloformis*	Cushion Centrolepis		R		2010	In mallee and disturbed communities on sand and other infertile soils, also on the margins of clay pans and salt marshes. SA: FR EP NL MU YP SL SE.	**Unlikely** - unsuitable habitat within Varied Project Area.
Dianella longifolia var. *grandis*	Pale Flax-lily		R		2015	Occurs under a variety of overstorey Eucalypt species but is a grassy woodland specialist, e.g., Blue Gum, Candlebark, Manna Gum, Stringybark and Grey Box.	**Unlikely** – no suitable habitat within the Varied Project Area.
Eryngium ovinum	Blue Devil		V		2013	Found in the wetter parts of the Mount Lofty Ranges and a few sites in the lower South-East in South Australia, growing in open woodland on damp clay and sandy soils (SSCC 2018).	**Possible** – recent record and some suitable habitat within the Varied Project Area.
Eucalyptus fasciculosa	Pink Gum		R		2022	Pink gum grows in woodland or as an emergent low shrubland on soil of low fertility. It is mainly found in the south-east of South Australia, in the Mount Lofty Ranges, Barossa Valley and on Kangaroo Island (ALA 2023).	**Highly Likely/Known** - Recent records and identified during field survey
Glycine latrobeana	Clover Glycine	VU	V	Known to occur	2009	Inhabits native grasslands, dry sclerophyll forests, woodlands and low open woodlands, typically with a grassy ground layer, and growing on undulating plains. Prefers gentle south-west facing ridge slopes	**Possible** -Woodland community present. This species was not identified during the field survey.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						and lower south facing river valley slopes (Carter and Sutter 2010).	
Hypericum japonicum	Matted St John's Wort		R		2017	Found on Kangaroo Island, southern Mount Lofty Ranges and the lower South-east in South Australia, growing in cool, moist, often shaded sites in swampy heathland (SSCC 2018).	**Possible** - Swamp community present. This species was not identified during the field survey.
Lachnagrostis robusta	Tall Blown-grass		R		2003	Occurs around margins of salt lakes, sandy flats and saline depressions.	**Possible** - Recent records and damp low-lying habitat present within Varied Project Area although no individuals observed within Varied Project Area.
Maireana rohrlachii	Rohrlach's Bluebush		R		2022	Species occurs from few locations on EP, but mainly YP, Mid North, Fleurieu Peninsula, Murraylands and western Victoria. Preferred habitat includes heavy clay and calcareous loam soil often fringing lakes in seasonally wet areas (Royal Botanic Gardens Victoria 2020).	**Likely/known** - Recent sighting and identified within previous survey (EBS Ecology 2014).
Mentha diemenica	Slender Mint		R		2009	Grows in dry forest, woodland, grassy areas, and seasonally damp places (PlantNet 2023).	**Likely** – some suitable habitat within the Varied Project Area, observed approximately 5 km north of the Varied Project Area.
Olearia pannosa ssp. *pannosa*	Silver Daisy-bush	VU	V	Known to occur	2016	Endemic to SA, scattered throughout agricultural areas. Occurring in sandy flat areas and in hilly rocky areas in woodland or mallee, including overlapping	**Possible** -Woodland community present. This

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						with Peppermint Box Grassy Woodland of SA (DotE 2013c).	species was not identified during the field survey.
Olearia passerinoides ssp. *glutescens*	Sticky Daisy-bush		R		2010	Found in the wetter parts of South Australia, on the tip of Yorke Peninsula, southern Mount Lofty Ranges and in the Murray (SSCC 2018).	**Possible** -Woodland community present. This species was not identified during the field survey.
Prasophyllum pallidum	Pale Leek-orchid	VU	R	Known to occur	2022	Pale Leek-orchid is known singly or in groups in better soils of woodland and grassy open forest. Recorded in woodlands and forests dominated by *Eucalyptus leucoxylon*, *E. goniocalyx*, *E. fasciculosa*, *E. microcarpa*, *Callitris gracilis/Eucalyptus fasciculosa*, and *Allocasuarina verticillata* (Bates 2009).	**Possible** -Woodland community present. This species was not identified during the field survey.
Ptilotus erubescens	Hairy-tails		R		2014	Occurs in SA in FR, NL, MU, SL and SE where it occurs in fertile soils in grassland, woodland and scrubland communities but not in mallee (Royal Botanic Gardens Victoria 2020).	**Likely** – recent records and some suitable habitat in the Varied Project Area.
Veronica derwentiana subsp. homalodonta	Mount Lofty Speedwell	CE	E	Likely to occur	No records	Grows beside streams and waterfalls or associated with limestone caverns. Occurs in moist sites in gullies or near creeks in high rainfall areas (DEWHA 2009)	**Unlikely** – outside of known distribution of this species, no recent records and unsuitable habitat.
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU		Known to occur	2022	Occurs in semi-arid woodlands, mallee, mulga, dry-country scrublands." Southern Whiteface favour habitat with low tree densities and a herbaceous understory litter cover. They live in a wide range of open woodlands and shrublands which are dominated by acacia, mallee, mulga and eucalyptus species (Higgins & Peter 2002)	**Known / Highly likely** - species observed within the Varied Project Area.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
Apus pacificus	Fork-tailed Swift	Mi (M)		Likely to occur	2014	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 2023).	**Possible** – species aerial, therefore unlikely to use the Varied Project Area, may occur as flyover only.
Botaurus poiciloptilus	Australasian Bittern	EN	E	Known to occur	2004	Occurs in coastal and sub coastal SE South Australia in or over water in tall reedbeds, sedges, rushes, lignum and occasionally in saltmarsh (Pizzey and Knight 2013).	**Unlikely** - no suitable habitat within the Varied Project Area.
Coracina papuensis spp. *robusta*	White-bellied Cuckooshrike		R	-	2022 (EBS record)	Scattered records near Varied Project Area, uncommon in South Australia (ALA 2023). Migrant. Occurs in forests and woodlands with River red gums, open grasslands, mangroves, plantations and gardens (Pizzey and Knight 2013).	**Highly likely/known –** observed within the Varied Project Area.
Corcorax melanorhamphos	White-winged Chough		R		2022	Prefers drier forests, woodlands of *Eucalyptus sp*., crops and pastures (Pizzey and Knight 2013).	**Highly likely/Known** - recent records and identified nearby within previous surveys (EBS Ecology 2014).
Coturnix ypsilophora australis	Brown Quail		V		2018	Prefers dense grasslands, often on the edges of open forests, and bracken (Birdlife Australia 2023).	**Possible** – some suitable habitat in the north, recent records.
Egretta garzetta nigripes	Little Egret		R		2017	Found in tidal mudflats, saltmarshes, mangroves and freshwater wetlands (Pizzey and Knight 2013).	**Possible** – recent records and some suitable habitat within the Varied Project Area.
Falco hypoleucos	Grey Falcon	VU	R	Known to occur	1964	The species occurs in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and WA. Preferred habitat includes lightly	**Possible** – some suitable habitat but no recent

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						treed inland plains, sand ridges and pastoral plains. (Pizzey and Knight 2013).	records within 10 km of the Varied Project Area.
Falco peregrinus	Peregrine Falcon		R		2020	Found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. This species prefers open habitats such as grasslands, tundra and meadows and nests on cliff faces and in crevices (Pizzey and Knight 2013).	**Highly likely/Known** - Recent records and suitable habitat present within Varied Project Area. Observed during survey.
Falcunculus frontatus ssp. *frontatus*	Eastern Shriketit		R		2021	Eucalyptus woodlands and forest, within a wide range of woodland/forest communities. Prefers dense grasslands, often on the edges of open forests, and bracken (Birdlife Australia 2023).	**Likely** - suitable habitat within the Varied Project Area and recent records.
Gallinago hardwickii	Latham's Snipe	VU, Mi (W)		Likely to occur	No records	Latham's Snipe is a non-breeding visitor to south-eastern Australia, including the Adelaide plains, MLR and EP. They usually inhabit open, freshwater wetlands with low, dense vegetation (DCCEEW 2023d).	**Possible** – some wetland habitat within the Varied Project Area, although habitat not preferred.
Grantiella picta	Painted Honeyeater	VU	R	Likely to occur	No records	Sparsely distributed from southern Victoria and south-eastern SA to far northern QLD and eastern Northern Territory Forest, woodland, dry scrub, often with abundant mistletoe. (Birdlife Australia 2023). Occur in forest, woodland, dry scrub, often with abundant mistletoe. Dependent on mistletoe berries (Morcombe 2021).	Unlikely - vagrant to this area and habitat within the Varied Project Area not preferred.
Hieraaetus morphnoides	Little Eagle		V		2018	Widespread over diverse habitats; forest, woodland, open scrub, tree-lined watercourses of interior Australia such as the Murray River. Prefers areas where	**Likely** - suitable habitat within the Varied Project Area and recent records.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						open country intermixes with wooded or forested hills, as in farmland, irrigated land (Morcombe 2021).	
Lophoictinia isura	Square-tailed Kite		E		2013	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses (Pizzey and Knight 2013).	**Possible** - older record but some suitable woodland habitat present throughout Varied Project Area.
Melanodryas cucullata cucullata	Hooded Robin	EN	R	Known to occur	2022	Utilises woodland of eucalypt, mallee, mulga; coastal heath; semi cleared farmland. Sub-populations in SA are recorded from the Barossa, Monarto, Onkaparinga River, Ashbourne, Port Willunga areas as well as isolated records from elsewhere in the hills and Fleurieu. Requires large remnants (>50 ha) with open areas, young eucalypts or shrubs for nesting and numerous perches for foraging (DEH 2008). South-eastern subspecies found in Eucalypt woodland and mallee and Acacia shrubland (Wilson and Bignall 2009).	**Likely** - recent records, Eucalypt woodland and Acacia shrubland exist within the Varied Project Area.
Melithreptus gularis	Black-chinned Honeyeater		V		2014	The Black-chinned Honeyeater is found in the upper levels of open eucalypt forests and woodlands dominated by box and ironbark eucalypts. It is often found along waterways, especially in arid and semi-arid areas and in northern Australia. It is occasionally seen in gardens and street trees (Birdlife Australia 2023).	**Possible** - older record and some suitable habitat, but on the edge of known distribution of this species.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
Microeca fascinans fascinans	Jacky Winter (MLR, SE)		R		2022	Widely distributed throughout mainland Australia. Prefer open woodland (Eucalypt and mallee) with an open shrub layer and bare ground. Often seen in farmland and parks (Morcombe 2021).	**Likely** - suitable habitat within the Varied Project Area and recent records.
Myiagra cyanoleuca	Satin Flycatcher	Mi	E	Likely to occur	No records	Known inhabitant of forest, woodland, mangroves and coastal heath scrub. Prefers dense, wet gullies of heavy eucalypt forest in breeding season (Morcombe 2021).	**Unlikely** - some suitable habitat within the Varied Project Area, vagrant to area.
Myiagra inquieta	Restless Flycatcher		R		2018	Found throughout northern and eastern mainland Australia, as well as in south-western Australia. The Restless Flycatcher is found in open forests and woodlands (Birdlife Australia 2023). Occupies open forests, woodlands and mallee, inland coastal scrubs (Pizzey and Knight 2013).	**Possible** - recent records and suitable habitat, however species known to require large connected patches of mallee vegetation which is limited in the Varied Project Area.
Neophema chrysostoma	Blue-winged Parrot	VU, Ma	V	Known to occur	1999	This species mainly occurs in Tasmania and Victoria, particularly in southern Victoria and the midlands and eastern areas of Tasmania however sparser populations are also found in western New South Wales and eastern South Australia. Prefers grasslands and grassy woodlands but will inhabit a range of habitats from coastal, sub-coastal and inland areas, right through to semi-arid zones (Birdlife Australia 2023).	**Possible** - some suitable habitat within the Varied Project Area and older record, but habitat unlikely to be preferred by this species.
Neophema elegans elegans	Elegant Parrot		R		2021	The Elegant Parrot occurs in eastern parts of South Australia, north to the Flinders Ranges and west to the Eyre Peninsula. It can be found in a wide variety of	**Highly likely/Known** - Recent records and suitable woodland habitat

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						habitats, including grasslands, shrublands, mallee, woodlands and thickets, bluebush plains, heathlands, saltmarsh and farmland (Birdlife Australia 2023).	present within Varied Project Area. Observed during October 2022 survey.
Petroica boodang boodang	Scarlet Robin		R		2016	This species occurs in foothill forests, woodlands and watercourses. In autumn-winter, they occur in more open habitats such as river red gum woodlands, golf courses, parks, orchards and gardens (Birdlife Australia 2023). Occur in eucalypt woodlands and forests. Breeds in Eucalypt forest, but not in adjacent grasslands even though individuals occupy this habitat during the non-breeding season (DEW 2008b).	**Possible** - vegetation within Varied Project Area not preferred but recent records within the last 10 years.
Rostratula australis	Australian Painted Snipe	EN	E	Likely to occur	No records	Occurs in shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, rushes and reeds, low scrub, Muehlenbeckia spp. (lignum), open timber or samphire (DSSEWPC 2013).	**Unlikely** - no suitable habitat within the Varied Project Area.
Stagonopleura guttata	Diamond Firetail	VU	V	Known to occur	2020	Diamond firetails occur in eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees (Higgins et al. 2007). They prefer areas with relatively low tree density, few large logs, and little litter cover but high grass cover (Antos *et al.* 2008).	**Highly Likely/Known** - recent records and observed during field survey in March 2022 and October 2022.

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
Tringa nebularia	Common Greenshank	EN, Mi, Ma		Likely to occur	2006	This species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms (Higgins & Davies 1996).	**Possible** – some wetland habitat within the Varied Project Area, although habitat not preferred.
Turnix varius ssp. *varius*	Painted Buttonquail		R		2018	These birds range almost continuously, in appropriate habitat, from about the Atherton Tableland in Qld, round the coast to the EP and north to the southern Flinders Ranges in SA, avoiding only the driest regions of Qld and NSW. Temperate and eastern tropical forests and woodlands form the habitats of this species (Morcombe 2021).	**Likely** - some suitable habitat within the Varied Project Area, recent records nearby.
Zanda funerea whiteae	Yellow-tailed Black Cockatoo		V		2020	Occurs in coastal heath, woodland and forest. Increasingly recorded in pine plantations and trees in urban and rural areas (Birds SA 2023).	**Possible** - some suitable habitat in the Varied Project Area, recent records nearby.
Zoothera lunulata ssp. *halmaturina*	South Australian Bassian Thrush Southern FR, MLR, KI	EN	V	Likely to occur	2012	The subspecies mostly inhabits damp eucalypt forest or woodland. Its habitat consists of densely forested areas and gullies, usually with a thick canopy overhead, a thick understorey of small trees and tall shrubs, and leaf-litter below (DAWE 2022).	**Unlikely** - no suitable habitat within the Varied Project Area, recent record is closer to the ranges.
MAMMALS							
Pteropus poliocephalus	Grey-headed Flying-fox	VU	R	Likely to occur	2020	Grey-headed Flying-foxes forage up to 40 km from their roost at Botanic Park each night. Food plants are	**Likely** - flowering and fruiting trees and shrubs in the Varied Project Area

Scientific Name	Common Name	Conservation Status		PMST likelihood of occurrence within 5 km	Last sighting within 5 km (year)	Habitat Description and Distribution	Likelihood of Occurrence within Varied Project Area
		Aus.	SA				
						typically planted trees, both native and exotic, that provide fruit or a rich source of nectar (DAWE 2021).	may provide foraging habitat for this species. Recent nearby records.
Trichosurus vulpecula	Common Brushtail Possum		R		2002	Utilises various woodland habitats and suburban environs. Feeds on flowers, fruit, buds and leaves of native vegetation. Requires hollows (within dead or alive tree) or on ground for daytime nesting (Strahan & van Dyck 2008). Anywhere where trees with suitable hollows occur, including open forests and woodlands but also urban areas and cities. The species can be common in urban areas (Strahan, 2004).	**Likely** – older records, but some suitable habitat within the Varied Project Area.
REPTILES							
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		Likely to occur	No records	Known from the Flinders Ranges of South Australia, extending south to the western slopes and northern and central MLR. The species inhabits open woodland, native tussock grassland, riparian habitats, and rocky isolates, preferring stony or clay soils with a stony / rocky surface, but has also been found sheltering in soil beneath sones and rotting stumps (Commonwealth Government, 2008). It occurs in open woodland, native tussock grassland, riparian habitats and rocky isolates (DEWHA 2008c).	**Unlikely** –Although there is grassland, open woodland and riparian habitats present, the area consists of embedding rocks rather than surface rock. There are no recent records and the Varied Project Area is outside of the known range of this species.

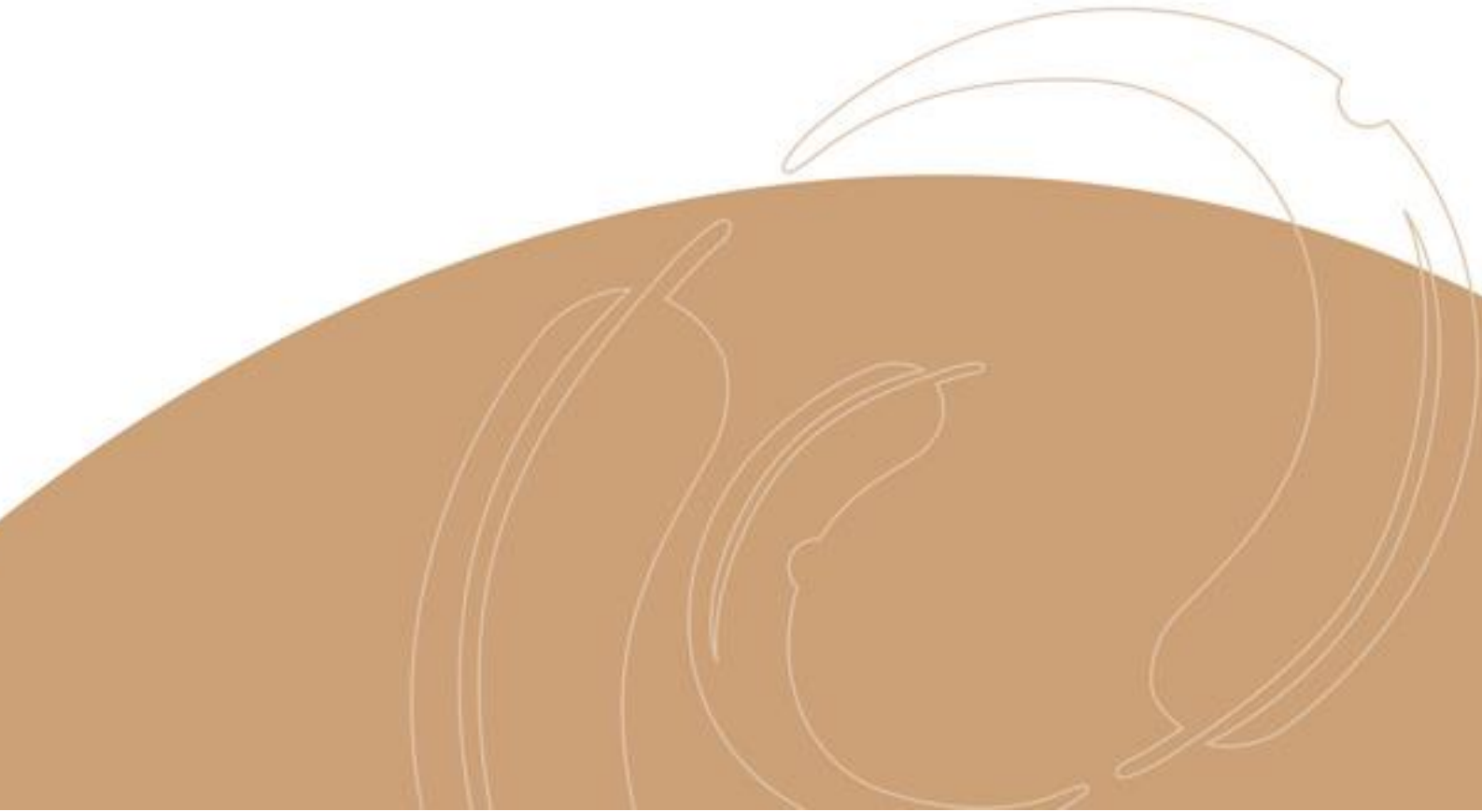
Conservation status

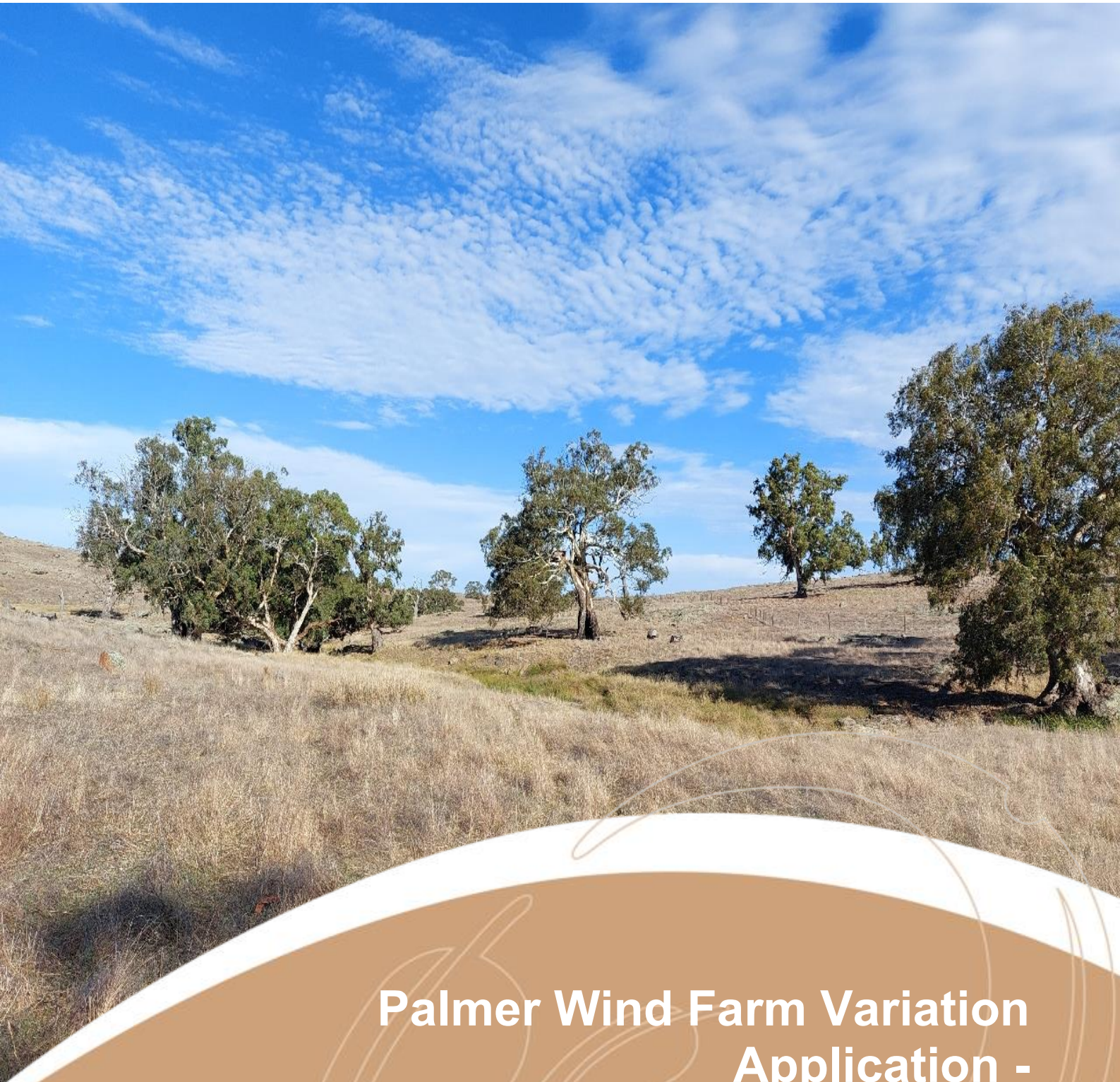
EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*). NPW Act (*National Parks and Wildlife Act 1972*). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. Mi: listed as migratory under the EPBC Act. Ma: listed as marine under the EPBC Act.

Source of Information

1. **EPBC Act Protected Matters Report (DCCEEW 2023) – 5 km buffer applied to Varied Project Area.**
2. **Biological Database of South Australia data extract (DEW 2023a) (Recordset number DEWNRBDBSA230614-1) - 5 km buffer applied to Varied Project Area.**
3. **Observed during the field survey.**

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Palmer Wind Farm Variation Application -

Bird and Bat Risk Assessment

Palmer Wind Farm Variation Application - Bird and Bat Risk Assessment

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Version 4

Prepared by EBS Ecology for Tilt Renewables

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Cover photograph: Scattered trees in a creek line within the Project Area.

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GLOSSARY AND ABBREVIATION OF TERMS

DRMF	Australian Defence Risk Management Framework
BDBSA	Biological Databases of South Australia database search
EBS	Environmental and Biodiversity Services Pty Ltd, trading as EBS Ecology
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
MNES	Matters of National Environmental Significance, as defined under the EPBC Act
NPW Act	*National Parks and Wildlife Act 1972*
PMST	Protected Matters Search tool
sp.	Species (singular)
spp.	Species (plural)
ssp.	Subspecies
the Varied Project	Palmer Wind Farm (as proposed to be varied, by the reduction of the number of WTG to 40 and the increase of the maximum tip height to 220m)
the Project Area	Several blocks of farming and cropping land located 70 km east of Adelaide, South Australia on which the Varied Project will be located.
Tilt	Tilt Renewables (the Proponent)
TrustPower	Former name of Tilt
WTG	Wind turbine generator

EXECUTIVE SUMMARY

Tilt Renewables (Tilt) has development plan consent for the Palmer Wind Farm Project, comprising up to 103 wind turbines with a maximum tip height of 165m. Tilt Renewables is seeking approval to vary the Project to reduce the number of turbines to 40 and to increase the maximum tip height to 220m.

EBS Ecology (EBS) has been engaged by Tilt to undertake an Avian and Bat Risk Assessment using past EBS collected data and results from the bird utilisation surveys undertaken in October 2022 and January 2023 to inform the assessment of the Variation Application. A risk assessment was undertaken in 2014 (EBS 2014) regarding the potential impact on birds of 114 turbines with a 165 m maximum blade tip height. The 2014 risk assessment considered the risk to birds of turbines with similar turbine parameters and dimensions as the turbine design approved in 2019. As such, EBS has taken into consideration the 2014 risk assessment as well as previous data collected at Palmer Wind Farm and combined this information with more recent 2022/2023 data, to update the risk assessment.

The proposed Palmer Wind Farm is located approximately 50 kilometres (km) east of Adelaide and is situated within the eastern hills of the Mount Lofty Ranges. The proposed varied Project Area extends approximately 15 km in a north to south direction, centred on ridgelines, and is split into Area B (the central area) and Area C (southern area).

As of information supplied to EBS on 14 February 2024, Tilt have selected the locations of 40 wind turbine generator (WTG) proposed to be installed at Palmer Wind Farm. As Tilt have not finalised the designs, EBS understands that variations to the WTG locations within the defined micro-siting areas may occur in subsequent design iterations.

Advice is being sought on the potential impact of the proposed Project to birds and bats on:

- The reduction in the number of WTG from 103 to 40 (reduction of 63 WTG); and
- The selected WTG size increasing from a rotor diameter of 130 metres (m) to 180 m (increase of 50 m).

A risk assessment matrix was used to qualitatively define the risk of the proposed Project on threatened bird species observed in the Project Area and threatened bird species defined as “possibly” or “likely” to occur within the Project Area (based on the database searches). Bird species identified as having performed at-risk-movements within the Project Area (such as raptors) were also assessed. A risk assessment matrix was also used to define the risk to all bat species identified during previous surveys as occurring within the Project Area, threatened bats identified and potentially in the region and other bat species determined as “likely” to occur in the Project Area (based on database searches). The assessment is an adaptation of the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework.

Risk Assessment – Birds

The maximum rotor diameter Tilt is considering as part of the WTG update is 180 m, with a 220 m tip height, resulting in a 40 m ground clearance.

Raptors

The assessment of the risk of raptor collisions with WTG identified the following:

- **Medium** risk: Wedge-tailed Eagle, Brown Falcon, Nankeen Kestrel and Peregrine Falcon
- **Low** risk: Black-shouldered Kite, Black Kite, Collared Sparrowhawk and Little Eagle.

Of the above listed raptor species, only the Peregrine Falcon (*Falco peregrinus*) has a formal conservation status, with it being listed as Rare under the NPW Act.

Woodland birds

Compared to the minimum blade tip height of the approved Project (2019), the risk to woodland birds being impacted by the turbines is reduced by the increase in blade tip height by 5 m as woodland birds typically utilise a low air space to fly between woodland habitats.

The assessment of the risk of woodland bird collisions with WTG identified the following:

- **Medium** risk:
    - Two threatened bird species observed in the Project Area were assessed as having a medium level of risk: the EPBC Act listed species Diamond Firetail (*Stagonopleura guttata*), and the NPW Act listed Elegant Parrot (*Neophema elegans*); and
    - Two common bird species observed within the Project Area, Australian Pelican (*Pelecanus occidentalis*) and Rainbow Bee-eater (*Merops ornatus*), were assessed as having a medium risk level.
- **Low** risk:
    - Three threatened bird species observed in the Project Area were assessed as having a low level of risk;
    - Four species assessed as “likely to occur in the Project Area” were assessed as having a low level of risk; and
    - Seven common bird species identified as having performed at-risk movements within the Project Area were assessed as having a low level of risk.

Risk Assessment – Bats

The likelihood of collision causing mortality was determined as likely for all bat species, except the South-eastern Long-eared Bat (*Nyctophilus corbeni*) which was unlikely. As such the overall level of risk for all bat species was determined as medium, except for the Nationally threatened South-eastern Long-eared Bat which was assessed as low. For those species considered to have a risk level of medium, all efforts should be made to mitigate against potential impact on the species.

Discussion

If the level of risk for a species is determined as **high** to **extreme**, then resulting impact on an individual species and local population would be unacceptable. If the level of risk for a species is categorised as **medium**, then all efforts should be made to mitigate against potential impact on the species. If the level of risk for a species is determined to be **low**, then impact would be limited to the level of individuals only, and impact at a species level would be low, and is therefore considered to be unlikely to affect the viability of a local population.

The level of risk was categorised as medium for 8 out of 25 bird species and for 11 of 12 bat species. The species with medium risk level assessments were generally also defined as having a minor consequence at a species / population level. This implies that there may be an impact on the local population of this species in the event of collision with a WTG. As such all efforts should be made by Tilt Renewables to mitigate against potential impact on bird and bat species, in particular placing WTG away from woodland areas as much as possible and away from sensitive areas, such as raptor nest locations.

However, compared to previous designs, the number of turbines proposed for construction within the Varied Project is fewer and the overall rotor swept area for all turbines combined is 26% less than the approved Project design and as such may promote fewer collision events for both birds and bats compared to previous designs. In addition, 4 fewer turbines have been located in or near woodlands than the approved Project designs, reducing the potential risks for woodland birds and bats.

The location of the proposed wind farm relative to bird species that may be present, the layout of the turbines, particular landscape features and the behaviour of bird species, influence the likelihood that a bird flying through a wind farm will collide with a WTG. As such, where possible, features that increase the risk of birds colliding with WTG (such as placement of turbines near Wedge-tailed Eagle nest and Peregrine Falcon nest, or placement of turbines near woodlands) should be considered and mitigated against.

Recommendations

Based on the risk assessment, EBS recommends adopting exclusion buffers between turbines and avoiding identified bat habitat (such as woodlands) to minimise potential impacts on bat species using the Project Area.

Given the increase in WTG size, EBS would advise on incorporating a bird and bat strike monitoring program, including scavenger and detectability trials as this would assist with understanding the potential impact of the Varied Project on birds and bats. This information can then be used to determine the adequacy of mitigation measures.

If the tower height and/or blade length (and ultimately the lowest extent of the rotating tip and the rotor swept area) of proposed WTGs change, this risk assessment will need to be re-evaluated and updated accordingly.

EPBC Act listed threatened species

The following EPBC Act listed threatened species have been identified in this risk assessment:

- Hooded Robin (*Melanodryas cucullata cucullata*) (EPBC Act: Endangered);
- Diamond Firetail (*Stagonopleura guttata*) (EPBC Act: Vulnerable);
- Southern Whiteface (*Aphelocephala leucopsis*) (EPBC Act: Vulnerable);
- Blue-winged Parrot (*Neophema chrysostoma*) (EPBC Act: Vulnerable); and
- South-eastern Long-eared Bat (*Nyctophilus corbeni*) (EPBC Act: Vulnerable)

Four of the bird species, listed above, are species that have been recently listed as being of national conservation significance under the EPBC Act. These include the Hooded Robin, Diamond Firetail,

Southern Whiteface and Blue-winged Parrot. For all of the species mentioned above, an EPBC self-assessment should be undertaken to determine the potential impact the construction and operation of the proposed windfarm may have on these species. This risk assessment and information from the two-year bird utilisation survey monitoring can be used to inform impacts to these species. If a significant impact is identified as potentially occurring, an EPBC referral is required.

If additional EPBC Act listed threatened species are detected during additional bird utilisation surveys, then these species should also be included in a self-assessment to determine impacts.

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1 INTRODUCTION

Tilt Renewables (Tilt) has development plan consent for the Palmer Wind Farm Project, comprising up to 103 wind turbines with a maximum tip height of 165m. Tilt Renewables is seeking approval to vary the Project to reduce the number of turbines to 40 and to increase the maximum tip height to 220m. The Project Area is located near Palmer, approximately 50 kilometres (km) east of Adelaide (**the Project Area**), in South Australia (Figure 1). The Varied Project will incorporate wind turbine generators (herein referred to as WTGs or turbines) along with associated infrastructure, including access tracks, transmission lines and underground cabling.

EBS Ecology (EBS) has been engaged by Tilt to undertake a Bat and Avian Risk Assessment using previously collected data as well as results from the bird utilisation surveys undertaken thus far in October 2022 and January 2023, to inform the assessment of the variation application. A risk assessment was undertaken in 2014 (EBS 2014) regarding the potential impact on birds of 114 turbines with a 165 m maximum blade tip height. The 2014 risk assessment assessed the risk to birds of turbines with similar turbine parameters and dimensions as the turbine design approved in 2019. As such, EBS has taken into consideration the 2014 risk assessment as well as previous data collected at Palmer Wind Farm and combined this information with recent data, to update the risk assessment.

1.1 Project Area

The Project Area is located approximately 50 km east of Adelaide and is situated within the eastern hills of the Mount Lofty Ranges. Land use within the area is predominantly agricultural (e.g., grazing for sheep and cattle). Native vegetation in the area has been extensively cleared, with most of the Varied Project's footprint containing grasslands with large outcrops of rocks and boulders. Woodland vegetation is generally restricted within small patches and within creek lines.

The Project Area extends approximately 15 km in a north to south direction, centred on ridgelines, and is split into Area B (the central area) and Area C (southern area) (Figure 2).

Previously, there were three areas comprising the Project Area. Area A, which was located further north, will be excluded from the Project Area as a result of the variation (EBS 2014).

The Varied Project layout will be finalised pending this report and the finalisation of the flora and fauna ecological report (EBS 2024).

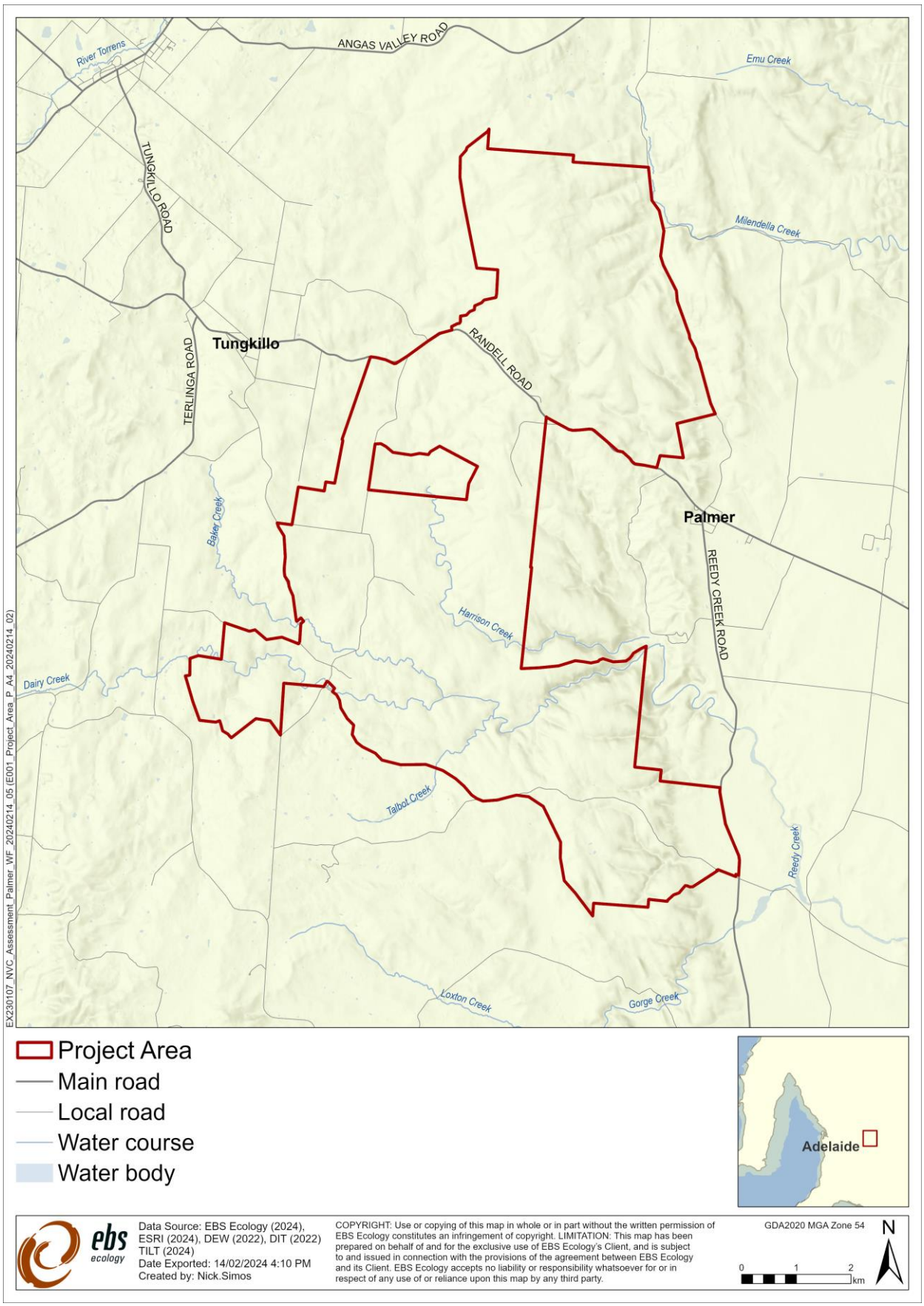


Figure 1. Location of the Varied Palmer Wind Farm Project Area.

2 BACKGROUND

2.1 Project details

As of information supplied to EBS on 14 February 2024, Tilt have selected the locations of 40 turbines proposed to be installed at Palmer Wind Farm, which is a reduction of 63 turbines from the approved designs of 103 turbines (Table 1). Tilt have not finalised the designs, thus EBS understands that variations to the turbine design and locations within the defined micro-siting areas may occur in future design iterations.

Advice is being sought on the potential impact to birds and bats as a result of:

- The reduction in the number of WTG from 103 to 40 (reduction of 63 WTG); and
- The selected WTG size increasing from a rotor diameter of 130 m to 180 m (increase of 50 m).

Figure 2 shows the number and location of WTG, distributed across the two areas remaining in the Varied Project layout, following the variation:

- Area B (central area) – 19 WTG; and
- Area C (southern area) – 21 WTG.

The Project commenced in 2009, with a Development Application lodged with the Mid-Murray Council pursuant to the Development Act 1993 in February 2014 for a layout of 114 turbines. The Development Application was approved in December 2015, then appealed and approved at the Supreme Court in 2019 subject to conditions (the approved Project). WTG designs for early planning, the approved Project and the Varied Project are provided in Table 1.

2.2 Previous risk assessments

The following report was prepared by EBS:

- A risk assessment was undertaken by EBS in 2014 as part of the Flora and Fauna Ecological Assessment for bird species at risk of potential impacts from wind turbines at the proposed Palmer Wind Farm (EBS 2014).

2.3 Current design plans

The maximum rotor diameter Tilt is considering as part of the update is 180 m, with a 220 m tip height resulting in a 40 m ground clearance (Table 1). This is an increase from the previously approved turbine design of 25 m to the blade length, 50 m to the rotor diameter, 55 m to the maximum tip height and 5 m to the minimum tip height.

While the rotor swept area for each turbine has increased by 92%, overall the number of WTG's has decreased by 63 (61% reduction) and the total rotor swept area of all turbines proposed for Palmer Wind Farm has decreased by 26% when compared to the approved Project (Table 1).

Table 1. Changes in WTG layout and parameters for Palmer Wind Farm.

Parameter	Early Planning (2014)	Approved Project (2019)	Varied Project (2024)	Change from Early Planning (2014) to Approved Project (2019)	Change from Approved Project (2019) to Varied Project (2024)
Number of turbines	114	103	40	Decrease by 11 WTG (10% reduction)	Decrease by 63 WTG (61% reduction)
Blade length (m)	65	65	90	No Change	Increase by 25m (38% increase)
Rotor diameter (m)	130	130	180	No Change	Increase by 50m (38% increase)
Maximum tip height (m)	165	165	220	No Change	Increase by 55m (33% increase)
Minimum tip height / ground clearance (m)	35	35	40	No Change	Increase by 5m (14% increase)
Rotor swept area per turbine (m^2)	13,273	13,273	25,447	No Change	Increase by 12,173m^2 (92% increase)
Rotor swept area all turbines (m^2)	1,513,122	1,367,119	1,017,880	Decrease by 146,003m^2 (10% reduction)	Decrease by 349,239m^2 (26% reduction)

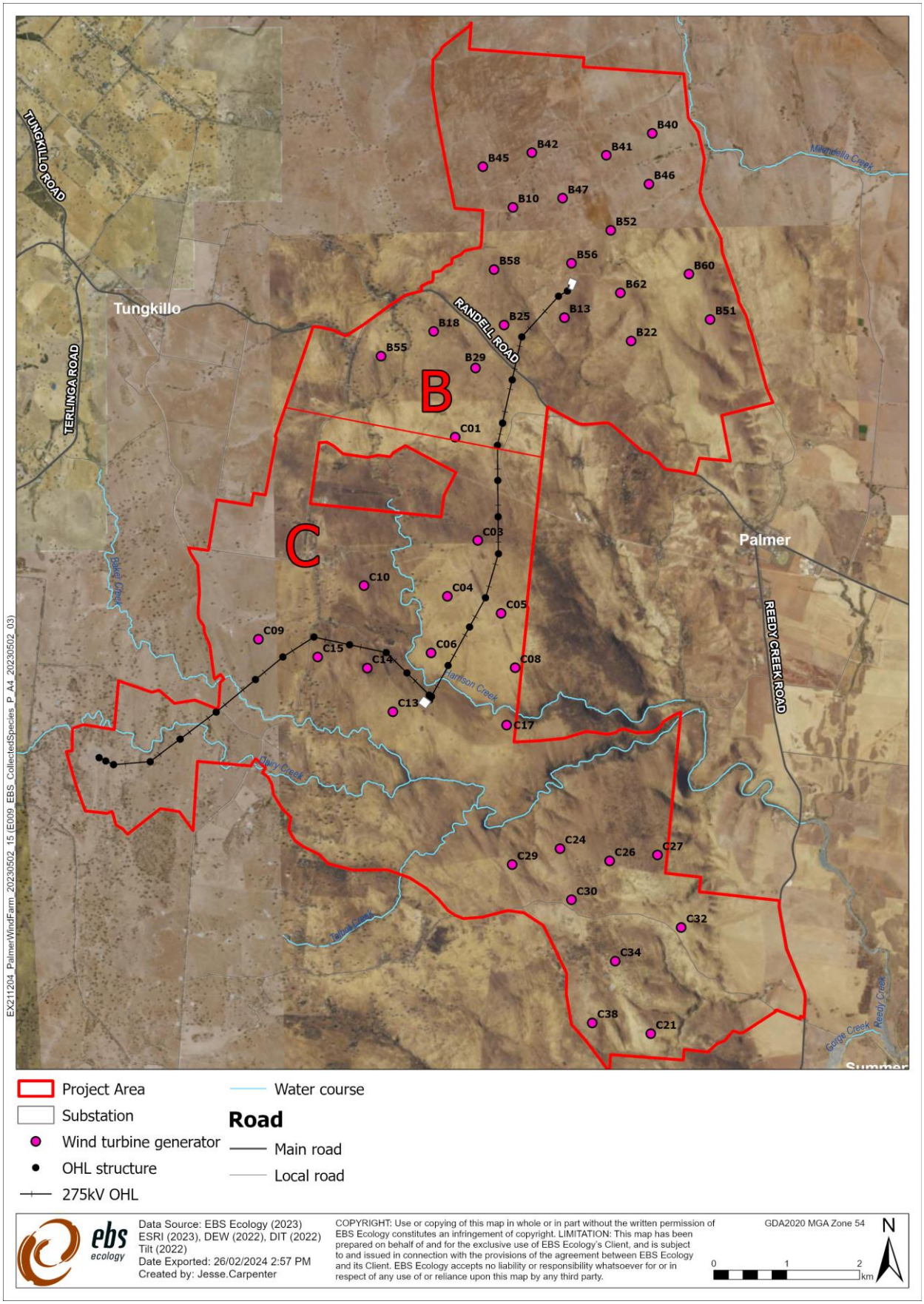


Figure 2. Location of the Wind Turbine Generators at Varied Project. Area B is located to the north and Area C is located to the south.

2.4 Wind farm impacts on avifauna

The potential impacts of wind farms on avifauna include:

- Rotor strikes (bird mortality);
- Barotrauma (bat mortality);
- Clearance and degradation of habitat;
- Acoustic masking; and
- Behavioural avoidance.

2.4.1 Rotor strikes

Bird species that regularly fly at heights swept by turbine rotors are prone to rotor strike. This includes raptors, which are one of the most at-risk groups of bird from wind farms due to their flight height, low fecundity and long lifespans (Beston *et al.* 2016), which means that the replacement of struck individuals within the population takes considerable time and energy, and population declines may occur (Dahl *et al*. 2012).

Worldwide, raptors and birds of prey have been extensively documented as a high-risk species for WTG collision (Thaxter *et al.* 2017), and in Australia collisions of raptors with WTG have been documented for Tasmania Wedge-tailed Eagle (*Aquila audax fleayi*) (Hull *et al.* 2015), Wedge-tailed Eagle (*Aquila audax*), White-bellied Sea Eagle (*Haliaeetus leucogaster*), Swamp Harrier (*Circus approximans*), Brown Falcon (*Falco berigora*), Black-shouldered Kite (*Elanus axillaris*), Australian Hobby (*Falco longipennis*), Brown Goshawk (*Accipiter fasciatus*), Collared Sparrowhawk (*Accipiter cirrocephalus*), Little Eagle (*Hieraaetus morphnoides*), Nankeen Kestrel (*Falco cenchroides*), Peregrine Falcon (*Falco peregrinus*), Whistling Kite (*Haliastur sphenurus*) and Black Falcon (*Falco subniger*) (Hull *et al* 2013; Maloney *et al.* 2019).

EBS has undertaken bird strike monitoring at Hornsdale Wind Farm. From the results analysed thus far (from either evidence of a carcass or feather spot), it has been determined that 4 raptor species (Wedge-tailed Eagle, Brown Falcon, Nankeen Kestrel and Peregrine Falcon) have collided with turbines at Hornsdale Wind Farm (EBS 2019). Additionally, EBS conducted raptor survey / monitoring at Snowtown Wind Farm over a six-year period (EBS 2013), whereby three Wedge-tailed Eagles were known to have collided with wind turbines. This number may be an underestimation of strike rates, as detectability and scavenging of the carcases may contribute to underrating collisions.

Bird collisions with seemingly slow-moving turbine blades occur as a result of the following possible reasons:

- Due to the optics of bird vision, as the bird approaches the spinning blades, the rate the image is transmitted to the bird's brain speeds up until the retina cannot keep up with it, creating a blur (called motion blur) that the bird likely translates as being safe air space (Hodos 2003). Birds could therefore assess this area as safe and risk colliding with the turbine blades.

- Due to birds narrow frontal field of view and expected high use of their lateral field of view for detecting prey, predators and other conspecifics, birds may not observe turbines while undertaking other activities, increasing their risk of collision (May *et al.* 2020).

2.4.2 Barotrauma

Bats succumb to barotrauma at wind farm turbines whereby the rapid air-pressure reduction near moving turbines causes tissue damage to air-containing structures (Baerwald *et al*. 2008). The number of bat mortalities at wind farms is expected to be substantial, with 44 bat carcasses identified within one year of monthly monitoring over 25 turbines at Ararat Wind Farm, Victoria (BL&A 2018). The true number of bat mortalities across these 25 turbines would be significantly higher than 44 deaths, as scavenging rates and surveyor error (failed detection during searches) was not accounted for. Bat monitoring at McArthur Wind Farm in south-western Victoria found annual bat mortality per turbine to be 1.41 ± 0.65 and 3.08 ± 1.68 in 2013 and 2014, respectively (AERS 2015).

2.4.3 Clearance and degradation of habitat

The proposed Project will result in the direct clearance of habitat for hardstands, access tracks, transmission lines and substations. For the construction of wind farms, clearance of remnant native vegetation is expected to be required and can contribute to habitat loss, fragmentation and degradation of habitat. In particular, habitat loss is expected to be unfavourable to small passerine species with specific habitat preferences and favourable to large generalist species (Szabo *et al*. 2011). If any hollow bearing trees, are to be cleared, this contributes to the loss of roosting and nesting habitat for bird and bat species with those specific habitat requirements. Furthermore, where native vegetation borders the infrastructure footprint, habitat is at a higher risk of to becoming degraded from weed invasion, erosion and other edge effects.

2.4.4 Acoustic masking

The noise associated with a wind farm may have adverse impacts on songbirds (Zwart *et al*. 2016). Acoustic masking caused by wind farm noise may affect the ability of individuals with established territories to deter a rival (Zwart *et al*. 2016). As such, increased time and energy would need be spent for maintaining territories, which could result in reduced breeding success of sedentary territorial bird species (Zwart *et al*. 2016). In South Australia, acoustic masking is thought to be one of the key drivers of reduced songbird abundance in areas within 500 m of mining activity (Read *et al*. 2015).

2.4.5 Behavioural avoidance

Raptors are known to substantially reduce their presence within an area following the construction of a wind farm. While this reduces the number of individuals that succumb to rotor strike, it may displace pairs from their established territories, which can reduce breeding success. The impact of rotor strike and displacement of individuals is considered to have reduced the breeding success of White-tailed Eagles (*Haliaeetus albicilla*) within occupied territories from 48% before wind farm construction to 22% post construction (Dahl *et al*. 2012). Displacement of raptors at a wind farm also occurred in Wisconsin, United States of America, where a 47% reduction in raptor abundance was recorded following wind farm construction (Garvin *et al*. 2011). At two wind farms in Tasmania, flight tracks and behaviour of Wedge-

tailed Eagles were recorded over two years, which demonstrated that Wedge-tailed Eagles had avoidance rates of 81% to 97% higher compared to pre-construction, although this varied between sites and in different weather conditions (Hull & Muir 2013).

3 METHODS

3.1 Risk assessment

3.1.1 Assessment of the likelihood of species utilising Project Area

A likelihood of occurrence rating (i.e., likelihood of that species occurring on or near the Project Area) was assigned to each threatened species identified in the Protected Matters Search Tool (PMST (DCCEEW 2023) and Biological Databases of South Australia (BDBSA) database search (DEW 2023 Recordset number: DEWNRBDBSA230614-1) with a 10 km search area around the Varied Project. The PMST identifies nationally threatened flora, fauna, migratory fauna and threatened ecological communities relevant to the search area. The BDBSA database search 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. As EBS records are submitted to the BDBSA databased, records from surveys conducted in 2014 are also included in the BDBSA database that are used to inform the likelihood of species using the Project Area.

This likelihood of occurrence rating, 'Highly Likely', 'Likely', 'Possible' and 'Unlikely' takes the following criteria into consideration:

- proximity of the records (distance to the Project Area);
- date of the records;
- landscape features, vegetation remnancy and vegetation type at the location of the record (taking into consideration similarities within the Project Area); and
- knowledge of species' habitat preferences, causes of decline, and local population trends.

Bird and bat species observed in the Project Area during field surveys undertaken at Palmer Wind Farm were assigned as "known" to occur within the Project Area. Threatened species assessed as potentially occurring in the area (i.e., "possible", "likely", "highly likely", or "known") were included in the risk assessment. Common bird and bat species that are known to occur in the Project Area and that were assessed as at risk of flying within the rotor swept height of WTG were included in the assessment.

A detailed description of the criteria for likelihood assessments is provided in the ecological assessment report (EBS 2024).

3.1.2 Level of risk

A risk assessment matrix was used to qualitatively define the risk of the Varied Project on threatened bird species observed in the Project Area and threatened bird species defined as "possibly" or "likely" to occur within the Project Area (based on the PMST search and BDBSA search). Bird species identified as having performed at-risk movements within the Project Area (such as raptors) were also assessed.

A risk assessment matrix was used to define the risk to all bat species identified during previous surveys as occurring in the Project Area, threatened bats identified and potentially in the region and other bat species determined as "likely" to occur in the Project Area (based on the BDBSA search).

The assessment is an adaptation of the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework (Gaidow and Boey 2005). The Australian Defence Risk Management Framework provides generic guidance on the introduction and ongoing implementation of a risk management process; it may be applied to different activities or operations of any corporate, community or public sector organisation (Gaidow and Boey 2005). The risk assessment matrix considered the risk consequences (impact or magnitude of effect) and likelihood (measured by frequency or probability) of risk occurrence to combine both into the overall level of risk.

The risk assessment methodology used within the Australian Defence Risk Management Framework was adapted to include likelihood and consequence of an event on a species or local population. EBS used the matrix to qualitatively define the risk of a proposed wind monitoring mast on birds within numerous proposed wind farms located in the mid-north of South Australia and has been accepted (when previously used by EBS) by the Environment, Resources and Development Court. State threatened bird species, raptors and migratory species were targeted in the assessment.

Likelihood was defined as how likely mortality from collision is to occur, and consequence was defined by significance of associated impact on species viability (Table 2):

- Categories A to E were used to define likelihood, ranging from chronic (the event is expected to occur in most circumstances) to rarely (where the event may occur only in exceptional circumstances).
- Categories 1-5 were used to define consequence, where one equated to nil/insignificant (individuals may be affected, but viability of local population was not impacted) and five equated to catastrophic disaster (potential to lead to collapse of a species) (Table 2).

Table 3 outlines the qualitative risk analysis matrix, which summarises four levels of impact: low, medium, high and extreme.

If the level of risk was determined to be high to extreme, then resulting impact on an individual species and local population may be unacceptable when considered through regulatory approval processes. If the level of risk was categorised as medium, then all efforts should be made to mitigate against potential impact on the species. If the level of risk was low, then impact would be restricted to an individual level and impact on a species would be unlikely to affect the viability of a local population.

3.2 Limitations

The findings and conclusions expressed by EBS are based solely upon information available at the time of the assessment.

Existing flora and fauna records were sourced from the BDBSA. The BDBSA only includes verified flora and fauna records submitted to the Department for Environment and Water or partner organisations. Although much of the BDBSA data has been through a variety of validation processes, the lists may contain errors and should be used with caution.

There is limitation in determining the resulting impact of acceptability and significance with regard to the risk assessment matrix. The risk assessment matrix provides a guide to risk consequences and likelihood

of risk occurrences, based on the bird species that were identified as performing flights considered as ‘at-risk’ movements.

Table 2. Qualitative measures of likelihood and consequence (adopted from AS/NZS 4360:1999, now superseded by AS ISO 31000:2018).

Likelihood (how likely is mortality from collision to occur)		Consequence (Significance of associated impact on species viability)	
Rating	**Definition**	**Rating**	**Definition**
Chronic	The event is expected to occur in most circumstances.	**Catastrophic/ Disaster**	Potential to lead to collapse of species.
Frequent	The event probably will occur in most circumstances (e.g., weekly to monthly).	**Major**	Critical event, very likely to have significant impact on species.
Likely	The event should occur at some time (i.e., once in a while).	**Moderate**	Likely to have impact on population, potential to impact on long-term viability under some scenarios.
Unlikely	The event could occur at some time.	**Minor**	May have impact on local population, no impact on species.
Rarely	The event may occur only in exceptional circumstances.	**Insignificant**	Individuals may be affected, but viability of local population not impacted.

Table 3. Qualitative Risk Analysis Matrix – Level of Risk (adopted from AS/NZS 4360:1999 [superseded by AS ISO 31000:2018] and HB 143:1999 [superseded by SA SNZ HB 436-2013]).

Likelihood	Consequences				
	Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
A (Chronic)	High	High	Extreme	Extreme	Extreme
B (Frequent)	Medium	High	High	Extreme	Extreme
C (Likely)	Low	Medium	High	Extreme	Extreme
D (Unlikely)	Low	Low	Medium	High	Extreme
E (Rarely)	Low	Low	Medium	High	High

4 AVIAN RISK ASSESSMENT

4.1 Results from previous risk assessments (EBS 2014)

The risk assessment completed by EBS in 2014 was based on proposed turbines with a maximum tip of blade height of 165 m. The dimensions of the WTG tower and blade were yet to be decided by TrustPower. Indicative dimensions were 100 m for the tower height and 65 m for the blade lengths. The 2014 risk assessment was based on the lowest extent of a rotating blade tip being 35 m from the ground.

Flight height and movement details were specifically recorded for 'at-risk' bird species; meaning those species with the potential to fly at heights within the rotor-swept area, making them at risk of collision with WTG. Flight height and movement details were used to assess the potential collision risk of avian species. In 2014 flights that were performed above 35 m over the top of a ridge were considered at-risk movements.

The overall level of risk for all bird and bat species was determined as **low** in the 2014 assessment (Table 4). The likelihood of collision causing mortality was determined as unlikely for six raptor species (including the Peregrine Falcon (*Falco peregrinus*)) and five threatened bird species. Two State threatened bird species known to occupy woodland habitats were assessed in the likelihood of a collision event causing mortality as rare. The consequence of mortality at a species/population level was determined as **minor** for four species: the Peregrine Falcon, Hooded Robin (*Melanodryas cucullata cucullata*), Elegant Parrot (*Neophema elegans*) and Diamond Firetail (*Stagonopleura guttata*).

4.2 Updated avian risk assessment 2024

The updated risk assessment was undertaken to determine the potential impact of the proposed Project on bird species, where the risk element of concern remain unchanged, as collision. The maximum rotor diameter of proposed WTGs is 180 m, with a 220 m tip height, resulting in a 40 m ground clearance.

The updated risk assessment is based on the lowest extent of the rotating blade tip and the rotor swept area being 40 m from the ground, which is a difference of 5 m from the 2014 risk assessment. For the purposes of the updated risk assessment, flights that would be performed above 40 m over the top of the ridge would be considered at-risk movements, as this air-space would correspond with the rotor-swept area of turbines.

It is anticipated that with the varied WTG design, with the updated blade tip height, reduces the risk of woodland birds being impacted by turbines by 5 m compared to the approved Project, as woodland birds typically utilise a low air space to fly between woodland habitats. In addition, 4 fewer turbines have been located in or near woodlands than the approved Project designs, further reducing the potential risks for woodland birds.

New assessments were performed for additional raptor species (two species) and threatened bird species known to the Project Area since 2014 (three species), and any common bird species assessed in field surveys as flying within the rotor swept height of the turbines (eight species). The Collared Sparrowhawk and Nankeen Kestrel were additional raptor species to be included in the risk assessment as they were observed in the Project Area and have been identified as colliding with turbines in a study of Victorian Wind Farms (Maloney *et al.* 2019).

One bird species listed as vulnerable under the EPBC Act and four species listed under the *National Parks and Wildlife Act 1974* (NPW Act), were observed during surveys at the proposed Palmer Wind Farm Project Area. Of the species recorded in the Project Area, eight raptors and nine common bird species were considered at risk, as determined by flight heights and / or flight behaviours (Table 4). One species not observed in the Project Area but assessed as possibly occurring in the Project Area (Blue-winged Parrot, *Neophema chrysostoma*) was also considered at risk due to the potential to fly in the rotor swept zone.

Raptors

As a result of bird strike monitoring data at other wind farms, as well as the larger rotor-swept area of the proposed wind turbines compared to the approved design, EBS has increased the risk assessment levels for four raptor species (Table 4). However, it is noted that the reduction in the number of turbines has decreased the total rotor-swept area of the Varied Project by 26% and the potential impact of this is discussed in section 6. As such Wedge-tailed Eagle, Brown Falcon, Nankeen Kestrel and Peregrine Falcon have been assessed as having a **medium** risk level, and Black-shouldered Kite, Black Kite, Collared Sparrowhawk and Little Eagle have been assessed as having a **low** risk level of impact due to collision with turbines.

The risk assessment levels for raptors changed from the 2014 assessment as listed below:

- Wedge-tailed Eagle, Brown Falcon, Peregrine Falcon and Little Eagle
    - Change in likelihood of an event causing mortality increased from unlikely to likely.

  - Change in their consequence at a species / population level changed from nil / insignificant to minor;
  - Risk level increased from low to medium.

- Collared Sparrowhawk was assessed as being unlikely to have an event causing mortality and nil / insignificant consequences at a species / population level resulting in a low level of risk.
- Nankeen Kestrel was assessed as being likely to have an event causing mortality and minor consequences at a species / population level, resulting in a medium level of risk.

All species assessed as having a medium level of risk were identified as potentially being affected at the local population level, but not at the overall species level. For the species of which risk was determined as low, individuals may be affected, but the viability of local populations will not be impacted upon.

Woodland birds

The risk of collision for woodland birds listed in Table 4 has been increased for two species, due to the larger rotor-swept area of the proposed larger wind turbines. In general, the potential effects of a wind farm on woodland bird species are related to (1) possible loss of habitat and (2) disturbance from turbines if situated close to woodlands. Direct interaction with turbine blades is now considered unlikely for woodland specific bird species (unless otherwise stated in Table 4), as the rotor-swept area is higher than typical flight heights observed for woodland birds at Palmer Wind Farm.

A summary of the risk assessment for threatened woodland birds known to occur in the Project Area is as follows (Table 4):

- One species of threatened bird had their likelihood of an event causing mortality changed from unlikely to likely (Elegant Parrot (*Neophema elegans*)). The consequence to the species / population for this species remained as minor and as such the risk level has been upgraded to **medium**;
- Two species assessments remained the same and their risk rating remained as **low** (White-winged Chough (*Corcorax melanorhamphos*) and Hooded Robin (*Melanodryas cucullata cucullata*));
- The likelihood of an event causing mortality for the Diamond Firetail (*Stagonopleura guttata*) remained the same as unlikely and the consequence for the species / population was upgraded to moderate due to the absence of suitable habitat for this species in the broader landscape. As such the risk level increased to **medium**;
- White-bellied Cuckoo-shrike was added to the list and was assessed as having a **low** risk level due to vagrant presence in the area and low flight height between woodlands.

A summary of threatened birds listed as possibly or likely to occur within the Project Area is as follows (Table 4):

- Two newly listed EPBC Act listed threatened bird species have been added to the risk assessment: Southern Whiteface (*Aphelocephala leucopsis*) and Blue-winged Parrot (*Neophema chrysostoma*);
- Three bird species (Southern Whiteface, Jacky Winter (*Microeca fascinans*) and Restless Flycatcher (*Myiagra inquieta*)) have been assessed for the likelihood of an event causing mortality as rarely with a consequence of minor.
- The Southern Whiteface, Jacky Winter, Restless Flycatcher and Blue-winged Parrot have been assessed as having a risk level of **low**.

A summary of “at risk” common bird species within the Project Area is as follows (Table 4):

- Seven bird species observed flying in the rotor swept zone have been assessed as being likely to have an event causing mortality with nil / insignificant consequences. As such these species have been assessed as having a **low** risk level;

- Two bird species, Australian Pelican (*Pelecanus occidentalis*) and Rainbow Bee-eater (*Merops ornatus*), were assessed as having a **medium** risk level as they are likely to have an event causing mortality and the impact on the species / population will be minor.

In summary – level of risk

Eight species included in this risk assessment have been assessed as having a **medium** level of risk. Of these, four are raptors and two are threatened species (one of which are EPBC Act listed). The remaining seventeen species have been assessed as having a **low** level of risk.

If the level of risk for a species is determined as high to extreme, then resulting impact on an individual species and local population may be unacceptable when considered through regulatory approval processes. If the level of risk for a species is categorised as medium, then all efforts should be made to mitigate against potential impact on the species. If the level of risk for a species is determined to be low, then impact would be limited to the level of individuals only, and impact at a species level would be low, and is therefore considered to be unlikely to affect the viability of a local population.

Table 4. Updated avian risk assessment of the proposed Palmer Wind Farm.

Scientific name	Common name	Aus. status	SA status	Likelihood of utilising Project Area	Likelihood of an event causing mortality		Consequence at a species / population level		Level of risk	
					2014	2024	2014	2024	2014	2024
Raptor species										
Accipiter cirrocephalus	**Collared Sparrowhawk**			Known	-	Unlikely	-	Nil/ Insignificant	-	Low
Aquila audax	Wedge-tailed Eagle			Known	Unlikely	Likely	Nil/ Insignificant	Minor	Low	Medium
Elanus axillaris	Black-shouldered Kite			Known	Unlikely	Unlikely	Nil/ Insignificant	Nil/ Insignificant	Low	Low
Falco berigora	Brown Falcon			Known	Unlikely	Likely	Nil/ Insignificant	Minor	Low	Medium
Falco cenchroides	Nankeen Kestrel			Known	-	Likely	-	Minor	-	Medium
Falco peregrinus	Peregrine Falcon		R	Known	Unlikely	Likely	Nil/ Insignificant	Minor	Low	Medium
Milvus migrans	Black Kite			Known	Unlikely	Unlikely	Nil/ Insignificant	Nil/ Insignificant	Low	Low
Hieraaetus morphnoides	Little Eagle			Known	Unlikely	Unlikely	Nil/ Insignificant	Minor	Low	Low
Threatened birds known to occur in the Project Area										
Coracina papuensis	**White-bellied Cuckooshrike**		R	Known	-	Unlikely	-	Nil/ Insignificant	-	Low
Corcorax melanorhamphos	White-winged Chough		R	Known	Unlikely	Unlikely	Nil/ Insignificant	Minor	Low	Low
Melanodryas cucullata cucullata	Hooded Robin	EN	R	Known	Unlikely	Unlikely	Minor	Minor	Low	Low
Neophema elegans	Elegant Parrot		R	Known	Unlikely	Likely	Minor	Minor	Low	Medium
Stagonopleura guttata	Diamond Firetail	VU	V	Known	Unlikely	Unlikely	Minor	Moderate	Low	Medium
BDBSA determined as 'Possible' or 'Likely' to occur in the Project Area										
Aphelocephala leucopsis	**Southern Whiteface**	VU		Possible	-	Rarely	-	Minor	-	Low
Microeca fascinans	Jacky Winter		R	Likely	Rarely	Rarely	Nil/ Insignificant	Minor	Low	Low

Scientific name	Common name	Aus. status	SA status	Likelihood of utilising Project Area	Likelihood of an event causing mortality		Consequence at a species / population level		Level of risk	
					2014	2024	2014	2024	2014	2024
Myiagra inquieta	Restless Flycatcher		R	Likely	Rarely	Rarely	Nil/ Insignificant	Minor	Low	Low
Neophema chrysostoma	**Blue-winged Parrot**	VU	V	Possible	-	Unlikely	-	Minor	-	Low
"At risk" common bird species that occur in the Project Area										
Cacatua sanguinea	**Little Corella**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Corvus mellori	**Little Raven**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Eolophus roseicapilla	**Galah**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Gymnorhina tibicen	**Australian Magpie**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Hirundo neoxena	**Welcome Swallow**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Merops ornatus	Rainbow Bee-eater	Ma		Known	Unlikely	Likely	Nil/ Insignificant	Minor	Low	Medium
Pelecanus occidentalis	**Australian Pelican**			Known	-	Likely	-	Minor	-	Medium
Petrochelidon ariel	**Fairy Martin**			Known	-	Likely	-	Nil/ Insignificant	-	Low
Platycercus elegans	**Crimson Rosella**			Known	-	Likely	-	Nil/ Insignificant	-	Low

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. Mi: Migratory. Ma: Marine – protected in Marine Protected Areas. "-" = not assessed. Species in bold were not assessed in the 2014 assessment.

Likelihood definitions (how likely is mortality from collision to occur):

- **Chronic – the event is expected to occur in most circumstance**
- **Frequent - the event probably will occur in most circumstances**
- **Likely - the event should occur at some time**
- **Unlikely – the event could occur at some time**
- **Rarely – the event may occur only in exceptional circumstances.**

Consequence definitions (significance of associated impact on species viability):

- **Catastrophic disaster – the event has the potential to lead to collapse of species**
- **Major– critical event, very likely to have significant impact on species**
- **Moderate– likely to have impact on population, potential to impact on long term viability under some scenarios**
- **Minor – the event may impact on local population, no impact on species**
- **Nil/Insignificant - individuals may be affected, but viability of local population not impacted.**

5 BAT RISK ASSESSMENT

5.1 Results from previous risk assessments (EBS 2014)

The risk assessment matrix (EBS 2014) was not used to determine the likelihood and significance of bat mortality associated with turbine collision. However, the potential risk of impact to bat species was considered to be very low (EBS 2014), based on the identification of only common bat species in the area and that the majority of bats recorded were within the vicinity of woodlands, open water and linear movement corridors. These location preferences reduced the likelihood of collisions.

AnaBat surveys confirmed the presence of seven bat species (EBS 2014), none of which had a conservation rating at state or national level. Although undetected, a further three species of bat were determined as likely to be in the Project Area and two threatened bat species (one national/state vulnerable and one state rare), were determined as potentially occurring within the region, which was based on potential habitat and distribution of the species. The state listed threatened species was determined as possibly occurring, although only infrequently and in low numbers (EBS 2014).

No flight heights were recorded for bat species recorded during the surveys conducted by EBS, due to the methods used to identify bat species (a combination of AnaBat and Harp Traps), as well as the fact that the methodology used was at a Level 1 bat survey (as per *AUSWIND Best Practice Guidelines* 2006).

5.2 Updated bat risk assessment 2024

For the purposes of this risk assessment, EBS has assumed that all bat species recorded during the surveys and determined as likely to occur within the Palmer Wind Farm, are at risk of colliding with turbines.

There is a possibility of bats flying into the rotor swept area as they traverse between areas and through wooded habitats. Being nocturnal, bats need places to roost during the day that provide shelter from the weather and potential predators. Most microbats will roost in tree hollows or under bark; flight height of bats as they leave their roosting sites and fly between areas may coincide with the revised rotor swept area.

The risk assessment includes assessing 12 bat species (Table 5):

- Seven bat species (confirmed through AnaBat surveys);
- Three additional bat species, which were determined as likely to occur in the Project Area; and
- Two threatened bat species determined as potentially occurring within the region (based on habitat and distribution of the species).

The likelihood of occurrence for the EPBC Act listed South-eastern Long-eared Bat (*Nyctophilus corbeni*) was decreased from likely in the 2014 risk assessment to unlikely as the removal of turbines in Area A has increased the distance from past records and as such reduced the likelihood the species will occur in the Project Area.

The consequence of mortality at a species/population level was determined as minor for all 12 bat species; the consequence of mortality may impact on the local population for these species, however, is unlikely to impact on the overall species.

Updated literature indicates that bat species in Australia are known to have mortality events with turbines (Maloney *et al.* 2019) and as such the risk level was increased to medium for all bats, except the South-eastern Long-eared Bat. Risk to bats from this Project is discussed further in section 6. As such the overall level of risk for all bat species was determined as **medium**, except for the nationally threatened South-eastern Long-eared Bat which was assessed as **low**.

Table 5. Updated bat risk assessment of the proposed Palmer Wind Farm.

Scientific name	Common name	Aus status	SA status	Likelihood of utilising Project Area	Likelihood of an event causing mortality 2024	Consequence at a species / population level 2024	Level of risk 2024
Bat species (ID AnaBat)							
Chalinolobus gouldii	Gould's Wattled Bat			Known	Likely	Minor	Medium
Chalinolobus morio	Chocolate Wattled Bat			Known	Likely	Minor	Medium
Mormopterus species 4 "big dick")	Southern Freetail-bat			Known	Likely	Minor	Medium
Nyctophilus geoffroyi	Lesser Long-eared Bat			Known	Likely	Minor	Medium
Tadarida australis	White-striped Freetail-bat			Known	Likely	Minor	Medium
Vespadelus darlingtoni	Large Forest Bat			Known	Likely	Minor	Medium
Vespadelus regulus	Southern Forest Bat			Known	Likely	Minor	Medium
Threatened bats (potentially in the region)							
Nyctophilus corbeni	South-eastern Long-eared Bat	VU	V	Unlikely	Unlikely	Minor	Low
Saccolaimus flaviventris	Yellow- bellied Sheath-tail Bat		R	Likely	Likely	Minor	Medium
BDBSA determined as 'Likely to occur in the Project Area'							
Mormopterus species 3.	Inland Freetail Bat			Likely	Likely	Minor	Medium
Scotorepens balstoni	Inland Broad-nosed Bat			Likely	Likely	Minor	Medium
Vespadelus vulturnus	Small Forest Bat			Likely	Likely	Minor	Medium

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

Likelihood definitions (how likely is mortality from collision to occur):

- **Chronic – the event is expected to occur in most circumstance**
- **Frequent - the event probably will occur in most circumstances**
- **Likely - the event should occur at some time**
- **Unlikely – the event could occur at some time**
- **Rarely – the event may occur only in exceptional circumstances.**

Consequence definitions (significance of associated impact on species viability):

- **Catastrophic disaster – the event has the potential to lead to collapse of species**
- **Major– critical event, very likely to have significant impact on species**
- **Moderate– likely to have impact on population, potential to impact on long term viability under some scenarios**
- **Minor – the event may impact on local population, no impact on species**
- **Nil/Insignificant - individuals may be affected, but viability of local population not impacted.**

6 DISCUSSION

The level of risk was categorised as medium for 8 out of 25 bird species listed in Table 4 (p18) and for 11 of 12 bat species listed in Table 5 (p22). The species with medium risk level assessments were generally also defined as having a minor consequence at a species / population level. This implies that there may be an impact on the local population of this species in the event of collision with a turbine. As such all efforts should be made by Tilt Renewables to mitigate against potential impact on bird and bat species, in particular placing turbines away from woodland areas as much as possible and away from sensitive areas, such as raptor nest locations.

Since the designs were approved in 2019, two new species have been added to the EPBC Act list of threatened species: Southern Whiteface (*Aphelocephala leucopsis*) (EPBC Act: Vulnerable) and Diamond Firetail (*Stagonopleura guttata*) (EPBC Act: Vulnerable; NPW Act: Vulnerable). Both of these species are woodland birds, and with the minimum tip height for the turbines being 40 m as a result of the variation, the likelihood of these birds experiencing a collision is reduced. However, given the presence of Diamond Firetails in the Project Area and the limited connected woodland habitat within the broader region, the consequence of a collision event for the Diamond Firetail has been assessed as having a moderate impact on the species. As such, the consequence of mortality may have the potential to impact the long-term viability of the population for this species.

Four raptors remain at a medium impact level due to their flight behaviour (particularly while foraging) and that they are frequently recorded flying at heights within the rotor swept area. Additionally, raptor species listed as medium have been observed in the Project Area occurring near proposed turbine sites (in particular Nankeen Kestrel and Wedge-tailed Eagles) (Appendix 1). Raptors such as Wedge-tailed Eagles and Peregrine Falcons generally reside and nest in permanent home ranges. As such when they intersect with wind farms there is a higher risk of collision (Smales 2006). These raptors are particularly at risk during the breeding season as they are restricted to a nesting location and are foraging more regularly to feed their young. Given there are known nest locations of Wedge-tailed Eagles and Peregrine Falcons at the Palmer Wind Farm, these species have been assessed as having a medium risk level.

Common bird species have been added to this assessment for the potential for these species to be impacted at the local population level. In particular, the Australian Pelican has been highlighted as having a medium risk level with the potential for collisions to impact on local populations as this species has been observed catching the thermal updrafts over the Project Area at potential turbine locations (pers. obs.). Additionally, Australian Pelicans typically fly in flocks and so if a collision is to occur, it is likely to result in the fatalities of multiple Pelicans at each collision event. There is, however, limited research into avoidance of turbines by these species, and if Pelicans do display avoidance behaviour, then the likelihood of collision incidence may be reduced.

All bats (except the South-eastern Long-eared Bat) were assessed as having a medium risk level. Despite not having flight height data for bats, the medium risk level was based on knowledge of bat movements and on the study by Maloney *et al.* (2019) which highlighted that six bat species that also occur at Palmer Wind Farm have previously been recorded in mortality events with wind turbines. Bats are more at risk of rotor strike when traversing between woodlands, as such, similar to woodland birds, the proximity of

turbines to woodlands and the minimum blade tip height are likely to be the main risk factors for strikes. Tilt have reduced the number of turbines placed in woodland by 4 compared to the 2014 risk assessment, which may reduce the risk of strike for bats. However, as we do not have flight height data for bats we cannot decrease the potential risk to these species.

For bats, a risk level of medium can be defined as all efforts should be made to mitigate against potential impact on the species. If efforts cannot be made to mitigate against potential impacts, alternative methods should be considered. For example, curtailment (restricting operation of turbines at low wind speeds between dusk and dawn during periods of high bat activity (summer to autumn) may reduce bat strikes (Bennet et. al 2022).

Fewer turbines with larger turbine capacity versus collision rates

A systematic literature review of recorded collisions between birds and bats and wind turbines within developed countries was undertaken by Thaxter *et al.* (2017). Collision rate was related to species-level traits and turbine characteristics to quantify the potential vulnerability of 9538 bird and 888 bat species globally. For birds, larger turbine capacity (megawatts) increased collision rates; however, constructing a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output (Thaxter *et al.* 2017). Compared to previous designs, the number of turbines proposed for construction within the Varied Project is fewer as a result of the variation. The overall rotor swept area for all turbines combined is 26% less than the approved Project design and as such may promote fewer collision events for both birds and bats compared to previous designs. In addition, 4 fewer turbines have been located in or near woodlands than the approved Project designs, reducing the potential risks for woodland birds and bats.

In the data summarised by Thaxter *et al.* (2017), vulnerability to collision was related to habitat, migratory status and dispersal distance for birds. It was found that high collision rates for species associated with agricultural habitats may reflect the disproportionate number of wind farms from agricultural landscapes that were in the sample. Results suggested that grassland species may also be more vulnerable to collision (Thaxter *et al.* 2017). Migratory species are often suggested as being vulnerable to collision with wind farms, for which the results outlined in Thaxter *et al.* (2017) were supportive.

Thaxter *et al*. (2017) cautioned that model certainty for bats was low, as more research is required to understand the relationship between collision risk and turbine size for larger (and more efficient) turbines, and how this may vary between habitats. For example, grassland cover may best reflect openness of a landscape, a factor generally associated with reduced bat activity and abundance that may also reduce turbine collisions. Thaxter *et al.* (2017) reported that for bats, optimum turbine size of approximately 1.25MW may minimize collision and described that for bats, long-distance dispersers had the highest collision rates. It is known that tree-roosting bat species are frequently recorded in collision, potentially through attraction mechanisms (Cryan *et al.* 2014 in Thaxter *et al.* 2017), although this effect was weaker than dispersal.

The location of the wind farm relative to bird species that may be present, the layout of the turbines, particular landscape features and the behaviour of bird species influence the likelihood that a bird flying through a wind farm will collide with a turbine (Krijgsveld *et al.* 2009). As such, where possible, features that increase the risk of birds colliding with turbines (such as placement of turbines near Wedge-tailed

Eagle nest and Peregrine Falcon Nest, or placement of turbines near woodlands) should be considered and mitigated against.

Mitigation undertaken by Tilt

Based on previous recommendations, since the approved 2019 wind farm layout, Tilt have reduced the number of turbines and amended locations to reduce impacts on sensitive areas in the following ways:

- All wind turbines have been removed from Area A (an area with a high density of Wedge-tailed Eagle and Peregrine Falcon nests);
- In Area B turbines are being placed outside of a 1,000 m exclusion buffer of Wedge-tailed Eagle and Peregrine Falcon nest sites, compared to the 500 m exclusion buffer included in the approved Project; and
- In Area C, near areas of multiple Peregrine Falcon and Wedge-tailed Eagle nests (such as Bakers Gorge and Harrisons Gorge) turbine numbers have been reduced with a reduction from 38 (Approved Project) to 21 (Varied Project).

7 RECOMMENDATIONS

Based on the risk assessment, EBS recommends adopting exclusion buffers between turbines and avoiding identified bat habitat (such as woodlands) to minimise potential impacts on bat species using the Project Area.

Given the increase in WTG size, EBS would advise that incorporating a bird and bat strike monitoring program, including scavenger and detectability trials, as this would assist with understanding the potential impact of the Palmer Wind Farm on birds and bats. This information can then be used to determine the adequacy of mitigation measures.

If the tower height and/or blade length (and ultimately the lowest extent of the rotating tip and the rotor swept area) of proposed WTGs change, this risk assessment will need to be re-evaluated and updated accordingly.

EPBC Act listed threatened species

The following EPBC Act listed threatened species have been identified in this risk assessment:

- Hooded Robin (*Melanodryas cucullata cucullata*) (EPBC Act: Endangered);
- Diamond Firetail (*Stagonopleura guttata*) (EPBC Act: Vulnerable);
- Southern Whiteface (*Aphelocephala leucopsis*) (EPBC Act: Vulnerable);
- Blue-winged Parrot (*Neophema chrysostoma*) (EPBC Act: Vulnerable); and
- South-eastern Long-eared Bat (*Nyctophilus corbeni*) (EPBC Act: Vulnerable)

Four of the bird species, listed above, are species that have been recently listed as being of national conservation significance under the EPBC Act. These include the Hooded Robin, Diamond Firetail, Southern Whiteface and Blue-winged Parrot. For all of the species mentioned above, an EPBC self-assessment should be undertaken to determine the potential impact the construction and operation of the proposed windfarm may have on these species. This risk assessment and information from the two-year bird utilisation survey monitoring can be used to inform impacts to these species. If a significant impact is identified as potentially occurring, an EPBC referral is required.

If additional EPBC Act listed threatened species are detected during additional bird utilisation surveys, then these species should also be included in a self-assessment to determine impacts.

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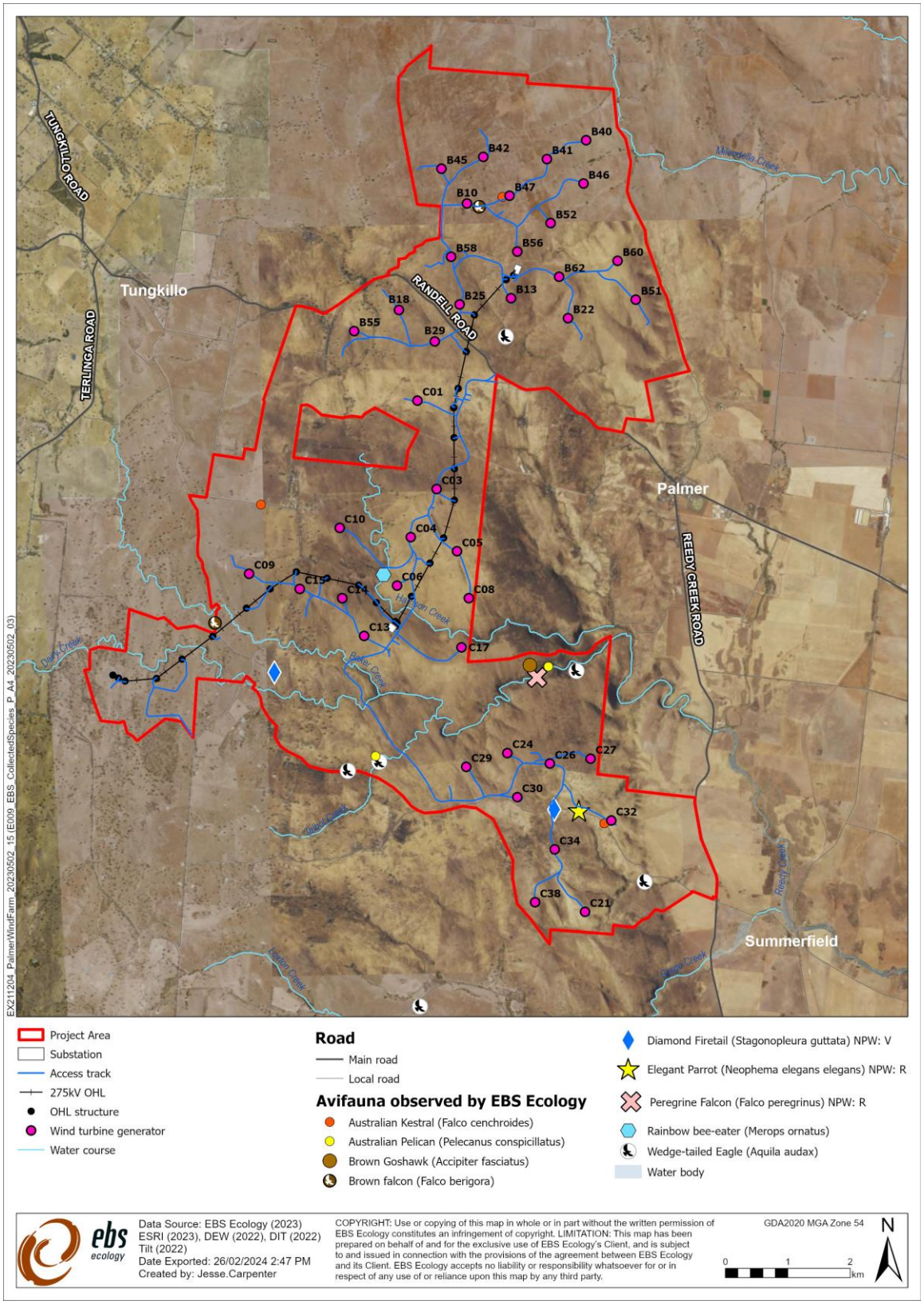
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9 APPENDICES

Appendix 1. Threatened species and raptors recorded in the Varied Project Area in October 2022 and January 2023 in relation to the location of the Wind Turbine Generators.



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Landscape Character and Probable Visual Effect Assessment

for Palmer Wind Farm Variation Application

Prepared for Tilt Renewables

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26 February 2024

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Executive Summary

Introduction

This report has been prepared by Warwick Keates of WAX Design in association with Dr Brett Grimm of Brett Grimm Landscape Architect to assess the potential visual impact of a Variation to the Approved Palmer Wind Farm (Varied Project) based on a reduced Project Area, a reduced number of wind turbines (103 to 40), and an increase in maximum turbine height (165m to 220m to the blade tip).

Purpose and Methodology

The aim of the report was to evaluate the existing landscape character and the degree of visual change that will be produced by the introduction of the Varied Project and its associated infrastructure into the existing landscape character of the locality. The potential visual effect has been assessed using a detailed methodology that involves on-site assessments, comparative assessments against the Approved Project and the preparation of photomontages that illustrate the anticipated visual effect of the Varied Project.

Existing Landscape Character

The visual impact assessment evaluates and describes the likely visual effect of the Varied Project on the landscape, with consideration of changes in character and the resultant effects on the visual amenity of the locality, considering the existing character of the landscape within a 20 kilometre radius of the site locality.

The landscape that surrounds the Varied Project Area is defined by a series of landscape character units that relate to the underlying topography and vegetation of the region. To the west, the Mount Lofty Ranges form an undulating topographic landscape with extensive areas of remnant woodland that provide a degree of amenity and localised visual screening. The Southern Mount Lofty Ranges Tablelands have an open visual character with little or no vegetation. While the eastern escarpment of the Mount Lofty Ranges produces a prominent landscape feature within the regional context of the Varied Project Area. The Murray Plains to the east represent a low-lying agricultural landscape punctuated by belts of vegetation.

Comparative Assessment

The proposed wind turbine height of 220m is likely to increase the visual impact associated with the Varied Project when compared with the Approved Project. However, the comparative assessment illustrates that the increase in visual impacts are likely to be contained to the local area (up to 5 kilometres away from the Varied Project Area) due to the reduced ability of the local landforms and vegetation to provide screening for the additional turbine height.

The visual assessment demonstrates the relative visual effect of the Varied Project within the landscape from a sub-regional and regional context. From locations to the east, the agricultural land use, absence of natural vegetation cover and prominent topographic form of the Southern Mount Lofty Ranges mitigate the potential visual impact of the wind turbines.

In addition, the layout of the 40 wind turbines and the separation of the wind turbines into two areas provides additional visual mitigation, which moderates the degree of visual effect within sub-regional and regional landscapes. Consequently, the extent to which all 40 wind turbines are likely to be visible will be significantly reduced due to the interrelation of the topography and vegetation containment that is provided in the surrounding rural landscape.

Executive Summary

The Varied Project layout significantly reduced the number of wind turbines from the Approved Project, with a particular reduction to the northern areas adjacent to Sanderson and Cambrai. Additionally, the visual impact from areas surrounding Eden Valley and Marne River were likely to experience a substantial reduction in visual effect from the Varied Project.

The Varied Project provides additional separation between individual wind turbines. This was likely to increase the visual legibility of the proposed wind farm and reduce the complexity of the visual effects, particularly to the east and west.

Compared to the Approved Project, the Varied Project results in;

- Reduced locality and visibility to the north due to the reduced number of wind turbines.
- Reduced visual effects on the northern escarpment around Cambrai and the northern Murray Plains.
- Reduced visual effects to the northwest and impacts on the associated heritage planning overlays.
- Similar visual impacts to the south, east and west when the Approved and Varied Project

Based on the comparative assessment of the Approved and Varied Projects, this report concludes that the potential visual effect that will result from the Varied Project is likely to be moderate increasing to substantial, and that the Varied Project is likely to have less visual effect on the locality than the Approved Project.

While the Varied Project increases in the visual effect that is likely to be experienced in the local area (up to 5 kilometres away from the Project Area) due to the increase in the height of the wind turbines. This is offset by a decrease in the visual effect across the sub-regional and regional areas (5-10km) due to a reduction in the number of wind turbines resulting in a reduction in the visual complexity of the Varied Project. Overall, the Varied Project represents a notable reduction of the likely visual effect when compared to the Approved Project.

1.0 Introduction

1.1 Introduction

1.1.1 This report has been prepared by Warwick Keates of WAX Design in association with Dr Brett Grimm of Brett Grimm Landscape Architect and Convergen for Tilt Renewables (Tilt) to assess the potential visual impact of a varied proposal for the Palmer Wind Farm (Varied Project) based on 40 wind turbines. Each wind turbine is up to a maximum of 220 metres in height to the blade tip with a tower height of approximately 130m.

1.1.2 The aim of the report was to evaluate the existing landscape character and the degree of visual change that will be produced by the introduction of the Varied Project and its associated infrastructure into the existing landscape character of the locality. The potential visual effect has been assessed using a detailed methodology that involves on-site assessments, comparative assessments against the Approved Project and the preparation of photomontages that illustrate the anticipated visual effect of the Varied Project.

1.1.3 WAX Design and BGLA undertook the Landscape Character and Visual Impact Assessment for the Palmer Wind Farm (2014), which received planning approval (2018). The Approved Project consisted of 103 wind turbines positioned along the eastern ridgelines of the Southern Mount Lofty Ranges. Each wind turbine was up to a maximum of 165 metres in height to the blade tip. The wind turbines were typically located 600 - 700 metres apart across the underlying landscape. The wind farm layout for the Approved Project was sited in three areas, referred to as Areas A, B, and C.

1.1.4 In 2017, an appeal was made against the Approved Project to the Environment, Resources and Development Court (ERD Court). The Approved Project was then challenged in the Supreme Court, with the decision of the ERD Court being upheld in November 2019.

1.1.5 Following the Supreme Court decision in support of the Approved Project, Tilt Renewables undertook a review of the design and layout of the Approved Project with consideration of improvements in wind turbine technology since the Development Application was lodged in 2014.

1.1.6 In addition, the Planning and Development Infrastructure Act 2016 (the PDI Act) has now superseded the Development Act. Tilt proposes to lodge a Variation Application to the State Commission Assessment Panel (SCAP) pursuant to the PDI Act.

1.1.7 The Variation Application proposes to amend the Approved Project with a reduced Project Area, a reduction in the maximum number of turbines, an increase in the maximum blade tip height, and associated changes to the internal wind farm infrastructure associated with the Varied Project.

1.1.8 The Landscape and Visual Impact Assessment (LVIA) comprises two separate assessments, a landscape character assessment and a visual impact assessment; these are interrelated processes described in the Guidelines for Landscape and Visual Impact Assessment[1]. The landscape character assessment described in this report was based on the landscape assessments undertaken as part of the Approved Project and considers the existing character of the landscape within a 20 kilometre radius of the site locality. A review of the locality was undertaken with no substantial change noted.

1.1.9 The site locality is the area around the Varied Project from which the wind turbines and associated infrastructure will likely be visible in the landscape. The visual impact assessment evaluates and describes the likely visual effect of the Varied Project on the landscape, with consideration of changes in character and the resultant effects on the visual amenity of the locality.

[1] *Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment.*

1.1.10 The potential visual impact was assessed using the Grimke matrix methodology that involves on-site assessments, GIS modelling, the preparation of photomontages and a detailed visual impact assessment to illustrate the predicted visual effect of the Varied Project.

1.1.11 The Varied Project is based on the following:

- 40 wind turbines positioned along the ridgelines of the Southern Mount Lofty Ranges.
- Total wind turbine height of 220m to tip of blade and hub heights of 130m.
- The wind farm layout sited in two areas extending north and south of Palmer.
- Access tracks up to 10m wide and associated earthworks.
- Associated 275kV transmission lines (12km) from site sub-stations to the Tungkillo sub-station, comprising lattice towers up to 55m high (similar to existing high voltage towers in the area) and spaced approximately 300-600 metres apart.
- Up to five permanent masts
- Up to five temporary calibration masts (approximately 130m in height)
- Two internal substations to connect to the existing Tungkillo switching station.
- Hardstand areas and gravel pits for construction.
- Underground cable runs.
- Vegetation removal required.

1.1.12 The assessment of the proposal provided an overview of the landscape of the surrounding area in order to articulate the visual character of the site in relation to the local (0-3 km), sub-regional (3-10 km) and regional (>10 km) landscapes. This was followed by a detailed evaluation of the probable visual effect and degree of visual change that will occur across the regional landscape as well as within the infrastructure corridors associated with the wind farm and transmission lines. This assessment then provided the basis on which an evaluation of the suitability of the development could be made with regard to the visual effect within the regional area (20 km) and the Performance Outcomes of The Planning and Design Code (the Code) against which the application will be assessed.

1.1.13 For the visual assessment of the Palmer Wind Farm to represent 'best practice', the report and the assessment methodology have been prepared with reference to the experience of Mr Warwick Keates and Dr Brett Grimm and the following documents:

- Planning and Design Code and Planning, Development and Infrastructure Act (2016)
- Wind Farm Development Guidelines for Developers and Local Government Planners (2014), Central Local Government Region of South Australia[2];
- Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (Department of Environment, Land, Water and Planning, November (2021)
- Solar Energy Facilities Design and Development Guidelines (Department of Environment, Land, Water and Planning, August 2019)
- Environment Protection and Heritage Council (2010) National Wind Farm Development Guidelines;
- Siting and Designing Wind Farms in the Landscape (version 2)(2014) Scottish Natural Heritage;
- Grimm, B (2009). Quantifying the Visual Effects of Wind Farms; A Theoretical Process in an Evolving Australian Visual Landscape. PhD Thesis Adelaide University;
- Australian Wind Energy Association and Australian Council of National Trusts (2007) Wind Farms and Landscape Values: National Assessment Framework;

[2] *Source online (2015). http://www.lga.sa.gov.au/webdata/resources/files/2012.32%20-%20Windfarm%20Development%20Guidelines%20-%20Final%20Report.pdf. [Accessed 08 September 2015].*

- Visual Landscape Planning in Western Australia. (2007). A manual for evaluation, assessment, siting and design, Western Australian Planning Commission;
- Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia (2006);
- Lothian, A. (2008). Scenic perceptions of the visual effects of wind farms on South Australian landscapes. Geographical Research, 46:2, 196 – 207;
- Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment;
- South Australian Wind Farms Planning Bulletin (2002).

1.2 Limitations and exclusions

1.2.1 The scope of work and assessment was based on the visual effect of the Varied Project and its associated infrastructure. The assessment methodology aimed to provide a quantified measurement of the degree of visual change.

1.2.2 The scope of work has been undertaken as a collaborative assessment between Warwick Keates and Dr Brett Grimm. The qualitative GrimKe assessment of the landscape was also reviewed and discussed on site to ensure that a balanced opinion was reached.

1.2.3 Limited reference was made to the potential response or sensitivity of the viewer to landscape changes from each viewpoint assessed and how this influenced the perception of the visual effect. The degree of viewer sensitivity remains the personal preference of the viewer as to whether the visual change is positive or negative.

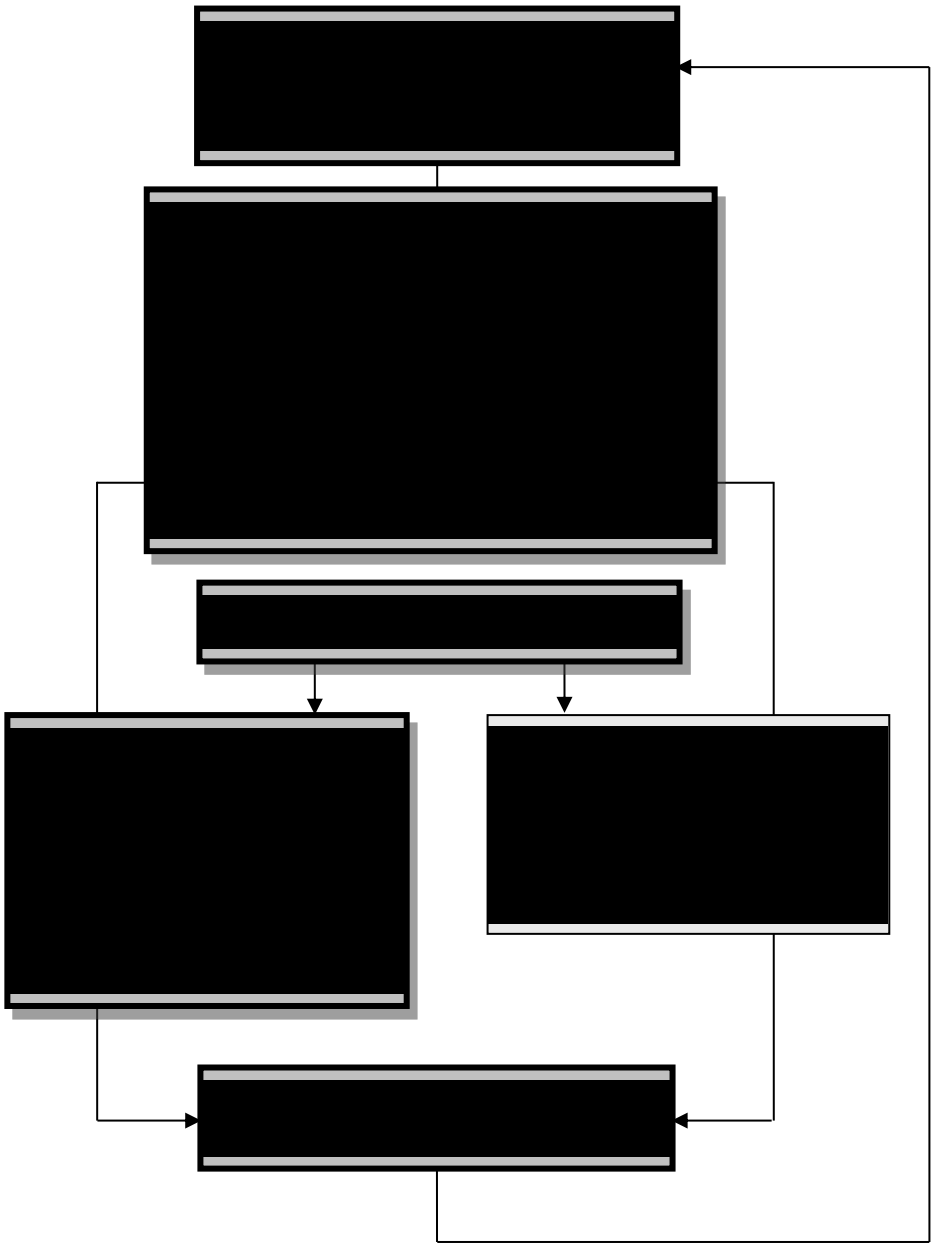
1.2.4 Accordingly, public perception surveys for each viewpoint did not form part of this process, and the degree of visual change was considered within the context of the existing landscape character with consideration of community evaluations of the regional cultural value, scenic quality and the capacity of the landscape to accommodate the physical visual change, not the degree of perceived change.

1.2.5 Furthermore, the assessment is based on the landscape character at a specific point in time and is limited in changes that may occur through regional development and on changes in landuse over time.

2.0 Methodology

2.1 Detailed Visual Site Assessment Process

2.1.1 The process for the visual assessment is based on the recommendations of John Ginivan (Executive Officer Victorian Coastal Council Submission, 2002) and considers the assessment in terms of the Primary Landscape Assessment, the Quantitative Objective Assessment and the Qualitative Subjective Assessment. The following Figure 1 illustrates the relation of these subject areas.



Based on John Ginivan, Executive Officer Victorian Coastal Council Submission, 7 March 2002 to the Independent Panel for the Portland Wind Energy Projects.

Figure 1: Detailed Visual Site Assessment Process:

2.2 Methodology

2.2.1 The LVIA was based on two assessment stages with reference to the Guidelines for Landscape and Visual Impact Assessment[3] and set out in Figure 2.

- Stage 1: Landscape Character Assessment - identified and assessed the importance of landscape characteristics and the existing landscape quality.
- Stage 2: The Visual Assessment - aimed to quantify the extent to which the development was visible and define the degree of visual change and the associated visual impacts using the photomontages, site observations and the Grimke Matrix.

2.2.2 The completed Landscape Character Assessment and Visual Impact Assessment are used to draw several observations and conclusions about the magnitude of the likely visual effects of the proposed development on the site locality.

2.2.3 Figure 2 outlines a detailed description of each process conducted within the methodology.

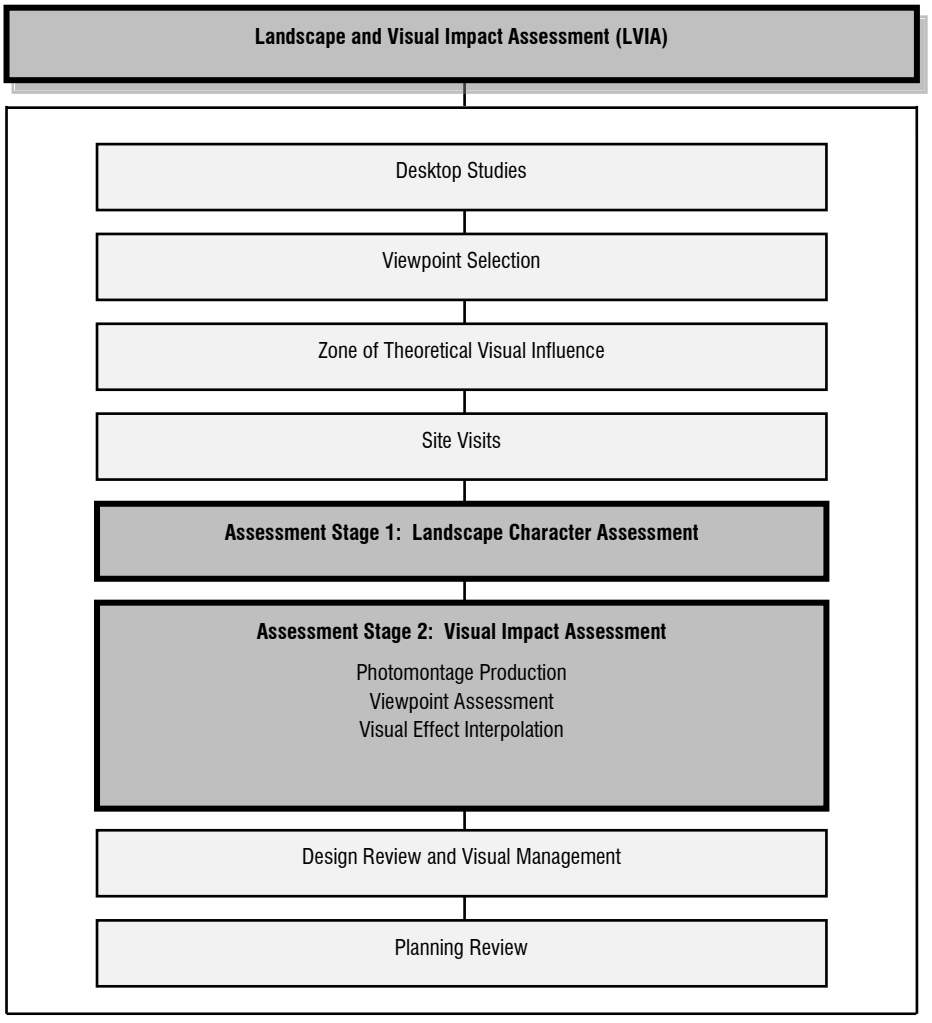


Figure 2: LVIA – Two Assessment Stages and Associated Tasks.

[3] *Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment*

2.0 Methodology

Desktop Studies

2.2.4 The landscape character assessment for the Varied Project included a review of the Varied Project documentation, the proposed development location and the infrastructure associated with the proposed development. Analysis of GIS maps, landscape photography, aerial photographs and supporting literature was reviewed to establish a broad comprehension of the scope of the Varied Project and the existing landscape character.

Viewpoint Selection

2.2.5 The viewpoint selection for the Varied Project was reviewed by WAX Design and BGLA as part of a site visit on 11 August 2023. The original viewpoints, for the Approved Project, selected in 2013 were reviewed against the Varied Project to confirm locations from which a detailed visual assessment of the potential visual effect was made as part of the Stage 2 assessment.

2.2.6 The ten (10) original viewpoint locations were reviewed using the Zone of Theoretical Visual Influence mapping for the Varied Project, which illustrates the likely degree of visibility according to the underlying topography.

2.2.7 The wind turbine layout for the Varied Project has been altered from the Approved Project, as a result four viewpoints were relocated. The viewpoints were relocated as they would not show any wind turbines if retained in their original locations. Additionally, to ensure that an accurate comparative analysis could be undertaken of the Approved Project assessment against the Varied Project each assessment needed to be based on the same number of viewpoints.

2.2.8 A total of eight (8) viewpoints were selected surrounding the Varied Project to support the assessment of the likely visual effect. In addition, two (2) viewpoints from the Palmer Lookout (north and south), were selected to support the assessment. A more detailed justification for the selection and relocation of viewpoints is discussed in Section 7.

2.2.9 The viewpoints selected are representative of the locality, publicly accessible, adjacent to areas of private land ownership and where a large proportion of the wind farm and associated infrastructure is visible. Each viewpoint represents a typical location where the most significant probable degree of visual change will be experienced due to the proposed development within the existing landscape.

Zone of Theoretical Visual Influence (ZTVI)

2.2.10 In order to gain an appreciation of the potential visual effect of both the Approved Project and Varied Project, ZTVI maps have been produced and overlaid for comparison. The mapping illustrates where and how many wind turbines may be seen within the landscape. The maps quantify the extent to which the wind turbines are likely to be seen, considering a maximum blade tip height of 220m and a hub height of 130m for the Varied Project.

2.2.11 The analysis uses a digital terrain model and computer-generated models of the wind turbines to illustrate how many individual turbines would be visible from any location around the wind farm within the 20 kilometre regional landscape assessment area. It should be noted that the ZTVI does not consider the impact of local vegetation and buildings or localised landforms as it is based on a combination of 5 and 10 metre contour data set. This means that theoretically, the visual impact of the wind turbines was evaluated within a landscape devoid of any screening vegetation or other features and represents a ‘worst case’ scenario.

2.2.12 The site assessment confirmed and qualified the ZTVI mapping with reference to vegetation screening and local landforms not depicted by the ZTVI.

Assessment Stage 1: Landscape Character Assessment – Varied Project

2.2.13 A review of the Approved Project assessment was undertaken that includes identification and description of the existing landscape character (considering areas of defined landscape quality determined by topographic form, land use, and vegetation associations, including patterning, colouration and textural relief). In addition, special landscape features and settlements were revisited. Mapping and photographic surveys were undertaken, and written commentary to describe the locality and existing landscape character of the site locality and any significant changes that had occurred between the assessment of the Approved Project and the Varied Project.

2.2.14 As part of the Landscape Character Assessment, the viewpoint selection was reviewed, and the base photography was taken to support the photomontage production.

2.2.15 The assessment was undertaken on 11 August 2023 to enable the project team to develop a comprehensive understanding of the existing landscape character and any changes that may have occurred since 2013.

Assessment Stage 2: Photomontage Production

2.2.16 Photomontages of the proposed development from each viewpoint were produced. The photomontages represent a 120-degree horizontal field of view with a 50mm lens digital equivalent photo capture. This has been proven to represent the human binocular field of view. Details of the methodology used to produce the photomontages are described in Appendix B and represent a best practice approach with reference to 'Photography and photomontage in landscape and visual impact assessment' (2011) Landscape Institute (advice note 01/11).

2.2.17 For the purposes of the photomontage production, a neutral off-white colour was used to represent the wind turbines. This colour selection was made to reflect the proposed colour of the turbines (RAL 7035, Light Grey) while allowing for variations in local light and environmental conditions. As part of the photomontage compositing process in Photoshop ™, adjustments were made to the contrast and luminosity levels of the wind turbine render. These adjustments were made to ensure the proposed wind turbines are visible in the photomontage. It is important to note that the adjustments made to the photomontages did not alter the assessment process, as all findings were validated by on-site observations and measurements.

2.2.18 WAX Design and BGLA confirmed the accuracy of the photomontages during a second site visit on 26 October 2023. The combined photomontage assessment and on-site review ensured that issues typically associated with photographic simulations, such as image compression and distortion, were mitigated by assessing and measuring the visual effect in the existing landscape using GPS and a bearing compass. This enabled the photomontages to be ground-truthed for positional correctness and scale. Any minor distortion to the edge of the 120 degrees provided by the horizontal field extent and 2-dimensional image representations were reflected relatively in the simulated modelling overlay.

2.2.19 The photomontage images were used to inform the detailed viewpoint assessment.

Assessment Stage 2: Visual Impact Assessment

2.2.20 The assessment of the visual impact included the production of photomontages to assist in the quantification and qualification of the potential visual effect. The viewpoints identified as part of the preliminary assessment stages were measured using a series of landscape and visual criteria. The assessment results were then mapped and interpolated to demonstrate the likely visual impact of the Varied Project across the regional landscape.

2.2.21 The Stage 2 assessment was undertaken on 26 October 2023. Site conditions were clear, providing good visibility and extending several kilometres throughout the landscape character zone.

2.2.22 The viewpoint assessment of the Varied Project used a combination of visual assessment measurements and descriptive text. This comprised of site observations with reference to prepared

photomontages and a detailed assessment of the baseline landscape character and resulting visual impact.

2.2.23 Initially, the baseline landscape character for each viewpoint was assessed considering the following:

- Relief (the complexity of the land that exists as part of the underlying landscape character);
- Vegetation Cover (the extent to which vegetation was present and the potential to screen and filter views);
- Infrastructure and Built Form (the impact of development on landscape and visual character); and
- Cultural Sensitivity (existing cultural overlays, planning designations and any identified listing of heritage items and local sensitivities to landscape, such as scenic drives/ viewpoints and frequency of views high main routes between townships etc.).

2.2.24 A numerical value was generated for the existing landscape relative to each viewpoint. This value formed the baseline assessment value. This baseline value was modified by the impact of the development on the landscape, which in turn informed the degree of visual effect.

2.2.25 Following the landscape character assessment, each viewpoint was then assessed against the following visual effects:

- Percentage of landscape absorption (the landscape's ability to absorb and screen the development form);
- Horizontal visual effect (percentage spread of the development in the field of view);
- Vertical visual effect (vertical scale of the development as a percentage of the existing landscape scale within the field of view); and
- Distance of visual effect (distance between viewpoint and development).

2.2.26 The landscape character and visual effect measurements were combined to produce a quantified value for the degree of visual change that resulted from the Varied Project at each viewpoint (refer to Appendix E for detailed assessment criteria and matrix methodology).

Assessment Stage 2: Visual Effect Interpolation

2.2.27 The findings of the visual impact assessment for each viewpoint were used to provide a percentage value to describe the degree of visual change. Each viewpoint was cartographically mapped in GIS, and the values were used in a weighted interpolation. The ZTVI was overlayed onto the visual effect interpolation map to define the extent of visibility. The combination of visual effect interpolation and ZTVI provided a map of the likely visual impact experienced in the regional locality as a result of the Varied Project. The map provided relativity to the possible experience of visual effect.

Approved and Varied Project Comparative Assessment

2.2.28 A comparative assessment of the visual effects associated with the Approved and Varied Project layouts was undertaken. This included a review of the ZTVI mapping, a review of the photomontages used for the visual assessment, quantitative and qualitative assessments of the visual effects using the GrimKe Matrix and a discussion of the differences in visual effects and degree of visual change between the Approved and Varied Projects. The assessment findings are contained in Section 5 and 7 of this report.

Planning and Design Code Review

2.2.29 A review of the landscape and visual impacts of the development from a planning context was also undertaken. The planning review included a review of the relevant frameworks and provisions of the Planning and Design Code.

2.2.30 In particular, the potential visual impact of the development has been reviewed and discussed against the relevant desired character statements with specific reference to landscape and visual considerations resulting from the development of the Varied Project.

2.2.31 The Landscape Character Assessment for the project includes reviews of the project documentation, the proposed development location and the infrastructure associated with the proposed development. Analysis of GIS maps, landscape photography, aerial photographs and supporting literature were also reviewed to establish a broad comprehension of the scope of the proposed wind farm and the existing landscape character.

3.0 Landscape Character and Site Context

3.1 The Site Locality

3.1.1 The proposed Palmer Wind Farm is located approximately 50 kilometres northeast of Adelaide, east of the Barossa Valley and close to the townships of Palmer, Tungkillo, Mount Pleasant, Eden Valley, Springton and Cambrai.

3.1.2 The Varied Project Area extends north/south along the escarpment of the Southern Mount Lofty Ranges for approximately 14 kilometres, with the proposed development forming two distinct clusters of wind turbines.

3.2 Land Use and Land Cover

3.2.1 The predominant land use of the local, sub-regional and regional landscape is agricultural, containing slight variations in cultivation and management techniques that create a number of land use characters in and around the site. This, in turn, leads to a series of defined rural landscape characters that extend across the regional landscape context and landscape locality.

3.2.2 The land use and land cover across the proposed development site and the locality immediately (<3km) surrounding the Varied Project Area is defined by a heavily cleared and grazed landscape with scattered pockets of remnant vegetation, isolated trees and scattered rocky outcrops. Grazing is the dominant land use, with occasional residential properties and farming buildings located in the landscape. Refer to Figure 3 for a typical view of the wider Murray Plains and the escarpment upon which the proposed development is located.



Figure 3: Typical view of the wider Murray Plains and the escarpment upon which the proposed development is located

3.2.3 The grazed agricultural landscape cover continues across the Southern Mount Lofty Escarpment and east towards the low lying plains of the Murray River. The absence of vegetation creates an exposed landscape character that reinforces the agricultural character of the area. While pockets of vegetation do exist across the escarpment, particularly in relation to larger creek lines and drainage

catchments, these areas remain isolated and do not create a dominant vegetation cover within the locality of the Varied Project Area.

3.2.4 In sharp contrast to the land cover and general landscape character of the escarpment, the Murray Plains to the east of the Varied Project Area is defined by a mixture of large open paddocks, vegetation belts and isolated tree groups. This creates a distinctly rural landscape character.

3.2.5 To the west, the land cover is wooded, with large areas of vegetation creating an attractive rural landscape of trees and open paddocks that is synonymous with the Barossa Valley and Adelaide Hills. This character is illustrated by the landscape that surrounds Mount Pleasant and extends to Eden Valley to the north of the Varied Project Area.

3.2.6 The amenity of the rural woodland setting is also reflected in the land use and smaller scale operations that occur amongst the belts of vegetation. These include small areas of cropping, hobby farming, horse agistment and some vineyard production.

3.3 Landform and Geomorphology

3.3.1 The landform and geomorphology on which the Varied Project Area is located are dominated by several distinct geologies, which in turn have led to the defined landforms and landscape characters associated with the proposed development site. A topographical digital terrain model of the area is included in Figure 4.

3.3.2 The Southern Mount Lofty Ranges is formed by the Kanmantoo Geological Group, which includes a range of sedimentary and metamorphic sandstone and limestone deposits, as well as areas of Delamerian granite to the Murray Plains[4].

3.3.3 The landform is created by the geophysical effects of the Bremer Fault and other minor faults along the eastern edge of the Mount Lofty Ranges. Extended periods of erosion have subsequently resulted in the gullies and hills that form the topographic character that surrounds the Varied Project Area.

[4] *Parkin, L.W. (1969). Handbook of South Australian Geology. South Australia: Government Printer. p107-109.*

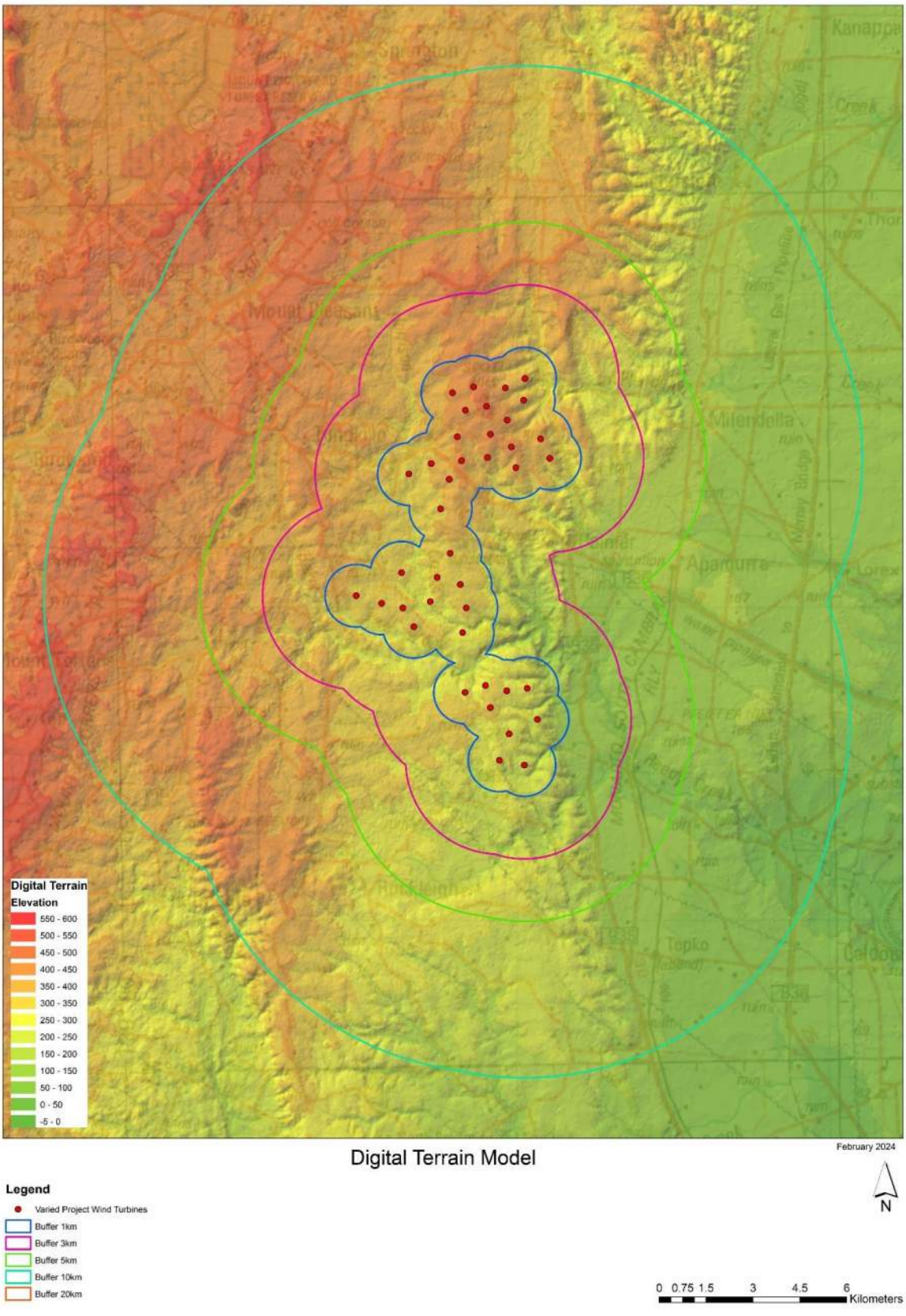


Figure 4: Varied Project Topographic digital terrain model (10m contours)

3.4 Landscape Character Units

3.4.1 In order to understand how the Varied Project will produce a visual effect on the landscape and to what degree, an assessment to identify character zones of the existing landscape has been undertaken. This assessment identified a number of landscape character units that contain similar landscape qualities in relation to land use, topography, vegetation, visual patterning, texture and scale, refer to Figure 5.

3.4.2 The visual effect and degree of visual change produced by the wind farm will vary from different viewpoints within each landscape character unit. In this way, the visual effect can be interpolated across the landscape character units, providing a comprehensive understanding of the impact of the proposal on the broader landscape character and the degree of visual change.

3.4.3 The regional landscape context surrounding the Palmer Wind Farm contains five major landscape character units and a number of other areas of specific landscape character in relation to townships and unique landscape features (refer to Appendix A). The following provides a description of each unit and the responding landscape and visual character. In order to provide clarity in the description of the landscape, the major landscape character units have been described sequentially from the west to the east.

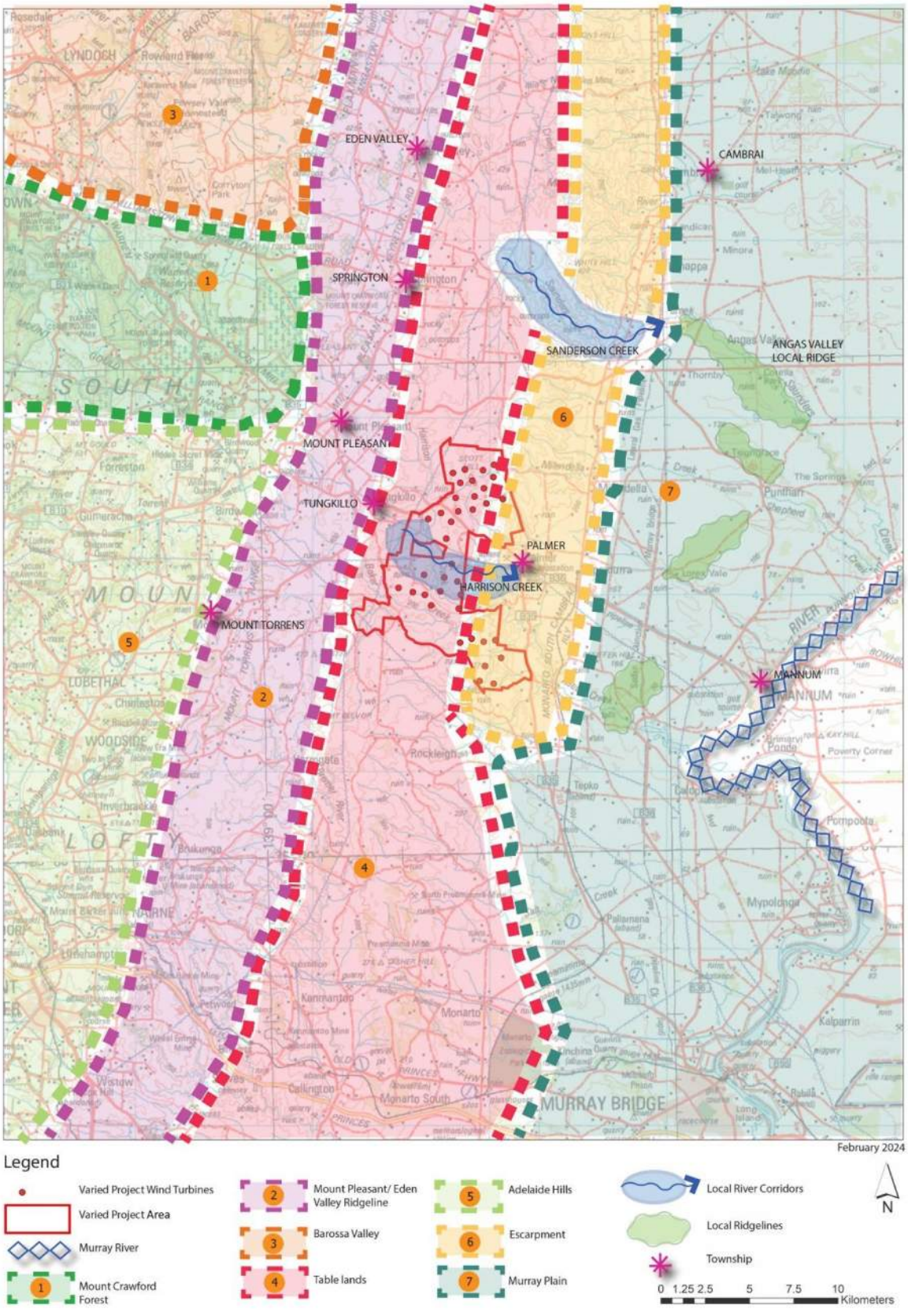


Figure 5: Landscape character units

3.5 Mount Crawford, Barossa Valley and Adelaide Hills (sub-regional and regional – west)

3.5.1 The topography of the southeastern edge of the Mount Lofty Ranges in and around Mount Torrens to the north is defined by a complex series of inter-related landforms that create a complex landscape of rolling and eroded ridgelines and broad valleys that criss-cross the regional landscape surroundings the development site. These landscape features form the eastern extent of the Barossa and Adelaide Hills regions. A typical view of the Mount Crawford and Barossa Valley character units is shown in Figure 6.

3.5.2 The topographic complexity of the landscape defines the visual character of the area, with local landforms limiting views to several hundred metres east/west within extensive north/south valleys before the surrounding relief creates a defined visual envelope. The topography of the Southern Mount Lofty Ranges creates localised view corridors across the landscape, reducing the potential panoramic views within the landscape character unit.

3.5.3 The landscape unit contains a number of notable landscape features, such as Mount Pleasant, Eden Valley, Torrens River and Mount Crawford Forestry Reserve. These features create natural landscape pockets and areas of amenity within the broader rural landscape.

3.5.4 Across the landscape character unit is a vegetation overlay of mature Eucalypts and pine plantations that enhances the visual enclosure and scenic value of the area. The extent and density of vegetation fragments views and reinforce the visual containment of the area while providing a significant degree of visual amenity in relation to natural (arboreal) features.

3.5.5 This interaction between landforms and vegetation across the landscape occurs throughout the landscape character unit, extending north and south parallel with the orientation of the Ranges. The scale and extent of the vegetation limit the visual impact of development and infrastructure in the landscape. As a result, power lines, radio masts, buildings and roads are seen as recessive elements, visually fragmented by vegetation and screened by the underlying topography.

3.5.6 The dominant land use and landscape character of the Southern Mount Lofty Ranges consists of a well-vegetated rural landscape with extensive areas of Eucalypt woodland broken up by grazing land, horse agistment, and occasional vineyards. These open agricultural land uses provide a spatial contrast to the well established treed landscape character and create glimpsed and framed views into and across the surrounding area.

3.5.7 The sub-regional and regional western landscape character units provide a significant degree of scenic value to the west of the proposed development site. This is primarily due to the extent of Eucalypt and coniferous vegetation, the interrelationship with topography, and the visual amenity provided by the rural land uses such as horse rearing and farming. While the underlying land use is rural and expresses agricultural characteristics, these productive land uses are offset by the extent of vegetation cover that creates natural landscape character qualities as an overlay to the agricultural landscape.



Figure 6: Typical view of Mt Crawford and Barossa Valley character areas

3.6 Mount Pleasant and Eden Valley Ridgeline- transitional landscape (sub-regional – west)

3.6.1 Between the well vegetated landscape character of the Adelaide Hills, Barossa Valley and the tablelands of the Ranges is a transitional landscape defined by complex topographic variations of low undulating landform, creeks, rocky outcrops and scattered belts of vegetation.

3.6.2 The surrounding landscape character is described as a highly modified agricultural landscape punctuated with powerlines, roads, buildings and small scale quarrying operations. Throughout the area, there is limited vegetation cover, with sporadic tree groups that extend along creeks and valleys and extensive grazing, creating a denuded land cover to the ridges and hills in the area. A typical view across the Mount Pleasant and Eden Valley Ridgeline can be seen in Figure 7.

3.6.3 The underlying topography of the area is defined by a complex series of prominent ridgelines that run in multiple directions. Throughout the locality are wider valleys that lie in between these ridges and contain large areas of vegetation that provide screening to the broader landscape.

3.6.4 The locality to the south is defined by a distinct horizontal undulating visual and physical landscape character. The rolling context of the ridges is contrasted with the more incised valleys and creeks to the south of the proposed wind farm site. The over-riding horizontal forms are reinforced by remnant vegetation, which extends along creeks and valleys.

3.6.5 The dominant land use is pastoral, with grazed paddocks creating cleared hillsides with small vegetation groups to valleys and creeks. To the north, the area is open in visual character, with little screening provided by remnant vegetation. The topography to the north is defined by closely spaced narrow ridgelines that run east-west. These ridges have an undulating form with low lying valleys formed between elevated ridges, which enclose the field of view.



Figure 7: Typical view across the Mount Pleasant and Eden Valley Ridgeline from Church Road.

3.7 Southern Mount Lofty Ranges Tablelands (local and sub-regional)

3.7.1 The landscape character unit is defined by numerous topographic variations that form a complex undulating landform with low hills, small valleys, rocky outcrops and a general absence of vegetation (except for a grazed herb layer).

3.7.2 The rocky geological features combined with an absence of vegetation create a wind-swept and desolate visual character, which expresses a rugged quality that contrasts the visually enclosed and well-vegetated qualities of the Southern Mount Lofty Ranges. Within the landscape character unit are several defined landforms, including Scotts Hill, White Hill, North Rhine Valley, Marne Valley, Sanderson Gorge, Harrison Creek and Gorge and Sugarloaf Hill.

3.7.3 Throughout the dominant north/south ridgeline that defines the tablelands are local topographic variations that create additional complexity and, at times, a more intimate scale. Small ridgelines, promontories and valleys provide an additional degree of visual complexity that is contrasted by the panoramic characteristics of the broader landscape further to the east.

3.7.4 The landscape character unit creates a defined separation between the complex enclosed visual character that occurs around Mount Pleasant and Eden Valley and the open visual character of the Murray Plains Escarpment and its associated landforms such as White Hill, Cooke Hill, Scotts Hill and Palmer Hill.

3.7.5 The presence of the Mannum Adelaide pipeline that extends east/west across the landscape character unit and a 275kV power line that runs north/south reinforces the sense of a modified landscape, emphasising the impact of development and progressive change on the landscape.

3.7.6 The elevated and undulating characteristics of the tablelands provide opportunities for panoramic views across the Murray Plains to the east. These views over the plains extend for significant distances due to the limited vegetation and absence of major topographic variations. A typical view across the Tablelands and the eastern escarpment can be seen in Figure 8.

3.7.7 While the landscape is agricultural and lacks vegetation, the elevated location and expansive views provide scenic value when viewing the broader landscape from the Eastern Mount Lofty Escarpment edge towards the Murray Plains.



Figure 8: Typical view across the Tablelands with undulating topography associated with the Eastern escarpment.

3.8 The Southern Mount Lofty Ranges Escarpment (local and sub-regional – east)

3.8.1 The Southern Mount Lofty Ranges escarpment is a prominent north/south landform that defines the eastern edge of the Mount Lofty Ranges. The escarpment provides pronounced topographic elevation within the region rising approximately 360 m above the low lying land of the Murray Plains. A typical view west towards the Southern Mount Lofty Ranges can be seen in Figure 9.

3.8.2 The north/south ridgelines of the escarpment are defined by a series of complex landforms with numerous smaller east/west promontories and gullies forming serrations and distinct undulations across the escarpment. These forms transition into a more eroded relief to the lower slopes of the escarpment, creating undulation foothills between the escarpment and the plains.

3.8.3 The serrated landform qualities and interrelationship of ridges and gullies create contrasting visual and topographic variation. This provides a distinct scale to the local topography, reinforcing the escarpment as the prominent landscape feature, particularly when experienced from the Murray Plains.

3.8.4 The diversity in the visual character of the escarpment is further reinforced by variations created by the light and shade that is cast across the landscape. Areas of considerable tonal variation (patches of light and dark) occur in response to localised ridges and gullies. This tonal variation is further reinforced during periods of cloud cover when shadows form, increasing the visual contrast of the landscape. The visual patterning of light, as well as the topographic variation, creates an additional layer of visual complexity to the escarpment. The visual complexity contrasts the uniformity of the agricultural land use that covers the escarpment, which consists of extensive areas of grazing and an absence of woodland or remnant vegetation.

3.8.5 The denuded land cover reinforces the agricultural context, which is typical of the Murray Plains and Mid-North agricultural areas of South Australia.



Figure 9: Typical view west towards the Southern Mount Lofty Ranges escarpment

3.9 Murray Plains (regional – east)

3.9.1 The Murray Plains area is formed by an expansive low-lying landscape that extends from the foothills of the Southern Mount Lofty Ranges Escarpment east towards the Murray River and beyond. A typical view of the Murry Plains looking back towards the Southern Mount Lofty Ranges Eastern Escarpment can be seen in Figure 10.

3.9.2 The landscape is crisscrossed with occasional small low-lying ridgelines and belts of vegetation that provide moderate visual screening and areas of visual enclosure.

3.9.3 Local low lying ridgelines form broad east/west running undulations that extend across the Plains. These undulations and associated valleys respond predominantly to the floodplain and other drainage features within the landscape. Extending along these seasonal watercourses, floodways and creek features are large belts of vegetation.

3.9.4 The vegetation cover is supplemented by linear bands of Eucalypts along field boundaries, together with the underlying topography; these features, such as the Angas Valley, define the visual and physical containment within the landscape character unit.

3.9.5 The land use character is formed by an open field structure of arable and cropping land, which capitalises on the flat landscape and remnant alluvial soils of the Murray Plains. The openness of the horizontal field pattern provides a contrast to the localised visual enclosure of the vegetation and topography. Views across the landscape character unit extend over the underlying field structure, providing pockets of visibility that extend over a few hundred metres. To the west is the elevated landscape of the Southern Mount Lofty Ranges Escarpment.

3.9.6 The Murray Plains landscape character unit contains numerous townships as well as road corridors, power lines and other infrastructure associated with settlement and extensive farming of the landscape. The frequency and form of development reinforce the rural qualities of the landscape.

3.9.7 The visual character of the Murray Plains is defined by localised views of adjacent ridgelines and vegetation belts. The combination of a horizontal landform and defined containment creates a specific visual character. Panoramic qualities are limited throughout the landscape, with vegetation and local topography framing glimpsed views of surrounding regional landscapes across fields.



Figure 10: Typical view of the Murray Plain back towards the eastern escarpment

3.10 Specific Landscape Character Areas, Features and Townships

3.10.1 Throughout the locality of the proposed development site are several specific and, in some cases, unique landscape features. For the purposes of the landscape character assessment, these features have been described separately from the general landscape character unit description discussed above.

3.11 Mount Pleasant and Mount Crawford (west)

3.11.1 To the west of Mount Pleasant Township is the Mount Pleasant summit and the River Torrens corridor, forming a defined landscape corridor running through the sub-regional landscape character of the area. The landscape character surrounding the summit of Mount Pleasant (refer to Figure 11) is defined by large strands of remnant eucalypt woodland vegetation. This is interspersed with open paddocks over an undulating landscape character punctuated with rock outcrops and small scale creeks providing a variety of natural elements. This combination of topography and vegetation provides an attractive pastoral and woodland character to the locality.

3.11.2 Throughout the landscape are small scale dwellings and farm buildings that reinforce the rural qualities of the landscape without forming a dominant development form. These pockets of development are contrasted by water bodies, damns and creek lines that provide additional landscape amenity and natural features in the landscape.

3.11.3 The Mount Pleasant and Mount Crawford landscape characters contain defined pockets of mature eucalypt vegetation. The tree cover creates belts of vegetation and forms the dominant landscape feature. The grazing of the understory and pastoral activities means that clear sight lines occur through the understory of the trees to surrounding paddocks and ridge lines but with limited distant views.

3.11.4 The visual character of the landscape is enclosed with framed and filtered views extending to local topographic variations that limit views to only a few hundred metres. The visual character is described as enclosed with pockets of higher amenity and rural character.

3.11.5 Further to the west are extensive areas of forestry plantation associated with the Mount Crawford Forestry Reserve. This landscape is typical of a commercial forestry area with large blocks of pine trees in various stages of management and cropping. The management of the forest creates a patchwork landscape with significant vegetated qualities. Subsequently it is noted this landscape is subject to significant visual change with felling operations and regrowth on a 20-30 year cycle.

3.11.6 The scenic value of the landscape is moderate due to the agricultural character of the forestry, which further enhances the scenic value of the surrounding remnant eucalypt woodland.



Figure 11: View from Mount Pleasant Summit illustrating the surrounding landscape character

3.12 Harrison Gorge (southeast)

3.12.1 Harrison Gorge forms a significant natural landscape feature that is part of the Southern Mount Lofty Ranges escarpment. The Gorge is formed by several deeply incised water courses that run east/west across the underlying topography of the escarpment, Figure 12 shows the view looking west towards Harrison Gorge.

3.12.2 The gorge is heavily vegetated with extensive rock outcrops and various valley features that create a natural landscape character. Surrounding the gorge are areas of grazing and cleared land. However, the dominant feature of the locality remains the natural landscape qualities of the trees, remnant vegetation and interrelationship with the topography and rock escarpments of Harrison Gorge.

3.12.3 These features, particularly from areas to the east and within the gorge itself, create a strong contrast with the heavily cleared and denuded landscape character of the surrounding escarpment. The landscape character of the gorge provides a defined area of natural amenity, which is contained by the surrounding topography. Outside the immediate area of the gorge, the landscape character remains extensively rural.



Figure 12: View looking west towards Harrison Gorge

3.13 Palmer Township (central)

3.13.1 The township of Palmer is located at the base of the foothills and forms an established settlement of buildings and landscape areas. Other dwellings and farms are scattered throughout the landscape surrounding the town, with pockets of vegetation located to the escarpment and creek lines that run across the elevated topography in which the town is located. A typical view from the residential streets of Palmer looking towards the Varied Project Area can be seen in Figure 13.

3.13.2 The landscape above the township of Palmer is punctuated with numerous rocky outcrops and areas of disbursed remnant vegetation. These create a unique landscape character that forms a backdrop to the town and a sense of arrival from Tungkillo

3.13.3 One rock formation, Bear Rock, has been adopted as a motif for the town, while not a significant landscape feature, the rocky outcrop forms a notable landmark.

3.13.4 The granite rocky outcrops associated with the escarpment and outskirts of Palmer are notable visual features. Graffiti is an additional visual element on these boulders, creating opportunities for social interaction and community value for some members of the community.



Figure 13: Typical view from the residential streets of Palmer towards the Varied Project Area which will not be visible from this location

3.14 Mount Pleasant Township (west)

3.14.1 The township of Mount Pleasant is defined by the main road corridor that runs predominantly north/south through the township. The built form is typically single storey with building facades facing onto the main road creating an attractive streetscape that is punctuated with mature trees.

3.14.2 The development pattern of the town is linear and extends along the mainstreet of the town with a more fragmented settlement pattern occurring as properties move away from the town centre. To the edges of the town, the properties increase in size and represent a rural living development pattern.

3.14.3 The underlying topography of the township is defined by two ridgelines to the east and west. These ridgelines create an enclosed visual character that limits views from the township to surrounding areas, particularly the proposed development site, which is located approximately 5 kilometres to the east.

3.15 Tungkillo Township (local west)

3.15.1 The township of Tungkillo is located approximately 4 kilometres to the west of the proposed development site. The township consists of a collection of properties that extend east/west along Randell Road. Properties to the west are elevated, and generally, the settlement pattern follows the underlying topography of the area. A typical view from the eastern edge of Tungkillo towards the Varied Project Area can be seen in Figure 14.

3.15.2 To the eastern side of the town, the properties are larger and reflect a rural living land use character. These properties are punctuated with numerous trees and boundary vegetation that creates a defined landscape screen to the open character that surrounds the township, particularly to the east of the Varied Project Area.

3.15.3 The dominant visual element within the township of Tungkillo is the Mannum water pipeline. This element traverses the landscape approximately 2m-3m above the ground level, screening views towards the development from properties adjacent to the west.

3.15.4 Residential properties to the southern side of Tungkillo are on an elevated localised ridgeline which presents easterly views across the landscape towards the proposed development site. The landscape vegetation pattern is limited to cadastral boundaries and scattered copse within agricultural paddocks. The residential dwellings within the township are mixture of one and two storey typically on smaller allotments associated to an urban township setting.



Figure 14: Typical view from the township of Tungkillo

3.16 Mannum Township

3.16.1 The township of Mannum is located 16 kilometres to the east and is a recognised destination and tourist attraction within the Murray River area. The main street runs parallel to the course of the river and is defined by the profile of the river on which the town is located, refer to Figure 15. The enclosed landscape character created by the embankments of the river provides limited views of the surrounding landscape further west towards the Varied Project Area. Furthermore, the distance to the Varied Project Area is >10km limiting the visual presence and scale from the regional locality.

3.16.2 In this instance, the potential to experience any visual effect will not occur, and the existing visual character of the township and river corridor remains.



Figure 15: Typical view of the main street in Mannum, which is lower lying and internalised

3.17 Scenic Roads - Camel Hump Road and Mine Road

3.17.1 To the south of Palmer are Camel Hump Road and Mine Road. These roads provide access to local landscape features. Throughout the locality of the roads, the undulating grazed landscape with rocky outcrops is replaced by areas of woodland that consist of Callitris, Sheoak and Eucalypts, as well as other remnant vegetation. In addition to the change in vegetation, the presence of large boulders creates a unique landscape feature. A typical view of the vegetation and boulders along Mine Road can be seen in Figure 16.

3.17.2 The landscape amenity provided by natural features increases the importance of the areas in relation to scenic quality and its community value.



Figure 16: Typical view of vegetation and boulders along Mine Road

4.0 Landscape Values Assessment

4.1 Landscape Values Assessment

4.1.1 As part of the planning process for the Approved Project, several community sessions were held (2013). Over the course of the sessions, the community was provided with information about the Approved Project.

4.1.2 As part of the sessions, members of the community were asked to describe the landscape value of the locality mapping exercises and the completion of a survey. The comments provided a clear insight into the value that the community places on the existing landscape character and potential areas of sensitivity to visual change.

4.1.3 The mapping process and community surveys for the Approved Project invited members of the community to locate landscape values within the locality (refer Appendix D). These values consisted of the following:

- Rural and Agricultural (areas of farming with grazing and cropping land uses)
- Natural (locations where farming and human interaction is not prominent, e.g. rivers, woodland, rocky outcrops)
- Scenic (locations or viewpoints that are picturesque or could be seen as beautiful, e.g. lookouts, hilltops and creek lines)
- Recreation (areas used by the community for leisure, sport and other past times, e.g. ovals, trails, community hall, memorial sites)
- History (locations of historical significance that are recognised by the community, e.g. churches, ruins, burial sites)

4.1.4 A review of the mapping and surveys against the Varied Project highlighted the following landscape locations that remained relevant as part of the assessment process, including:

- Harrison Gorge
- Reedy Creek
- Camel Hump Road and surrounding landscape areas

4.1.5 Other more general areas identified by the community as having scenic qualities during the Approved Project landscape assessment remain relevant to the Varied Project. These included the escarpment of the Southern Mount Lofty Ranges and the foothills.

4.1.6 The community survey asked a series of questions that allowed members of the community to provide greater detail on the specific features, locations and characters of the landscape. The questions considered the following:

- Key features that have specific importance
- Roads where views are appreciated
- Comments on the visual amenity of the area

4.1.7 The key features identified by the community reflected the cognitive mapping. They included the escarpment, the various creek lines and gorges across the area, as well as the Lavender Trail, old ruins and mine sites.

4.1.8 These features remain relevant in relation to the landscape assessment of the Varied Project.

5.0 Approved and Varied Project Review

5.1 Approved and Varied Project Review

5.1.1 The following review considered the potential differences between the Approved Project and the Varied Project. A preliminary comparative assessment was based on a review of the ZTVI mapping, for the Approved Project, and a review of how the visibility of the Varied Project will impact the landscape character of the locality. The following tasks were undertaken;

- Review of previous planning approved landscape character and visual assessment study
- Develop Zone of Theoretical Visual Influence (ZTVI) maps for the Varied Project.
- ZTVI desktop analysis of comparative visibility of the development proposals

5.1.2 The Approved Project was defined as;

- 103 wind turbines positioned along the ridgelines of the Eastern Mount Lofty Ranges (modified from 114 WTGs).
- Maximum of 165m to the blade tip with a hub height of 100 metres and blade lengths of approximately 65 metres.
- The wind farm layout was sited in three areas: Area A, located in the north, consisted of 15 wind turbines, Area B, located in the centre, consisted of 50 wind turbines, and Area C, located to the south, consisted of 38 wind turbines.
- Hardstand areas and gravel pits for construction
- Gravel access tracks 5 metres wide post construction
- Underground cable runs
- Substation and operations and maintenance facilities
- 33kV electrical cables linking turbines to the onsite substation, comprising single steel poles of up to 25 m in height for a distance of 30 km
- 275kV transmission line for approximately 10 km from the on-site sub-station to the Tungkillo sub-station, comprising lattice towers up to 46m high
- Seven meteorological masts approximately 100m in height.

5.1.3 The Varied Project has been defined as;

- 40 wind turbines positioned along the ridgelines of the Southern Mount Lofty Ranges
- Total wind turbines height of 220m to tip of blade and hub heights of 130m
- The wind farm layout is sited with 40 wind turbines in two areas extending north and south of Palmer. For clarity within the comparative assessment the naming of the areas has been retained from the Approved Project. Area B is located north of Palmer and Area C is located south of Palmer. Area A does not form part of the Varied Project.
- Access tracks up to 10m wide and associated earthworks.
- Associated transmission lines (12km)
- Permanent lattice wind monitoring anemometry masts up to 150 metres high for wind resource and data validation.
- Two internal substations to connect to the existing Tungkillo switching station
- Hardstand areas and gravel pits for construction
- Vegetation removal required

5.1.4 The potential visual effects and the associated mitigation of the visual effect will be a direct response to the two key differences between the Approved Project and the Varied Project, namely;

- A reduction in wind turbine numbers from 103 to 40
- Increase in the total height of the wind turbines from 165m to 220m

5.2 Zone of Theoretical Visual Impact Assessment

5.2.1 Zone of Theoretical Visual Influence (ZTVI) maps were produced separately for the Approved Project (refer to Figure 17), the Varied Project (refer to Figure 18) as well as combined, showing a comparison of both the Approved and the Varied Project (refer to Figure 19).

5.2.2 These maps quantify the extent to which the wind turbines (including the height of blades) will be seen within the broader landscape. The analysis clearly indicates where the wind turbines might be visible.

5.2.3 The analysis used a digital terrain model and computer-generated models of the turbines to understand how many individual turbines would be visible from any location around the wind farm. It should be noted that the ZTVI does not take into account the impact of vegetation, buildings or localised landforms as it is based on a 10m contour data set. This means that the visual impact of the wind turbines is evaluated within a landscape devoid of any screening vegetation or other features and represents a 'worst case' situation.

5.2.4 The assessment of the Varied Project indicated a reduction in the visual effect to the north, south, and west. The number of turbines and the locations from which turbines were visible is reduced. Similarly, the intensity and clustering of visible wind turbines from the Murray Plain landscape geographic area was reduced. Generally, there was a reduction in the number of wind turbines that will be visible from many locations within the regional landscape context (as indicated by Figure 19 when compared with Figure 17 and Figure 18).

5.2.5 The Varied Project layout significantly reduced the number of wind turbines, with a particular reduction to the northern areas adjacent to Sanderson and Cambrai which resulted from the removal of Area A. Additionally, the visual impact from areas surrounding Eden Valley and Marne River were likely to experience a substantial reduction in visual effect.

5.2.6 The Varied Project provides additional separation between individual wind turbines. This was likely to increase the visual legibility of the proposed wind farm and reduce the complexity of the visual effects to the east and west, particularly in areas adjacent to Viewpoint 5, Viewpoint 6 and Viewpoint 7 (refer to Figure 17).

5.2.7 Across the Murray Plains, the number of visible wind turbines reduced by over 50% from 103 wind turbines associated with the Approved Project to 40 visible wind turbines associated with the Varied Project.

5.2.8 An overlay and comparison of the Approved and Varied Project layouts illustrated several differences in relation to the ZTVI and the potential visibility in the locality. The following observations were made based on a desktop review and subsequent site investigations with reference to the attached maps.

- Reduced locality and visibility to the north due to the reduced number of wind turbines.
- Reduced visual effects on the northern escarpment around Cambrai and the northern Murray Plains.
- Reduced visual effects to the northwest and impacts on the associated heritage planning overlays.
- Similar visual impacts to the south, east and west when the Approved and Varied Project was compared,

5.3 Landscape Review

5.3.1 A review of the ZTVI illustrates that the potential visibility and visual effects associated with the Varied Project are significantly reduced to the north. The removal of 63 wind turbines by way of the variation will specifically alter the potential visual effects on the following landscape receptors and landscape units;

- Mount Pleasant Road
- Pine Hut Road
- Cooke Hill
- Saunders Gorge
- Kanppa Hill and White Hill
- Marne River

5.3.2 Given the sensitivity of Mount Pleasant Road from a tourist and community perspective and the scenic and landscape values of the Marne River and Saunders Gorge corridors, the Varied Project layout represents a reduction in the probable visual impacts on sensitive receivers and areas of higher landscape visual quality.

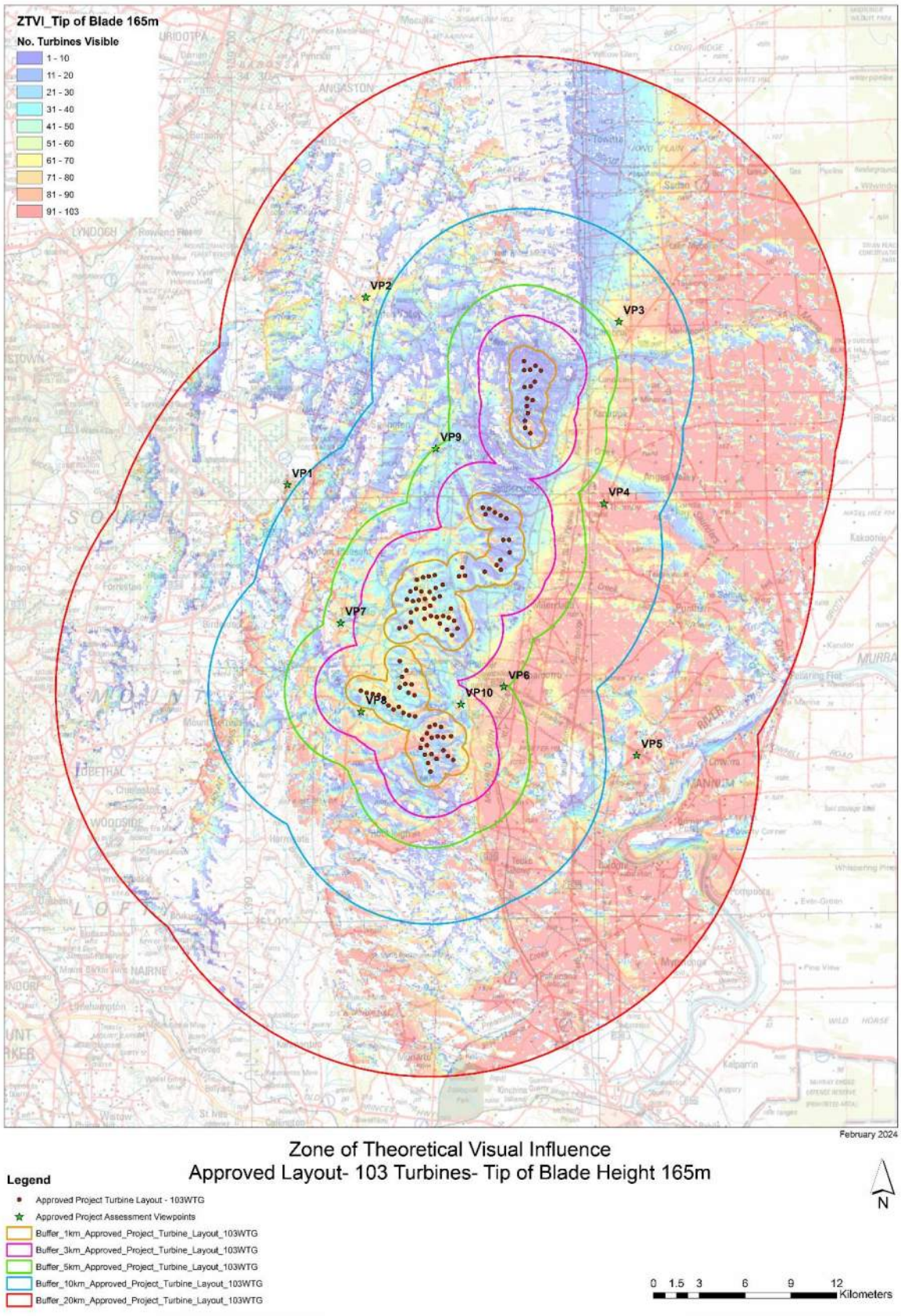


Figure 17: ZTVI mapping of Approved Project based on Tip Height (165m)

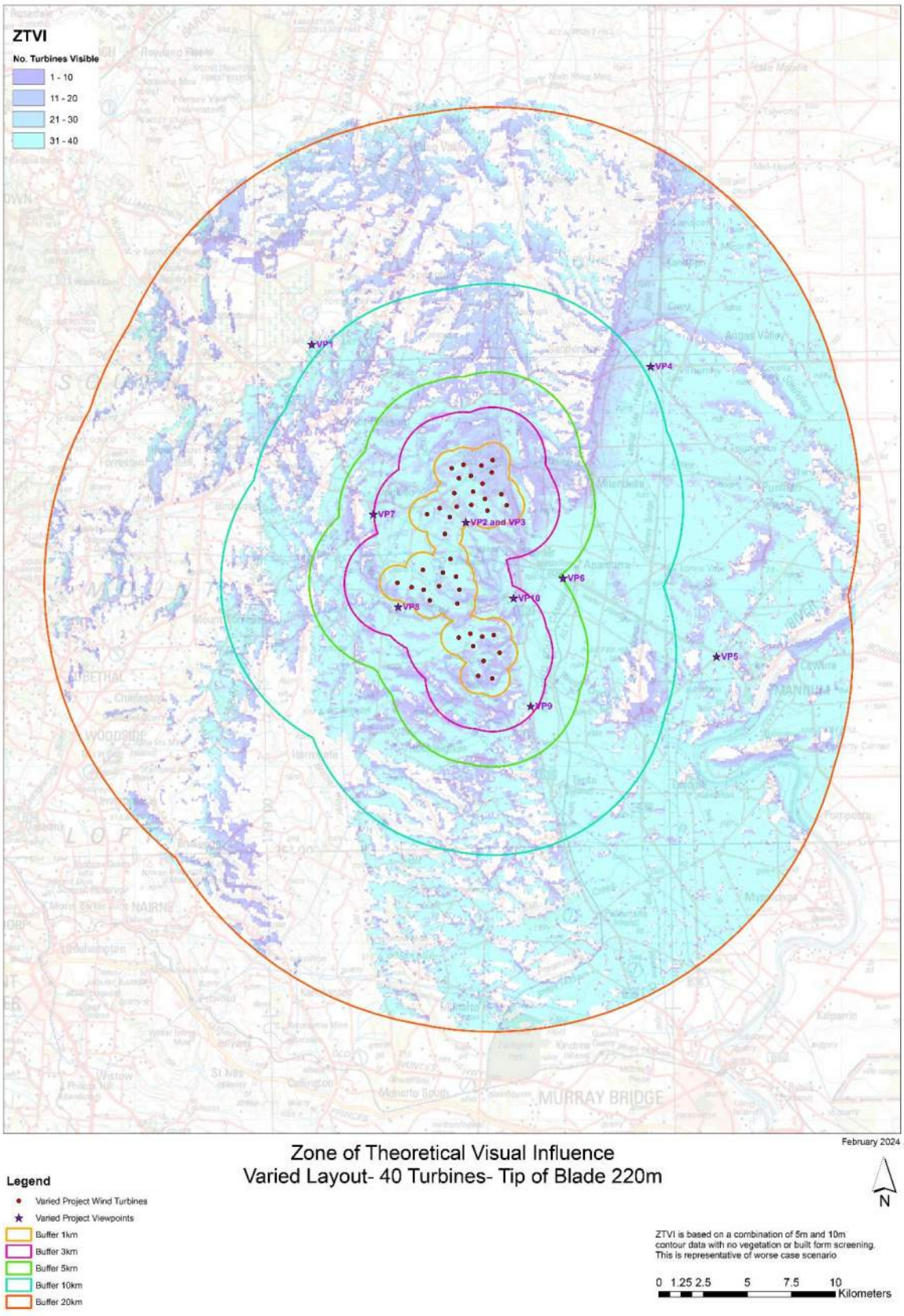


Figure 18: ZTVI mapping of Varied Project based on Tip Height (220m) assessment

5.0 Approved and Varied Project Review

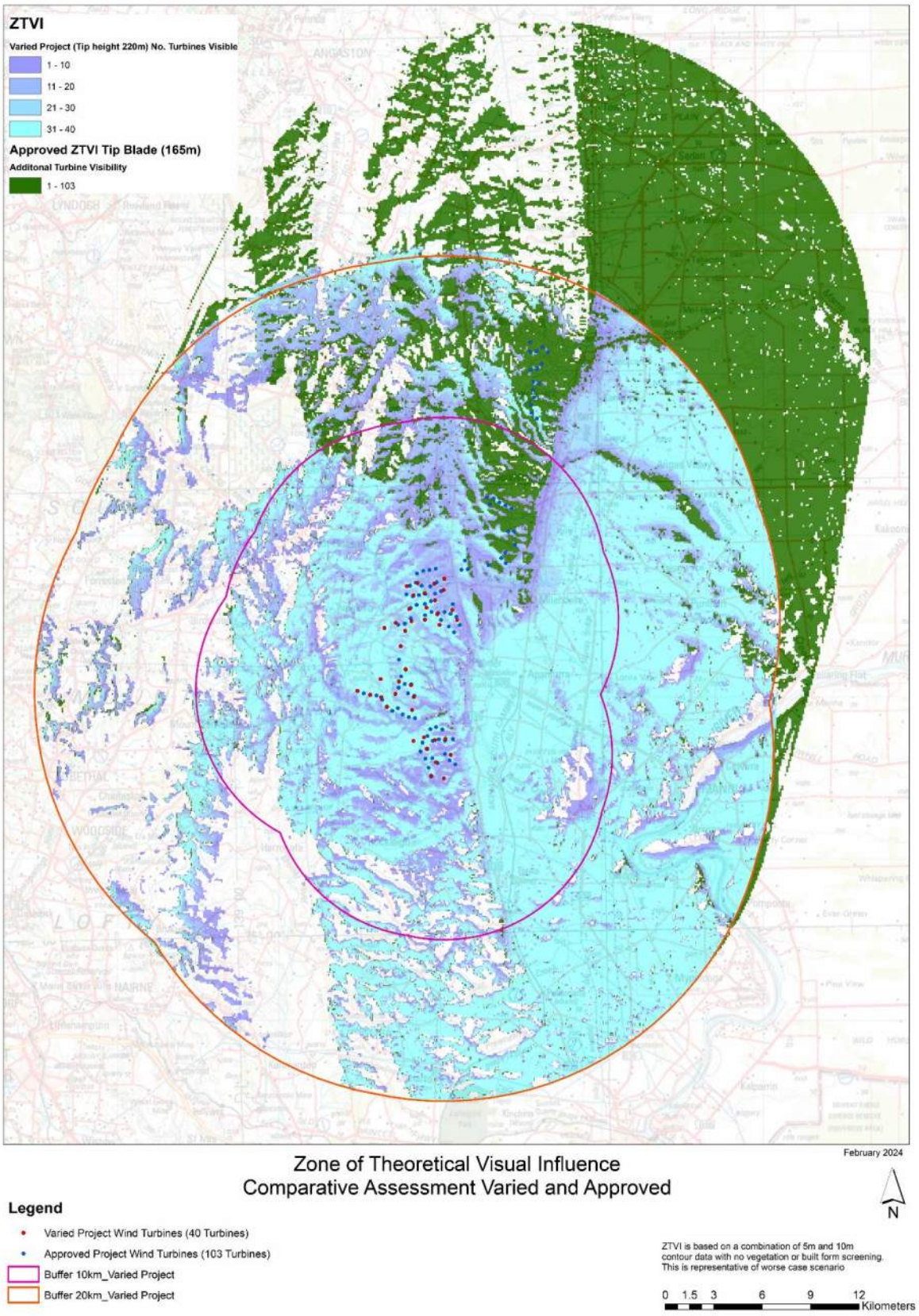


Figure 19: Comparative ZTVI mapping of Approved and Varied Projects based on relative Tip Heights (165m and 220m)

6.0 Visual Impact Assessment

6.1 Visual Impact Assessment

6.1.1 The following visual impact assessment was undertaken for the Varied Project and considers the degree of visual and potential visual impact that the Varied Project with have on the existing landscape character. A comparison of the findings of the visual impact assessment for the Varied Project against the Approved Project is provided in Section 7.

6.1.2 The Varied Project consists of 40 wind turbines located in two clusters, Areas B and C, on the elevated ridgelines and the Southern Mount Lofty Ranges escarpment. The site is defined by a transition from well-vegetated and topographically varied landscapes to the west to an undulating plateau and defined escarpment to the east.

6.1.3 In response to the modifications to the wind farm layout between the Approved and Varied Project, 10 viewpoints were selected for a detailed visual assessment, and photomontages were produced to illustrate the anticipated visual change that will be experienced in the surrounding landscape character units, as described in section 3 of this report. These viewpoints were selected with reference to the Zone of Theoretical Visual Influence mapping, on site investigations and in discussion with Tilt. Further detail on the viewpoint selection and comparative visual assessment is provided in section 7 with reference to the Visual Impact Assessment finding below.

6.1.4 The viewpoints represent a range of locations and landscape characters around the proposed development. Each viewpoint has been selected to illustrate locations that are publicly accessible, representative of typical views of the landscape character units and where a large number of wind turbines will be visible in the landscape. In this regard, each viewpoint represents the greatest probable degree of visual change within the locality that will be experienced as a result of the Varied Project. Viewpoints 2 and 3 are taken from the Palmer Lookout and represent a location that is important to the community

6.1.5 The ten viewpoints were assessed using the GrimKe matrix (refer to Appendix E for the GrimKe matrix). The matrix has been used to quantify the visual effect of the development from a number of locations. Refer to Appendix C for photomontages and detailed maps in Appendix A, locating viewpoints and GPS geographic coordinates.

6.1.6 The matrix considers key aspects of the existing landscape, such as relief (topographic variance), vegetation, built form and infrastructure, as well as cultural and landscape value. These aspects were each scored out of 5 to produce an assessment value out of 20. This provided a baseline measurement of the landscape from which the degree of visual change could be assessed and considers the degree to which the introduction of the wind farm will alter the existing landscape character. The matrix assesses this degree of change using a framework by which the aspects that affect visual change, such as landscape absorption, horizontal and vertical effect and distance, are quantified.

6.1.7 The visual assessment was then combined with the assessment of the existing landscape character to produce a value that represents the degree of visual change, that is to say, the extent to which the development will alter the existing landscape. This is measured as a percentage of visual change and is accompanied by a descriptive reference to qualify the visual effect (refer to Table 1).

Table 1: Percentage of visual change description

Percentage of Visual Change	Descriptive of Visual Effect	Comments
80-100%	**Extreme**	Extreme change in view: change very prominent involving total obstruction of existing view or change in character and composition of the landscape and view through loss of key elements or addition of new or uncharacteristic elements which significantly alter underlying landscape visual character and amenity. The sensitivity of the underlying landscape character to change cannot accommodate or mitigate the introduction of development, and the visual effect is highly adverse.
60-80%	**Severe**	Severe change in view involves the obstruction of existing views or alteration to the underlying landscape visual character by introducing new elements. Change may be different in scale and character from the surroundings and the wider setting or a severe change in the context of the existing landscape character. Resulting in a perceived adverse visual effect and an increase in proportional change to the underlying visual character of the landscape.
40-60%	**Substantial**	Substantial change in view: which may involve partial obstruction of existing view or alteration of underlying landscape visual character and composition through the introduction of new elements. Composition of the view will alter however the sensitivity of the underlying landscape character to change is low and is provides opportunities for mitigation, management and absorptions of the visual effect. View character may be partially changed through the introduction of features.
20-40%	**Moderate**	A moderate change in view: change will be distinguishable from the surroundings whilst composition and underlying landscape visual character will be retained. The sensitivity of the existing landscape to change is low.
0-20%	**Slight**	Very slight change in view: change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.

6.1.8 The following mapping, paragraphs and images describe the landscape character assessment and visual effect resulting from the Varied Project (more detailed information regarding the GrimKe Matrix is provided in Appendix E).

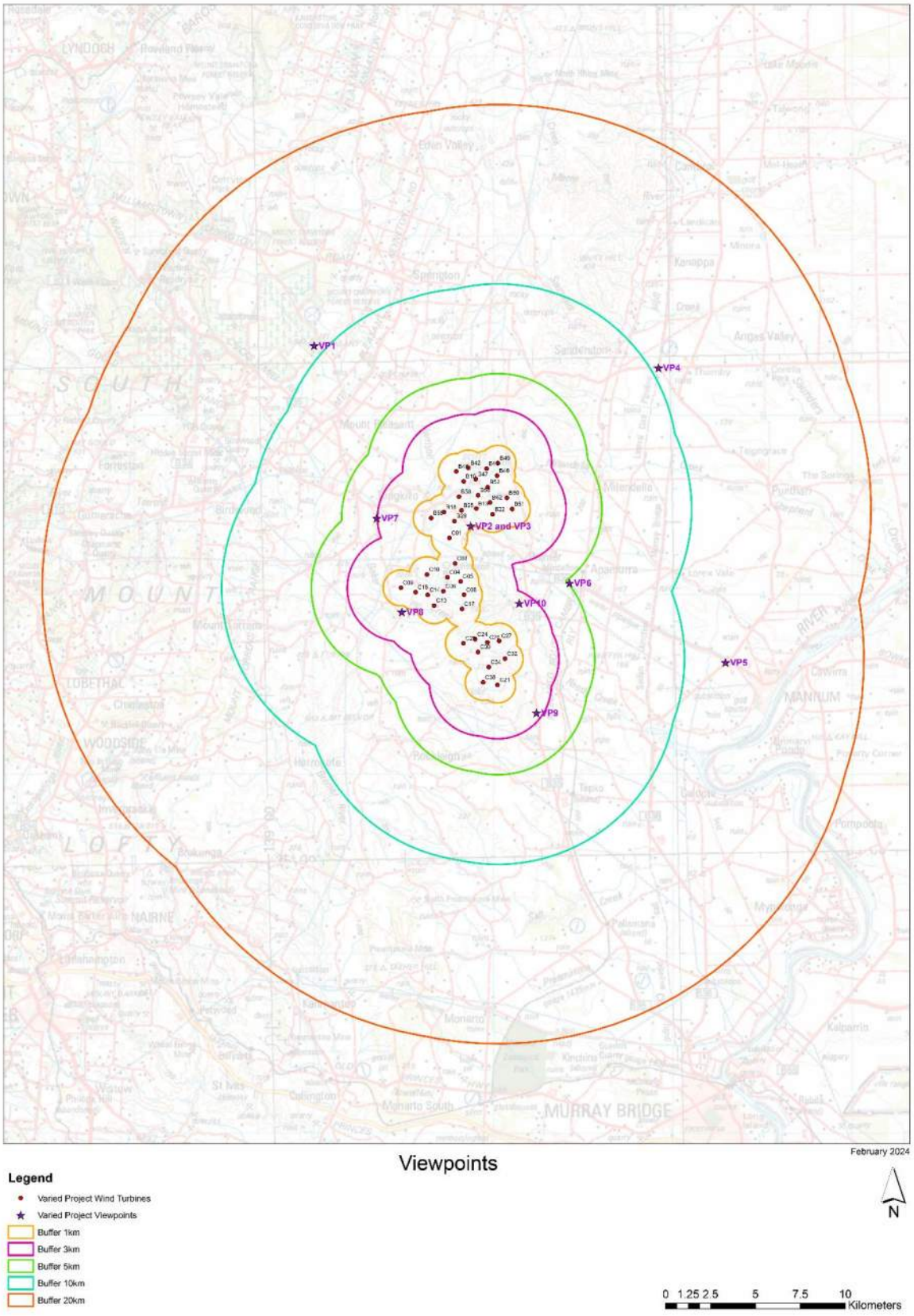


Figure 20: Viewpoint location (Varied Layout)

6.2 Viewpoint 1: Summit of Mount Pleasant (west – sub-regional)

6.2.1 Viewpoint 1 is located adjacent to the summit of Mount Pleasant (refer Figure 21). This viewpoint is located approximately 10 kilometres from the nearest turbine. It demonstrates the probable visual effect that will be experienced from elevated locations within the Barossa, Adelaide Hills and Mount Crawford Forest landscape areas to the west of the proposed wind farm.

6.2.2 The landscape surrounding the viewpoint is typical of the undulating wooded landscape character of the Mount Pleasant and Eden Valley Ridgeline and from locations across the Barossa and Adelaide Hills.

6.2.3 Within the field of view is an attractive rural landscape defined by expansive vegetation cover, open pasture, and paddocks with numerous rolling and undulating ridgelines that extend to a defined visual envelope formed by the elevated topography of the Mount Lofty ranges

Visual Assessment

6.2.4 The Varied Project will be seen as a collection of infrastructure elements located on the distant ridgeline to the southeast (refer Figure 22). A cluster of thirteen wind turbines creates the visual effect associated with the Varied Project. The visual impact stems from the clustering of wind turbines on the horizon line formed by the ridgelines of the rural landscape to the east surrounding Mount Pleasant.

6.2.5 While a proportion of the Varied Project is likely to be visible, the visibility of the rest of the development along the ridgeline is fragmented by the existing vegetation.

6.2.6 The height of the proposed wind turbines within the existing rural landscape increases the visual prominence of the Varied Project. However, the proportional scale of the infrastructure is offset by the topography of the local ridgelines. The proportional scale of the wind turbines is also mitigated by the vegetated character of the rural landscape, and the wind turbines appear as recessive infrastructure elements visible from specific viewpoints and glimpsed within the broader rural landscape.

6.2.7 The vegetation cover and layered topography of the landscape define the character of the locality and the valley in which Mount Pleasant is situated. The arrangement and location of the wind turbines form recessive visual elements located on the eastern edge of the visual envelope. The relationship between the rural character of the foreground and the proposed location of the wind turbines behind the ridgelines of the Southern Mount Lofty Ranges and the Torrens Ranges reduces the potential visual effect and mitigates potential visual impacts.

6.2.8 The proposed wind turbines will be visible as a series of large infrastructure elements located as part of the background character of the locality, on the edge of the visual envelope, partially screened by existing vegetation.

6.2.9 The arrangement and layout of the wind turbines are likely to form uniformly located infrastructure elements along the horizon line, screened by existing vegetation. In this regard, there are unlikely to be prominent visual impacts or outlying visual elements that will increase the potential visual effect of the Varied Project from this location.



Figure 21: Viewpoint 1



Figure 22: Wire line Viewpoint 1



Figure 23: Absorption capacity calculations Viewpoint 1

6.2.10 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 2: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 1

Assessment	Value	Description
Relief	3	The local topography is undulating and layered, associated with Mt Pleasant, the River Torrens and the transitional landscape that connects the Barossa Valley and Adelaide Hills character areas.
Vegetation Coverage	4	Densely vegetated foreground to mid ground, comprising of native Eucalypt woodland and managed pine forestation to the north and southeast.
Infrastructure and Built Form	5	Limited infrastructure with some residential farm dwellings and linear transmission lines evident to the distant background
Cultural and Landscape Value	3	Mount Pleasant Summit Trail and Kidman Trail provide local cultural and recreational values to this area.
Landscape Character	**15**	

Assessment	Value	Description
Landscape Absorption	2	The landscape provides increasing absorption levels due to the foreground and mid-ground vegetation screening and local ridgelines to the mid-ground. The absorption capacity is equated to be 64% (refer Figure 23). Total development is 821756 pixels, and screening comprises 527475 pixels from this viewpoint.
Horizontal	2	The horizontal visual effect is created by turbines B40 and C9, which equates to 37 degrees within the field of view. Hence, the horizontal visual effect is 30%.
Vertical	1	The vertical visual effect is created by turbine B47, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 140m at a distance of 3200m. The variance in elevation created by turbine B47 is 151m at a distance of 11702m. Hence, the turbines create only a small proportion of the existing landscape vertical scale; hence, they will not be seen as a disproportionate element.
Distance	3	The closest turbine is B45, which is approximately 10.6km at a bearing of 133 degrees.
Visual Assessment	**8**	Landscape visual change coefficient 0.4
Degree of Visual Change	**30%**	Landscape Visual Character 15 x (0.4 coefficient) The visual effect is equates to be 6/20 = 0.3x100 = 30% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as moderate. The landscape character of this area provides increased levels of amenity and sensitivity to change. While the natural and vegetated qualities of the landscape increase the potential for visual effect, the increased levels of vegetation, topographic form and distance to the proposed development enhance the landscapes capacity to absorb the development, limiting the degree of visual change. The underlying landscape character will be retained.		

6.3 Viewpoint 2: Palmer Lookout (central looking north)

6.3.1 Viewpoint 2 represents the visual effect that is anticipated on the main road between Tungkillo and Palmer (refer Figure 24). The visual effect will be separated into two distinct areas to the north and south and represented by Viewpoints 2 and 3.

6.3.2 The lookout provides open panoramic views of the lower foothills of the eastern escarpment of the Mount Lofty Ranges. Expansive views over the Murray Plains define the viewpoint to the east.

6.3.3 While the visual and landscape characters are predominantly rural, the panoramic character provides a degree of scenic value. This is particularly reinforced by the distant views and expanse of the viewpoint to the east and southeast.

Visual Assessment

6.3.4 The visual effect from the Lookout at Palmer is defined by the two wind turbine Areas (B and C).

6.3.5 From the lookout, the visual effect of the Varied Project will be created by several wind turbines forming a collection of visually dominant infrastructure elements surrounding the lookout to the north, south and east. The arrangement of the proposed wind turbine reflects the underlying topography.

6.3.6 Several wind turbines, including B13, B22, B25, B62 and B56 (refer Figure 25) are likely to form dominant visual elements located a kilometre from the lookout due to the scale and proximity. Other wind turbines are located more distantly across the topography of the escarpment and form recessive visual elements in the landscape.

6.3.7 To the northwest, several wind turbines will be seen glimpsed behind tree screens that surround the lookout. The visual impact of these wind turbines is less significant, and the visibility is restricted to partial views of the tower, nacelle and blades appearing and disappearing behind the vegetation and canopy cover located around the lookout.

6.3.8 The lookout is orientated to the east and capitalises on the panoramic views across the Murray Plains. The location of the proposed wind turbines does not impact these views. However, the proposed wind turbines will frame views from the lookout and are likely to create a defined infrastructure edge to the existing rural landscape to the north.

6.3.9 The proposed arrangement of the wind turbines to the north forms a defined visual contrast between the modified rural landscape resulting from the introduction of the wind turbines and the distant panoramic views across the Murray Plains to the east.



Figure 24: Viewpoint 2

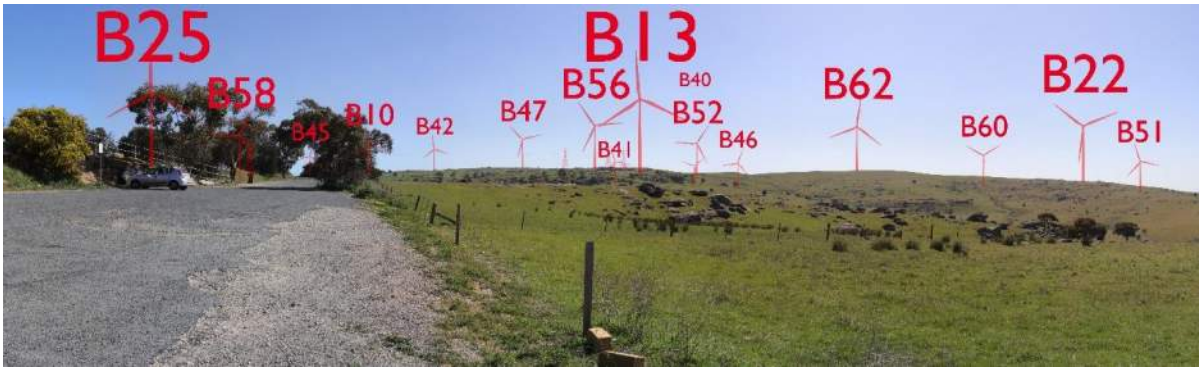


Figure 25: Wire line Viewpoint 2



Figure 26: Absorption capacity calculations Viewpoint 2

6.3.10 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 3: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 2

Assessment	Value	Description
Relief	4	The elevated viewpoint provides panoramic views towards the Murray Plain from the top of the escarpment. The scale and variance of the topography are some of the main visual amenity qualities from this aspect.
Vegetation Coverage	1	The vegetation within the viewpoint is limited, with only sporadic isolated tree groups within the foreground screening the western side of the scenic lookout.
Infrastructure and Built Form	3	Solar farms and grain silos are present across the Murray Plain.
Cultural and Landscape Value	3	The scenic lookout has a moderate frequency of visitation as a local to regional vantage point, valued by the local community.
Landscape Character	**11**	

Assessment	Value	Description
Landscape Absorption	4	The landscape provides limited levels of absorption due to the proximity of the turbines with limited topographic or vegetative screening. The absorption capacity is equated to be 22% (refer Figure 26). Total development is 22059908 pixels, and screening comprises 4936150 pixels from this viewpoint.
Horizontal	5	The horizontal visual effect is created by turbines B51 and B55, which equates to 147 degrees within the field of view. Hence, the percent of visibility represented is 100%.
Vertical	5	The vertical visual effect is created by turbine B13, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 5m at a distance of 145m. The variance in elevation created by turbine B13 is 232m at a distance of 1023m. Hence, the turbine scale from this viewpoint is experienced as substantial, being greater than 100% of the existing landscape vertical scale.
Distance	5	The closest turbine is B29, which is approximately 929m at a bearing of 288 degrees.
Visual Assessment	**19**	Landscape visual change coefficient 0.95
Degree of Visual Change	**52%**	Landscape Visual Character 11 x (0.85 coefficient) The visual effect is equates to be 10.45/20 = 0.5225x100 = 52% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as substantial. The landscape character of this area provides amenity due to the panoramic view across the Murray plains. Due to the distance of the visual effect, the scale of the turbines is seen as significant dominant elements. Given the elevated viewpoint, there is limited screening due to the panoramic scenic quality and close proximity.		

6.4 Viewpoint 3: Palmer Lookout (central looking south)

6.4.1 Viewpoint 3 represents the visual effect that is anticipated on the main road between Tungkillo and Palmer (refer Figure 27). The visual effect will be separated into two distinct areas to the north and south and represented by Viewpoints 2 and 3.

6.4.2 The lookout provides open panoramic views of the lower foothills of the eastern escarpment of the Mount Lofty Ranges. Expansive views over the Murray Plains define the viewpoint to the east.

6.4.3 While the visual and landscape characters are predominantly rural, the panoramic character provides a degree of scenic value. This is particularly reinforced by the distant views and expanse of the viewpoint to the east and southeast.

Visual Assessment

6.4.4 To the south, the anticipated visual impact associated with the lookout is formed by the more distant arrangement and layout associated with the Area C wind turbines (refer Figure 28). The undulating plateau on which Area C is located will provide a degree of uniformity to the visual effect. The wind turbines are likely to be seen as a consistent array of infrastructure elements similar in height and elevation extending across the regional landscape to the south.

6.4.5 While the nearest wind turbine (C1) is located within a kilometre from the lookout, local ridgelines and screening will create a visual barrier, and views further to the west are limited.

6.4.6 The visual effect from the lookout at Palmer can be split into two distinct regions - north and south. The opportunity to see the entire wind farm will be limited, and the visual effect can be described as ‘combined’ with the viewer turning to the north and south to experience the different visual effects associated with the wind farm.

6.4.7 The anticipated visual effect created by the Varied Project will not be experienced from a single location. While this does not remove the potential visual impacts, the anticipated grouping of the wind turbines has the potential to mitigate the direct visual impact of the entirety of the Varied Project.

6.4.8 Importantly, the visual effect from the picnic table, which forms a designated viewpoint, will be mitigated by existing vegetation to the west that screens some wind turbines. The wind turbines associated with Area B to the north will likely be partially visible above the screening vegetation. At the same time, views to the east will not be impacted by the proposed layout of the wind turbines.



Figure 27: Viewpoint 3

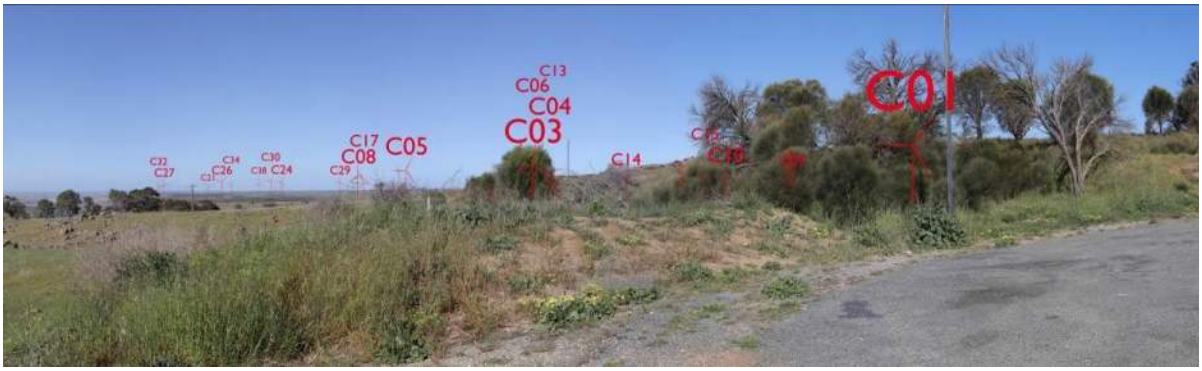


Figure 28: Wire line Viewpoint 3



Figure 29: Absorption capacity calculations Viewpoint 3

6.4.9 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 4: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 3

Assessment	Value	Description
Relief	4	The elevated viewpoint provides panoramic views towards the Murray Plain from the top of the escarpment. The scale and variance of the topography is some of the main visual amenity qualities from this aspect.
Vegetation Coverage	1	The vegetation within the viewpoint is limited, with only sporadic isolated tree groups within the foreground screening the western side of the scenic lookout.
Infrastructure and Built Form	3	Solar farms and grain silos are present across the Murray Plain.
Cultural and Landscape Value	3	The scenic lookout has a moderate frequency of visitation as a local to regional vantage point, valued by the local community.
Landscape Character	**11**	

Assessment	Value	Description
Landscape Absorption	2	The landscape provides moderate levels of absorption due to the foreground and mid-ground vegetation screening and local ridgelines to the mid-ground. The absorption capacity is equated to 63% (refer Figure 29). Total development is 5409233 pixels, and screening comprises 8518535 pixels from this viewpoint.
Horizontal	3	The horizontal visual effect is created by turbines C09 and C32, which equate to 62 degrees within the field of view. Hence, the percentage visible is represented as 52%.
Vertical	5	The vertical visual effect is created by turbine C01, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 10m at a distance of 137m. The variance in elevation created by turbine C01 is 178m at a distance of 1344m. Hence, the turbine scale from this viewpoint is experienced as an 83% increase of the existing landscape vertical scale, which is substantial
Distance	5	The closest turbine is C01, which is approximately 1.36km at a bearing of 241 degrees.
Visual Assessment	**15**	Landscape visual change coefficient 0.75
Degree of Visual Change	**41%**	Landscape Visual Character 11 x (0.75 coefficient) The visual effect is equates to be 8.25/20 = 0.41x100 = 41% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as substantial. Due to the distance of the visual effect and the prominent vertical scale of the turbines, the proposed development will produce an increased degree of visual change in the underlying landscape character.		

6.5 Viewpoint 4: Angas Valley Road and Punthari Road Intersection (east – sub-regional)

6.5.1 Viewpoint 4 at the intersection of Angas Valley Road and Punthari Road represents a major tourist and community road corridor and provides panoramic views of the proposed development site across the Murray Plain towards the Southern Mount Lofty Ranges escarpment (refer Figure 30).

6.5.2 The landscape is defined by belts of vegetation associated with creek lines. The land cover is arable, which decreases in intensity closer to the foothills of the escarpment and is replaced with grazing. The combination of pastoral land uses reinforces the open landscape character of the Murray Plains.

6.5.3 The escarpment continues to the south, decreasing in height and complexity, particularly around the township of Palmer. This change in topography and relief alters the background character of the viewpoint, resulting in the escarpment becoming a more recessive landscape element.

Visual Assessment

6.5.4 The oblique nature of the viewpoint creates a concentrated visual effect with the wind turbines clustered along the escarpment.

6.5.5 Wind turbines B13, B22, B51, B90 and B62 (refer Figure 31) form notable elements in the landscape. Other wind turbines associated with Area B to the west may be partially visible above the ridgeline, with parts of the nacelle and sections of the blades showing.

6.5.6 A similar situation occurs in relation to Area C to the south, with glimpsed views of some of the wind turbines set low on the horizon.

6.5.7 The degree of visual effect is moderate. The visual impact of the Varied Project is likely to be reduced further during non-windy weather when the blades are stationary, and the wind turbines are seen as partially visible infrastructure elements glimpsed low on the horizon line formed by the eastern Mount Lofty escarpment.

6.5.8 The majority of the wind farm is likely to be screened from the viewpoint and other locations to the north due to the prominent ridgelines that exist to the northern edge of the locality.

6.5.9 The small number of wind turbines visible on the elevated ridgeline will likely create a limited visual effect and slight visual prominence within the landscape. The scale of the escarpment provides a significant degree of visual mitigation. The visual prominence of the wind turbines will be fragmented and screened by the escarpment.



Figure 30: Viewpoint 4



Figure 31: Wire line Viewpoint 4



Figure 32: Absorption capacity calculations Viewpoint 4

6.5.10 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 5: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 4

Assessment	Value	Description
Relief	2	To the foreground there is limited variance in topographic form. The mid ground has moderate variance in vertical scale defining the field of view.
Vegetation Coverage	2	Limited cover in the way of trees and low lying vegetation. A land cover of crops and grazing with cadastral planting present
Infrastructure and Built Form	5	Minimal evidence of built form structures, limited to road infrastructure with fence lines and powerlines being present.
Cultural and Landscape Value	2	Frequency of views on a main transportation route.
Landscape Character	**11**	
Landscape Absorption	3	The landscape provides moderate levels of absorption due to the topographic variance between the turbines

Assessment	Value	Description
		and the escarpment with some turbines set behind. The absorption capacity is equated to be 55% (refer Figure 32). Screening comprises of 470395 pixels from this viewpoint with a total extent of development 796576 pixels.
Horizontal	2	The horizontal visual effect is created by turbine B45 and C21 which equates to 36 degrees within the field of view. Hence the percent of visual presence is 30%.
Vertical	2	The vertical visual effect is created by turbine B47 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 235m at a distance of 7000m. The variance in elevation created by turbine B47 is 543m at a distance of 11890m. Hence the turbines create a limited proportional vertical visual effect of 35%.
Distance	3	The closest turbine is B40 which is approximately 10.4km at a bearing of 240 degrees
Visual Assessment	**10**	Landscape visual change coefficient 0.5
Degree of Visual Change	**28%**	Landscape Visual Character 11 x (0.5 coefficient) The visual effect is equating to be 5.5/20 = 0.275x100 = 27.5% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as moderate. The proposed development will not alter the underlying landscape character from this locality due to the distance of the visual effect and capacity to screen and absorb the vertical scale behind the escarpment. Furthermore, existing infrastructure elements and limited natural vegetation within the field of view, reduces the visual quality and sensitivity of the landscape to visual change. From this locality to the north-east the development will only cause moderate visual effect on landscape character.		

6.6 Viewpoint 5: Randell Road and Mannum Road Intersection (southeast – regional)

6.6.1 Viewpoint 5 is located at a busy intersection on the main D1 and B36 Mount Pleasant Road to Mannum transport corridor. The landscape character surrounding the viewpoint is typical of the Murray Plains area with a low lying topographic undulation creating local screening and small scale landform variations (refer Figure 33).

6.6.2 The topographic prominence of the Southern Mount Lofty Ranges escarpment is visible as a backdrop to the viewpoint which increases in visual prominence to the north, while decreasing to the south to form a low lying elevated plateau that continues towards Murray Bridge.

6.6.3 The landscape contains numerous belts of vegetation that mark cadastral field boundaries as well as creek lines which run through the landscape. The agricultural nature of the locality results in an increased number of dwellings and farm buildings as well as infrastructure associated with water pipelines and transmission lines.

6.6.4 The ongoing residential development associated with 'The Crossing' demonstrates a changing character to the edge of Mannum. The residential land use provides additional private open space which is likely to facilitate views towards the proposed development.

Visual Assessment

6.6.5 While the development is distant within the landscape, the scale of the infrastructure on the ridgeline to the west will alter the visual envelope, changing the rural character and increasing the infrastructure context of the landscape (refer Figure 34).

6.6.6 The wind turbines extend across two distinct landscape characters. To the north is the more distant elevated ridgeline associated with the tablelands around Tungkillo and the escarpment of the Southern Mount Lofty Ranges. To the south, the wind turbines will be set behind a series of low lying ridges that form the rural landscape of the Murray Plains.

6.6.7 The height and elevation of the wind turbines within the rural landscape of the Murray Plains are likely to create a prominent visual effect. The scale of the proposed infrastructure elements appears greater than the underlying topography of the Murray Plains, increasing the infrastructure's visual prominence.

6.6.8 The arrangement of the wind turbines forms three distinct visual clusters. The northern cluster is associated with Area B wind turbines and Area C appears as two clusters. The visual gap in Area C is formed by the arrangement of the wind turbines on either side of Camels Hump Road. This layout is likely to partially fragment the effects of the wind turbine array visually, reinforcing the retention of the escarpment as the dominant visual element.

6.6.9 The arrangement and elevation of the wind turbines will remain visually consistent, as distant elements in the landscape. The wind turbines will be spread across the landscape, creating a linear array of infrastructure elements. This reduces the layering and overlapping of the wind turbines, increasing the legibility of the wind turbine array in the broader locality.



Figure 33: Viewpoint 5



Figure 34: Wire line Viewpoint 5



Figure 35: Absorption capacity calculations Viewpoint 5

6.6.10 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 6: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 5

Assessment	Value	Description
Relief	2	The view comprises of limited local topographic form, negligible sub regional and moderate regional scale variance.
Vegetation Coverage	2	Defined belts of vegetation associate to cadastral plantings. In addition some small pockets of isolated tree groups within paddocks
Infrastructure and Built Form	3	Residential development to the foreground provide a peri urban settlement pattern with associated infrastructure
Cultural and Landscape Value	3	High frequency of public viewing from this locality, travelling between Murray Bridge and Mannum and peri urban settlement of Mannum
Landscape Character	**10**	

Assessment	Value	Description
Landscape Absorption	4	The landscape provides limited to moderate levels of absorption due to foreground vegetation screening and topographic variance between the turbines and the escarpment upon which some of the turbines are located. The absorption capacity is equated to be 39% (refer Figure 35). Total development is 881922 pixels and screening comprises of 348306 pixels from this viewpoint.
Horizontal	2	The horizontal visual effect is created by turbine B40 and C21 which equates to 40 degrees within the field of view. Hence the percent of visual presence is 33%.
Vertical	4	The vertical visual effect is created by turbine B62 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 377m at a distance of 17,100m. The variance in elevation created by turbine B62 is 571m at a distance of 15,860m. Hence the turbines create an increasing vertical visual effect of 63% and will be seen as prominent elements.
Distance	3	The closest turbine is C32 which is approximately 12km at a bearing of 272 degrees
Visual Assessment	**13**	Landscape visual change coefficient 0.65
Degree of Visual Change	**33%**	Landscape Visual Character 10 x (0.65 coefficient) The visual effect is equating to be 6.5/20 = 0.325x100 = 32.5% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as moderate. Due to the distance of the visual effect and moderate landscape absorption capacity the development is seen as an integrated development form rather than imposing on the underlying character. On the other hand the vertical scale of the turbines on the visually dominant escarpment will increase the visual presence of the development from the Murray Plain Landscape Character Unit.		

6.7 Viewpoint 6: Outskirts of Palmer on Randell Road (east – sub-regional)

6.7.1 Viewpoint 6 is located on the outskirts of Palmer and represents an elevated location from which the surrounding topography, landscape character of Palmer and adjacent escarpment is visible. The viewpoint is typical of the foothills of the Murray Plains with expansive views of an agricultural landscape character to the east and the rising visual envelop of the Southern Mount Lofty Ranges escarpment to the west (refer Figure 36).

6.7.2 The existing rural landscape is impacted by several infrastructure elements, including pipelines, roads, solar farms and grain silos. However, the existing visual envelope and backdrop to the locality are formed by the rural escarpment of the Mount Lofty Ranges and natural landscape elements such as Harrison Gorge.

Visual Assessment

6.7.3 The visual effect generated by the Varied Project will result in a visually prominent array of large infrastructure elements located on the ridgeline of the eastern escarpment of the Southern Mount Lofty Ranges (refer Figure 37). The introduction of the wind turbines is likely to alter the visual character of the landscape.

6.7.4 The backdrop formed by the rural escarpment will become punctuated by wind turbines arranged along the top of the ridgeline. The wind turbines will be equal in scale to the elevation of the escarpment. The visual impact of the turbines, changes the landscape character and the degree of visual amenity that this landscape provides – particularly, the locality associated to Harrison Gorge.

6.7.5 While the proposed arrangement and grouping of the wind turbines are not visually complex, and the instance of overlapping turbines and rotating blades is limited, the scale of the wind turbines in relation to the topography of the locality creates a prominent visual effect.



Figure 36: Viewpoint 6

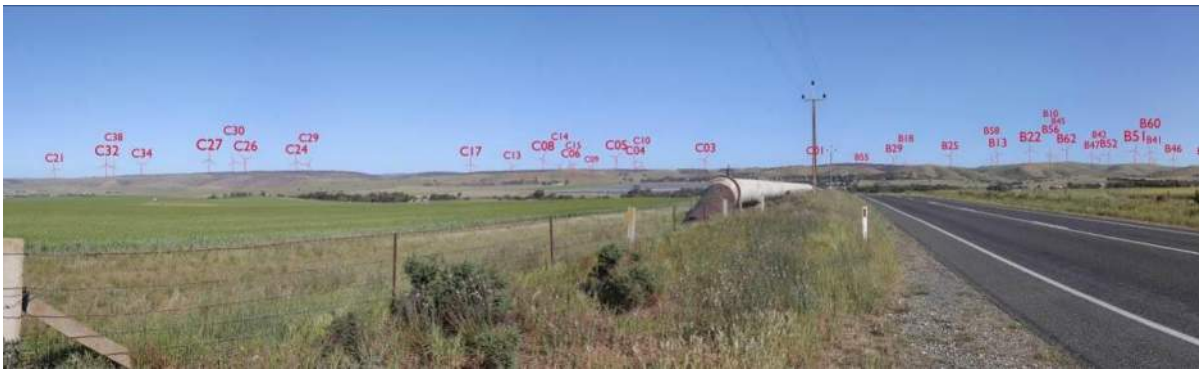


Figure 37: Wire line Viewpoint 6



Figure 38: Absorption capacity calculations Viewpoint 6

6.7.6 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 7: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 6

Assessment	Value	Description
Relief	2	The topography is classified as limited within the field of view for the foreground, associate to the rolling north south local ridges with more dominant escarpment within the sub regional context
Vegetation Coverage	2	More dense vegetation is associated to the periphery of the township of Palmer. In addition, natural vegetation is prominent to the south-west horizon associated to Palmer
Infrastructure and Built Form	2	The view and surrounding area is impacted by a number of built form structures. The township of Palmer to the west and grain silos to the east are two more prominent vertical elements. Solar farm arrays are also present within the mid ground to foreground that alters the character surrounding Palmer. Directly adjacent is the Mannum to Adelaide water pipeline.
Cultural and Landscape Value	2	Slight to low cultural sensitivity primarily associated to the township of Palmer and the approach from Mannum which translates into a prominent visual effect.
Landscape Character	**8**	
Landscape Absorption	4	The landscape provides limited levels of absorption due to the panoramic view across the Murray Plain which has limited mature foreground to mid ground vegetation screening and topographic variance between the turbines and the escarpment upon which some of the turbines are located. The absorption capacity is equated to be 32% (refer Figure 38). Total development

Assessment	Value	Description
		is 5428175 pixels and screening comprises of 1740894 pixels from this viewpoint.
Horizontal	5	The horizontal visual effect is created by turbine C21 and B40 which equates to 114 degrees within the field of view. Hence the percent of visual presence is 95% of the field of view.
Vertical	5	The vertical visual effect is created by turbine B22 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 235 at a distance of 6832m. The variance in elevation created by turbine B22 is 451m at a distance of 5745m. Hence the turbines create a proportional increased vertical visual effect in excess of 100% and will be seen as dominant elements.
Distance	4	The closest turbine is C27 which is approximately 5.08km at a bearing of 231 degrees
Visual Assessment	**18**	Landscape visual change coefficient 0.9
Degree of Visual Change	**36%**	Landscape Visual Character 8 x (0.9 coefficient) The visual effect is equating to be 7.2/20 = 0.36x100 = 36% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as moderate. Due to the low level of existing landscape amenity partially due to the existing degree of built form and infrastructure within the field of view, the proposed development will have only a moderate visual effect on the existing character which has a low sensitivity to visual change and effect.		

6.8 Viewpoint 7: Brinkworth Road and Memorial Drive Tungkillo Township (west – local)

6.8.1 Viewpoint 7 represents the potential visual effect that will be experienced within the elevated areas to the south of the township of Tungkillo and the associated transitional landscape between the tablelands to the east and the edge of the Adelaide Hills and Barossa Valley area (refer Figure 39).

6.8.2 The viewpoint is also typical of the potential visual effect associated with the Tungkillo Community Hall, which represents an important facility in the town.

6.8.3 The landscape character associated with the viewpoint provides panoramic views over an expansive, visually open undulating landscape character. The land use is typically grazed, with little evidence of cadastral enclosure defining field boundaries. Tree cover is sparse and sporadic due to the rocky and hilly character of the underlying topography.

6.8.4 Small belts of vegetation occur along local valleys and road corridors and around buildings. Several pieces of prominent infrastructure exist within the field of view, including transmission lines, the Mannum – Adelaide pipeline and several road corridors.

6.8.5 From the viewpoint distant views extend across the Murray Plains to the southeast forming a distant horizon line. To the north, the horizon line transitions to the edge of the Tungkillo plateau on which the proposed wind turbines will be located. This variation in visual envelope and horizon line results in two visual characters resulting from the introduction of the wind turbines.

Visual Assessment

6.8.6 The visual effect is likely to be formed by two distinct wind turbine areas associated with the Varied Project. Wind turbine Area B is to the north of the viewpoint and Area C to the south of the viewpoint. The proposed wind turbines extend across the ridge formed by Scott Hill and the edge of the eastern escarpment of the Southern Mount Lofty Ranges (refer Figure 40).

6.8.7 The wind turbines present as an irregular cluster of large infrastructure elements within the open rural landscape that surrounds the locality of the viewpoint and the town of Tungkillo.

6.8.8 The potential visual effect to the east is likely to be defined by several wind turbines located on the existing topography of the eastern ridgeline of the Mount Lofty Ranges. To the south, the elevation and arrangement of the proposed wind turbines responds to the lower lying topography of the eastern escarpment, and the wind turbines appear set in front of a horizon line that is formed by the Murray Plains. The introduction of the wind turbines is likely to alter the perceived depth of field, with panoramic views of the plains seen through numerous large infrastructure elements.

6.8.9 The resulting visual effects are likely to be governed by a range of different visual characteristics in relation to the wind turbines. Several of the wind turbines are likely to appear as prominent visual elements, with the entirety of the tower, nacelle and blades visible located on the ridgeline. These wind turbines are visually dominant in the landscape due to the proximity and scale.

6.8.10 Wind turbine C1 is likely to form a notable visual element in the landscape located between the Area B and C wind turbine clusters to the north and south. The size of the proposed wind turbine and its isolated location relative to Areas B and C increases its visual prominence.

6.8.11 Given the likely visibility of the Varied Project and the dynamic rotational character of the blades, the visual effects associated with Viewpoint 7 and other viewpoints in and around Tungkillo will be substantial. The absence of significant topographic screening or vegetation across the locality increases the visibility of the wind turbines and limits opportunities for visual mitigation.



Figure 39: Viewpoint 7

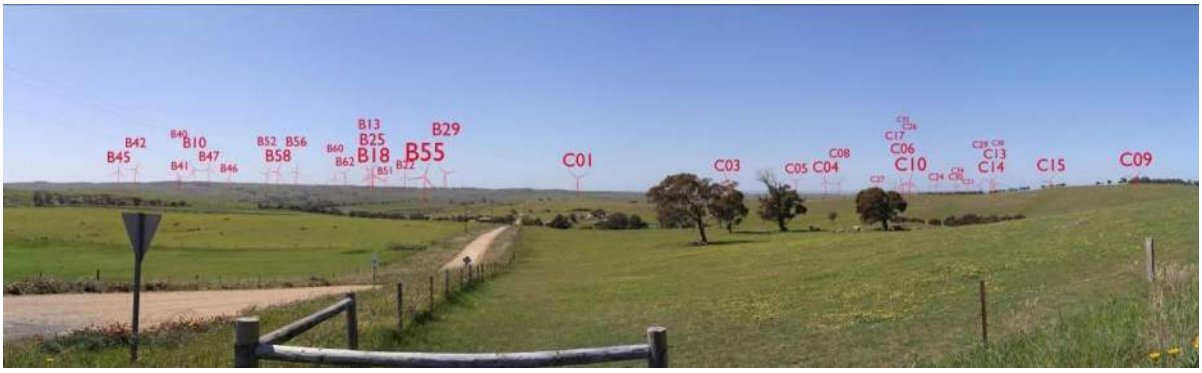


Figure 40: Wire line Viewpoint 7



Figure 41: Absorption capacity calculations Viewpoint 7

6.8.12 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 8: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 7

Assessment	Value	Description
Relief	3	The topography is moderate to the mid ground with complex layered ridges that contain views from the centre of Tungkillo. From more elevated locations on the fringe of the township more expansive views are provided towards the proposed development

Assessment	Value	Description
Vegetation Coverage	1	Limited sparse vegetation is present within the field of view.
Infrastructure and Built Form	4	Isolated elements comprising of water pipes and residential/ commercial properties provide a more urban context directly surrounding the viewpoint
Cultural and Landscape Value	2	Slight to low cultural sensitivity primarily associated to the township of Tungkillo and its residents and rural residential properties.
Landscape Character	**10**	
Landscape Absorption	4	The landscape provides moderate levels of absorption due to the variance in local topographic form and local vegetation screening. The absorption capacity is equated to be 38% (refer Figure 41). Total development is 6232800 pixels and screening comprise of 2348708 pixels from this viewpoint.
Horizontal	5	The horizontal visual effect is created by turbine C09 and B45 which equates to 101 degrees within the field of view. Hence the percent of visual presence is 84% of the field of view.
Vertical	5	The vertical visual effect is created by turbine B55 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 110m at a distance of 3140m below the viewpoint sightline. The variance in elevation created by turbine B55 is 133m at a distance of 3040m above the viewpoint sightline. To review the proportional scale the aggregate of above and below the lien of sight is required. The turbines will provide an increased vertical effect greater than 100% of the existing scale
Distance	5	The closest turbine is B55 which is approximately 3.04km at a bearing of 91 degrees
Visual Assessment	**19**	Landscape visual change coefficient 0.95
Degree of Visual Change	**48%**	Landscape Visual Character 10 x (0.95 coefficient) The visual effect is equating to be 9.5/20 = 0.475x100 = 48% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as substantial. Due to the elevated views across the valley to the east with limited to moderate variance in topography, vegetation, there will be a substantial horizontal and vertical degree of visual influence. The scenic quality and landscape amenity is impacted by existing infrastructure and built form associated to the township of Tungkillo and water pipeline within the town centre. The proposed development will have a substantial visual effect on the existing character.		

6.9 Viewpoint 8: Brinkworth Road and Hentschke Road (west – local)

6.9.1 Viewpoint 8 is located on the Brinkworth Road approximately 4 kilometres south of Tungkillo. The viewpoint is representative of the landscape character and potential visual effect that will be experienced across the tablelands to the southwest of Varied Project (refer Figure 42).

6.9.2 The existing landscape character is defined by undulating hills that extend throughout the area with localised valleys and trees punctuating the landscape. The land cover is grazed with a few isolated remanent trees as well as occasional belts of vegetation associated with creek lines.

6.9.3 Glimpsed distant views are created between the promontories, creating panoramic views that extend across the landscape. The prominence of the local ridgelines creates a defined sense of visual enclosure.

6.9.4 Generally, the visual character of the locality is open with views extending over several kilometres to adjacent ridge lines and along valleys. Within the landscape there are a number of power transmission lines as well as prominent fence lines. These objects create isolated pockets of infrastructure that reinforce the development character and productive nature of the landscape.

Visual Assessment

6.9.5 The visibility of the Varied Project is likely to be created by several wind turbines located within the rural landscape and across the ridgeline that forms the northern visual extent of the locality along Brinkworth Road (refer Figure 43).

6.9.6 Wind turbines C09, C14 and C15 form large, prominent visual elements within the rural landscape located 1.3 kilometres from the viewpoint. This visual prominence is reinforced by other turbines that are located on or behind the existing ridgelines—particularly wind turbines C04, C06 and C10.

6.9.7 The visibility of the wind turbines extends further to the south before local ridgelines provide screening to the locality and mitigate a potentially more extensive visual effect to the south.



Figure 42: Viewpoint 8



Figure 43: Wire line Viewpoint 8



Figure 44: Absorption capacity calculations Viewpoint 8

6.9.8 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 9: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 8

Assessment	Value	Description
Relief	3	Moderate undulations in the mid ground to background. Local land forms create defined visual enclosure in the landscape
Vegetation Coverage	2	Pockets of vegetation contained within the lower areas of the undulating landscape. Largely isolated remnant trees with some scattered groupings
Infrastructure and Built Form	5	Limited visual presence of infrastructure or built form. Predominantly associated to boundary fencing, transmission lines and dirt roads.
Cultural and Landscape Value	2	The locality has relatively low frequency of visitation however the Kidman trail does traverse the landscape
Landscape Character	**12**	
Landscape Absorption	4	The landscape provides low levels of absorption due to the close proximity of the turbines limiting the ability of the local topography to screen the vertical scale. The absorption capacity is equated to be 30% (refer Figure 44). Total development is 11742093 pixels and screening comprises of 3554321 pixels from this viewpoint.
Horizontal	5	The horizontal visual effect is created by turbine C09 and C38 which equates to 132 degrees within the field of view. Hence the percent of visual presence is 100% of the field of view.

Assessment	Value	Description
Vertical	5	The vertical visual effect is created by turbine C15 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 26m at a distance of 1170m. The variance in elevation created by turbine C15 is 231m at a distance of 1360m. From this aspect the turbines create a large scale element greater than 100% of the existing vertical scale.
Distance	5	The closest turbine is C15 which is approximately 1.36km at a bearing of 36 degrees
Visual Assessment	**19**	Landscape visual change coefficient 0.95
Degree of Visual Change	**57%**	Landscape Visual Character 12x (0.95 coefficient) The visual effect is equates to be 11.4/20 = 0.57x100 = 57% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as substantial. Due to the close proximity and vertical scale of the turbines, the landscape provides limited capacity to absorb the turbines, the wind turbines will be seen as large pieces of infrastructure. The moderate degree of existing landscape character amenity through visual clusters of natural landscape means the proposed development will provide substantial change for this locality primarily due to the close proximity and scale with limited visual management opportunities to absorb.		

6.10 Viewpoint 9: Reedy Creek Road (south – sub-regional)

6.10.1 Viewpoint 9 is located on Reedy Creek Road. The viewpoint demonstrates the visual effect that is likely to be experienced along the main arterial road adjacent to the foothills of the eastern escarpment. The orientation of the road in a north-south direction provides oblique views towards the wind turbines (refer Figure 45).

6.10.2 The existing landscape character is a mixture of arable cropping to the plains and grazing along the steeper escarpment of the foothills. The vegetation cover extends to small remnant trees clustered within valleys and gullies along the foothills of the escarpment to larger belts of vegetation across the Murray plains associated with field patterns and cadastral boundaries.

6.10.3 To the north is the defined ridgeline of the eastern Mount Lofty ranges. This forms a pronounced visual edge on which the proposed wind turbines will be located. The viewpoint also captures the new solar farms associated with Palmer. These introduce a renewable energy land use character to the area.

6.10.4 The landscape character remains rural with defined topographic variations.

Visual Assessment

6.10.5 The visual effect of the wind farm is likely to be created by two distinct visual effects that respond to the clustering and arrangement of the Varied Project and the oblique southerly location of the viewpoint (refer Figure 46).

6.10.6 Along the Southern Mount Lofty Ranges escarpment, the Varied Project will be visible with several wind turbines likely to form pronounced infrastructure elements within the landscape - particularly C26, C27, C32 and C34. Other wind turbines associated with Area C will be screened by the ridgeline of the escarpment. Glimpsed views of turbine blades flickering above the escarpment will be evident with particular note turbine C21

6.10.7 Set on and behind the escarpment and extending to the north, the Varied Project is likely to appear as a continuous line of infrastructure elements uniformly distributed along the ridgeline. The linear arrangement and limited overlap of wind turbines assist in reducing the visual complexity of the Varied Project.



Figure 45: Viewpoint 9

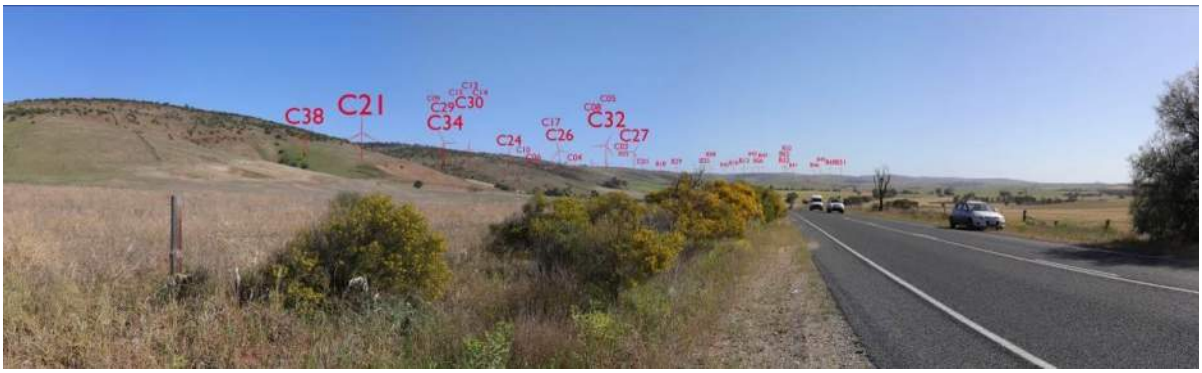


Figure 46: Wire line Viewpoint 9



Figure 47: Absorption capacity calculations Viewpoint 9

6.10.8 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Table 10: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 9

Assessment	Value	Description
Relief	3	The escarpment to the foreground and mid ground provides a dominant visual element and defines the viewshed
Vegetation Coverage	2	Sparse vegetation patterning with copse of trees and linear bands associated to drainage catchments and rural property boundaries
Infrastructure and Built Form	3	The landscape contains elements of built form infrastructure in particular solar farm, transmission line that reference renewable energy layer upon a rural underlying land use
Cultural and Landscape Value	3	This viewpoint represents a frequent transient experience for commuters between Mannum and Palmer and the surrounding south eastern Murray Plain.
Landscape Character	**11**	
Landscape Absorption	4	The landscape provides limited to moderate levels of absorption due to the local ridgeline and vegetation screening to the foreground and mid ground. The absorption capacity is equated to be 44% (refer Figure 47). Total development is 3672295 pixels and screening comprises of 1423720 pixels from this viewpoint
Horizontal	3	The horizontal visual effect is created by turbine C38 and B51 which equates to 53 degrees within the field of

Assessment	Value	Description
		view. Hence the percent of visual presence is 44% of the field of view.
Vertical	1	The vertical visual effect is created by turbine C21 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 98m at a variable distance of 781m. The variance in elevation created by turbine C21 is 332m at a distance of 2667m. Hence the turbines will be seen as a vertical proportion of the existing landscape or in other words smaller than the existing landscape vertical scale, hence will not be seen as a disproportionate element.
Distance	4	The closest turbine is C21 which is approximately 2.67km at a bearing of 307 degrees
Visual Assessment	**12**	Landscape visual change coefficient 0.6
Degree of Visual Change	**33%**	Landscape Visual Character 11x (0.6 coefficient) The visual effect is equates to be 6.6/20 = 0.33x100 = 33% visual change
Visual Effect: The visual effect of the proposed development from this viewpoint is described as moderate. Due to the close proximity and vertical scale of the turbines, the landscape provides limited capacity to absorb the turbines and they will be seen as large pieces of infrastructure flickering behind and along the escarpment to the north. The ridgeline limits the extent of the developments visibility, managing the complexity and layering of turbines which form a more linear effect to the north.		

6.11 Viewpoint 10: Harrison Gorge, Mine Road (southeast – local)

6.11.1 Viewpoint 10 represents the potential visual affect that will be experienced in the locality of Harrison Gorge and around Mine Road to the south of Palmer. The viewpoint and general locality is important as it represents a pocket of natural landscape character. The vegetation cover and rocky outcrops provide a high degree of visual amenity in relation to natural features within the local area (refer Figure 48).

6.11.2 The textural qualities of the rock escarpment and the vegetation create pockets of increased visual amenity within the natural landscape. This combination of rock and vegetation create a sense of wilderness within the heavily modified rural landscape of the area. The existence of these natural areas creates a contrast with the surrounding rural landscape thereby increasing its prominence in the overall landscape character.

Visual Assessment

6.11.3 The visual impact associated with Viewpoint 10 will be focused on the wind turbines of Area C. The wind turbines form a consistent array of infrastructure elements that extend northwest and south along the existing ridgeline that surrounds the Kitticoola Mine and Mine Road (refer Figure 49).

6.11.4 The ridgeline forms a significant backdrop with natural features such as large stands of trees, rock escarpments, creeks and rock lined gullies. To the north and south, the landscape transitions from the natural landscape of Harrison Gorge to rolling rural landscapes typical of the foothills of the escarpment.

6.11.5 To the north, the wind turbines will be seen as distinct infrastructure elements located behind the ridgeline. The introduction of wind turbines is likely to change the existing character and contrast the scenic values associated with the natural landscape of Harrison Gorge, Camel Hump Road and the Kitticoola Mine site.

6.11.6 While the introduction of the wind turbines is likely to change the visual character, the scale of the local escarpments and the extent of the natural vegetation remain as the underlying landscape character. Furthermore, the visual presence of the turbines will vary within the incised gorge valleys with screening being provided, removing the degree of likely change and visual experience of the natural qualities within the lower lying areas.

6.11.7 To the south, from elevated viewing locations, the visual effect increases and a cluster of nine turbines associated with Area C, become prominent visual elements on the rural ridgeline.

6.11.8 The visual effect associated with Viewpoint 10 is likely to be typical of other visual effects that will be experienced throughout the foothills and escarpment to the east of the Varied Project and the locality more broadly.



Figure 48: Viewpoint 10

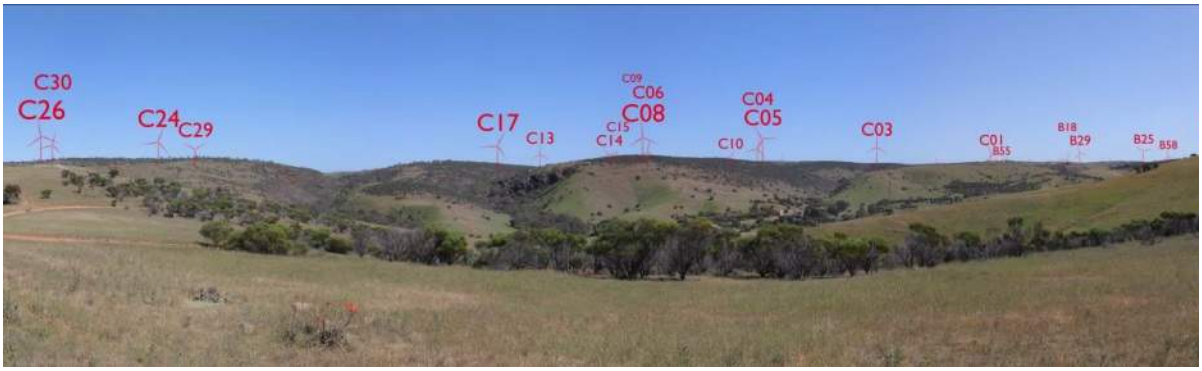


Figure 49: Wire line Viewpoint 10



Figure 50: Absorption capacity calculations Viewpoint 10

Table 11: Detailed Visual Impact Assessment (Varied Project) - Viewpoint 10

6.11.9 The following table is a summary of Assessment Stage 2: Visual Impact Assessment, as described in the methodology in Section 2, that was undertaken for this viewpoint. For the detailed assessment criteria and matrix methodology, refer to Appendix E.

Assessment	Value	Description
Relief	4	The topography varies considerably within the field of view, the depressed and hidden incised nature of the gorge elevates the scenic quality
Vegetation Coverage	3	Within the gorge and local surrounds there is layered natural vegetation coverage. Views from elevated aspects local to sub regional distances towards the gorge experience a proportional grazed landscape with an overlay of natural vegetation to the ridgelines and within the valleys
Infrastructure and Built Form	5	Infrastructure and built form is limited to isolated farming residents which do not impose visually due to the vertical scale of the gorge
Cultural and Landscape Value	3	During the community engagement sessions in 2013 this landscape character areas was identified by several community members to be of high sensitivity to visual change. Thus, this area has a local sensitivity to change

Assessment	Value	Description
Landscape Character	**15**	
Landscape Absorption	4	The landscape provides slight levels of absorption due to pronounced ridgeline associated to Harrison Gorge however due to the proximity there is limited screening potential with turbines elevated above the ridgeline. The absorption capacity is equated to be 24% (refer Figure 50). Total development is 8202937 pixels and screening comprises of 1939821 pixels from this viewpoint.
Horizontal	5	The horizontal visual effect is created by turbine C32 and B51 which equates to 162 degrees within the field of view. Hence the percent of visual presence is 100% of the field of view.
Vertical	1	The vertical visual effect is created by turbine C26 which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 110m at a variable distance of 550m to 890m. The variance in elevation created by turbine C26 is 317m at a distance of 2809m. From this aspect the turbines create a scaled element on the ridgeline however are proportionally smaller than the landscape scale
Distance	5	The closest turbine is C27 which is approximately 2.43km at a bearing of 209 degrees
Visual Assessment	**15**	Landscape visual change coefficient 0.75
Degree of Visual Change	**56%**	Landscape Visual Character 15x (0.75 coefficient) The visual effect is equating to be 11.25/20 = 0.56x100 = 56% visual change

Visual Effect: The visual effect of the proposed development from this viewpoint is described as substantial. Due to the elevated viewpoint, close proximity and vertical scale of the turbines, the landscape provides limited capacity to absorb the turbines and they will be seen as large pieces of infrastructure. The natural character of Harrison Gorge with its incised valley form and vegetation elevates the visual amenity and scenic qualities of this defined local area. The sensitivity to visual change is increased and the potential for adverse visual effect increases. The proposed development will be seen to alter the character of this area but will ultimately only be perceived form a defined locality along the elevated ridgelines surrounding the gorge. From within the gorge itself the development will have less of an impact as the turbines will be proportionally or completely screened from view. Hence this viewpoint is not considered to be reflective of the views experienced within the Gorge but from the approach along Mine Road.

6.12 Substation, Control building and Operational Maintenance Compound

6.12.1 The Varied Project will require two substations including a switching yard, associated electrical infrastructure, control building, staff facilities and small car park (refer Figure 51).

6.12.2 The substations / switching yard compounds will comprise of the following;

- One permanent 33kV / 275kV grid connection
- Grid Connection within a total compound area of approximately 150m by 150m.
- One control building
- Workshop, store room, staff facilities and small car park

6.12.3 The substations will be located approximately south of Bothwick Brae Road near to wind turbine B13 and north of Camel Hump Road close to C13. Where visible, the substations will create a visual contrast to the rural character of the landscape reinforcing the perceived land use changes that will occur with the introduction of the wind farm across the wider landscape.

6.12.4 The vertical scale of the substation gantries (approximately 20m) is likely to produce an increased degree of visibility within the locality of the substation. The gantries and towers are proposed to be lattice reducing the visual mass and form of the structure.

6.12.5 While the visual effect of the substations in relation to the overall effect of the wind farm is minimal, from local viewpoints around Randell Road, Borthwick Brae Road and Camel Hump Road, the degree of visual change within the rural landscape will increase and the substation will be a noticeable development form. Compared to the Approved Project, the potential visual effect is the same

6.12.6 In addition, it is proposed that landscape treatments are provided to the perimeter of the substation. The landscape treatment would be a combination of local provenance screening tree groups and shrubs suitable for the ridge, slope and valley conditions in which the infrastructure associated with the wind development is located. Any screening will need to be undertaken in line with electrical code best practice to avoid potential disruption of supply.

6.12.7 Tree species would include Allocasuarina verticillata, Pittosporum angustifolium, Melaleuca lanceolata, and Santalum acuminatum. These trees will provide elevated canopies of 6 to 10m. The shrub species would include Acacia paradoxa, Acacia euthycarpa and Cassinia uncata. Planted in a double row at 0.5 to 1m centres of the shrubs would create a 2 to 3m screen to the boundary of the substation, providing screening to the local area.

6.12.8 The introduction of vegetation screens to the substation and operational maintenance compound will overtime reduce the visual effect of this infrastructure in the landscape at a local level.

6.12.9 From more distant views the lattice towers will become recessive, limiting the visual presence and effect of the infrastructure. While the lattice construction of the gantries will not remove the visual effect completely, this visually permeable form of construction does mitigate to a certain degree the potential visual impact of the infrastructure associated with the substations. The recessive nature of the gantries will also be seen within the context of the existing transmission line infrastructure and will result in a proportional increase in the existing visual effect.

6.13 Access tracks

6.13.1 As part of the proposed development a series of gravel tracks will be required to access the turbine locations off public access roads. The tracks developed across private land areas will typically be 10 m during the construction period and reduced 5 m after implementation. Public road access track will be limited to 5-6 m width. The access tracks correspond with the alignment of the turbines and are located on the local profile of the ridges that form the Southern Mount Lofty Ranges Tablelands and the edge of the escarpment (refer Figure 51). Consideration of earthworks profiling (cut and fill) will require micro siting to establish batter profiles that are contiguous with the adjacent landform to support re-establishment of vegetative cover post development. This will support visual integration of the access tracks.

6.13.2 The proposed incline of the access tracks will be between 2 and 6%, increasing to 14% (1 in 7) in a few isolated locations. The slope profile closely follows the existing topography of the Ranges and would require limited cut and fill, which in turn will limit the extent of visual impact associated with access tracks.

6.13.3 Wherever possible the proposal will utilise existing access track and road connections. In addition, the form, materiality and colour of the new tracks will be in keeping with other tracks and roads in the area. While the proposed tracks will appear as new development post construction, they do not appear out of character with the wider rural landscape. The track surface will be crushed rock sourced either on site or from a local supplier. Overtime, the track material is likely to dull and weather naturally which will reduce the associated visual effect.

6.13.4 Finally, the visibility of the tracks needs to be assessed relative to the other development forms associated with the wind farm proposal. The proportional effect of the tracks will always be a secondary or partial visual element when considered against the degree of visual change produced by wind turbines. In this regard, the visual effect of the track is described as negligible and will progressively diminish over time.

6.14 Underground cable routes

6.14.1 The undergrounding of cable as part of the proposal limits visual impact. Trenching is typically 0.45 m wide by 1 m deep. All trenches will be backfilled to meet existing surface levels limiting associated visual impacts and should be considered in context with the access tracks and overall visual effect of the entire development. Cable trenches will predominantly be located immediately adjacent to access tracks thereby avoiding additional site and visual impacts associated with separate trenching.

6.15 Overhead transmission line

6.15.1 As part of the infrastructure provision of the Varied Project an overhead transmission lines will be required. Centrally through the Project Area, there will be a 275kV transmission line for approximately 12 kilometres which will link the on site sub-station to the Tungkillo sub-station (refer Figure 51). This line will comprise of lattice towers up to 55 m high (similar to existing high voltage towers in the area) and spaced approximately 300-600 metres apart.

6.15.2 The landscape assessment undertaken in Section 3 indicates that the existing landscape character is formed by a number of distinct landscape and topographic areas. These differing character landscape areas will produce various visual contexts in which the proposed transmission lines are located.

6.15.3 The presence of an existing transmission line that runs to the western edge of the proposed wind farm site produces a context for the degree of visual effect that is likely to result from the towers or poles. At an offset distance of between the 500m and 800m to the east of the existing transmission line, the proposed overhead connection will produce a proportional increase in the visual effect, rather than a new development form with the existing rural landscape.

6.15.4 Only from locations long Ayres Road and Brinkworth Road will the visual effect become more prominent. However, as previously stated, when the distance between the viewing point and the transmission line increases beyond 2 to 3kms, the degree of visual change decreases as a direct result of an increased degree of visual change associated with the proposed wind farm.

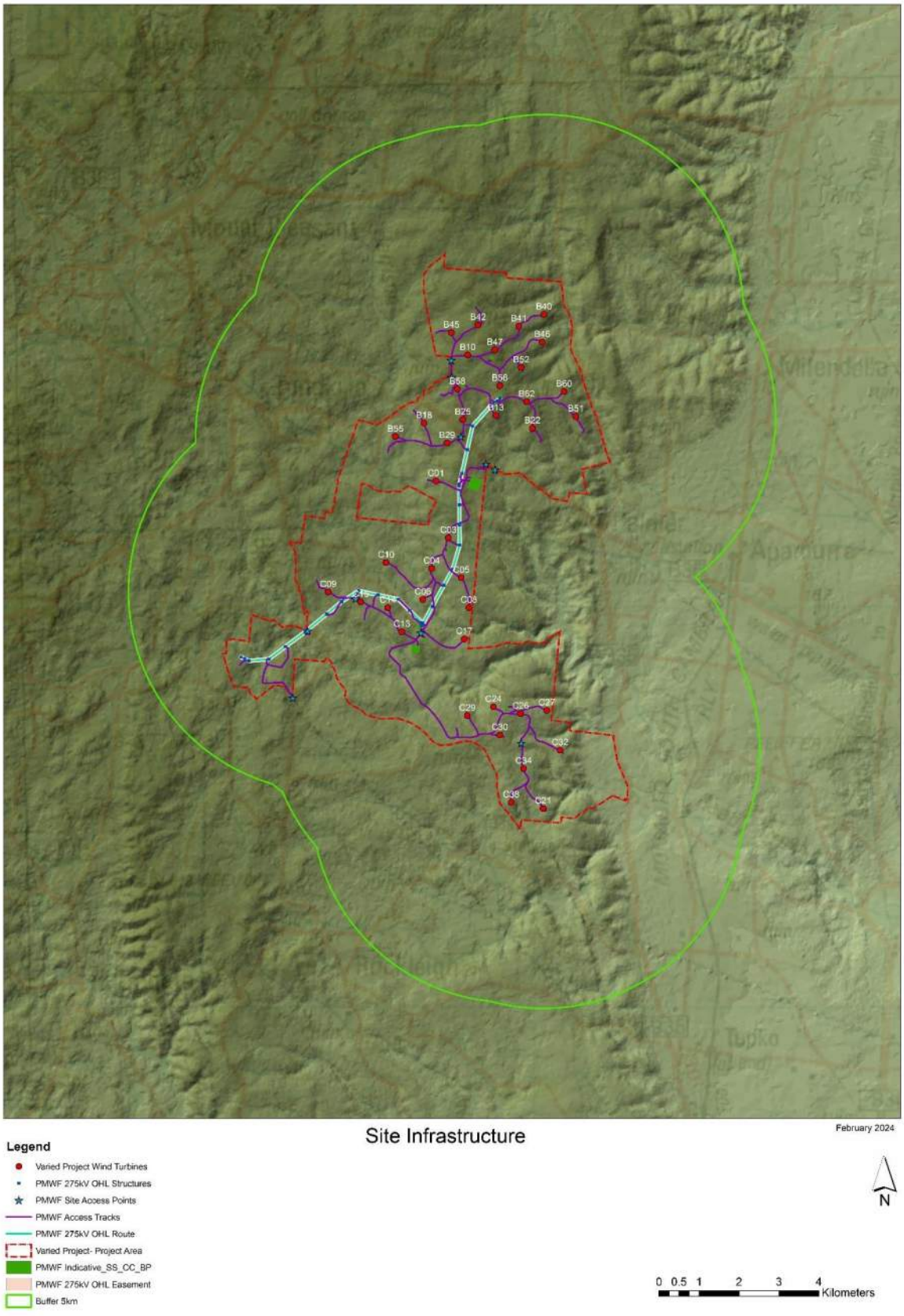


Figure 51: Varied Project Site Infrastructure

6.16 Summary of Visual Effects of the Varied Project

6.16.1 The visual assessment demonstrates that a variety of visual effects will be experienced within the local, sub-regional and regional landscapes that surround the Varied Project. Typically, the visual effects will occur within a highly modified rural landscape.

6.16.2 The following table illustrates the degree of visual change recorded at each of the viewpoints for the Varied Project. Of note are the key factors that will affect the visual impact that occurs at each viewpoint and in the wider landscape. These include:

- Existing landscape character value and the presence or absence of topographic screening or significant vegetation
- The degree of landscape absorption provided by the existing landscape character
- Panoramic and scenic qualities of the landscape
- Horizontal and vertical visual effects produced by the proposed wind farm

6.16.3 The degree of visual change varies significantly across the locality reflecting the different landscape characters. To the north of the Varied Project, the topographic variations of the Mount Lofty escarpment provide increased levels of the visual screening mitigation. The resulting degree of change is described as moderate.

6.16.4 Similar degrees of visual change are experienced to the northwest and southwest with a greater degree of visual effect to the west. The visual effect is described as moderate increasing to substantial. This reflects the uniformity in the existing landscape character in terms of land use, vegetation and topography.

6.16.5 Within 5 kilometres of the Varied Project, the visual effect increases from moderate to substantial. The increasing degree of visual change is primarily associated with the vertical scale of the wind turbines in the rural landscape.

Table 12: Varied Project Degree of Visual Change Assessment

Viewpoint (VP)	Relief	Vegetation Coverage	Infrastructure	Cultural/Landscape Value	**Landscape Character**	Landscape Absorption	Horizontal	Vertical	Distance	**Visual Assessment**	**Degree of Visual Change**	**Description of Visual Effect (sensitivity to Visual Change)**
Viewpoint 1	3	4	5	3	**15**	2	2	1	3	**8**	**30%**	**Moderate**
Viewpoint 2	4	1	3	3	**11**	4	5	5	5	**19**	**52%**	**Substantial**
Viewpoint 3	4	1	3	3	**11**	2	3	5	5	**15**	**41%**	**Substantial**
Viewpoint 4	2	2	5	2	**11**	3	2	2	3	**10**	**28%**	**Moderate**
Viewpoint 5	2	2	3	3	**10**	4	2	4	1	**13**	**33%**	**Moderate**
Viewpoint 6	2	2	2	2	**8**	4	5	5	4	**18**	**36%**	**Moderate**
Viewpoint 7	3	1	4	2	**10**	4	5	5	5	**19**	**48%**	**Substantial**
Viewpoint 8	3	2	5	2	**12**	4	5	5	5	**19**	**57%**	**Substantial**

Viewpoint (VP)	Relief	Vegetation Coverage	Infrastructure	Cultural/Landscape Value	**Landscape Character**	Landscape Absorption	Horizontal	Vertical	Distance	**Visual Assessment**	**Degree of Visual Change**	**Description of Visual Effect (sensitivity to Visual Change)**
Viewpoint 9	3	2	3	3	**11**	4	3	1	4	**12**	**33%**	**Moderate**
Viewpoint 10	4	3	5	3	**15**	4	5	1	5	**15**	**56%**	**Substantial**

6.16.6 Based on the detailed viewpoint assessment and the degree of visual change analysis, an interpolation of the visual effect has been calculated with reference to the visibility of the wind turbines using the ZTVI (refer Figure 52). The Visual Effect Interpolation mapping (refer Figure 53) illustrates the degree of visual effect as assessed using the GrimKe matrix to demonstrate the degree of potential change that may occur as a result of the proposed wind farm.

6.16.7 While the mapping shows the underlying degree of visual change, it does not represent the actual visual effect that will be experienced. It is a relative evaluation of the predicted visual effect from viewpoints and locations where the wind farm is visible and does not take into account local landforms and vegetation which may provide partial or complete screening.

6.16.8 The assessment of the visual effect demonstrates that the degree of visibility with reference to the ZTVI will be experienced as moderate increasing to substantial across the majority of the local, sub-regional and regional landscape to the east and west. The degree of visual change decreases to the north and south, particularly in relation to the topographically varied landscape character associated with eastern escarpment of the Mount Lofty Ranges.

6.16.9 Localised areas of substantial visual effect will only be experienced from elevated viewpoints looking towards Harrison Gorge which represents specific areas of high scenic value and will be impacted by the wind turbines associated with Area C. A similar situation occurs in relation the Palmer Lookout and the panoramic views east across the Murray Plains.

6.16.10 In summary, the Varied Project will produce a moderate to substantial degree of visual change across a highly modified rural landscape. This degree of visual change results from the visibility of the wind turbines located on the elevated profile of the Southern Mount Lofty Ranges. While the elevated location increases the visual prominence of the wind turbines, particularly to the east, the interaction of ridgelines, local topography and vegetation mitigates the visual effects and limits the extent to which the wind turbines are visible in the landscape.

6.16.11 This coupled with the lower sensitivity to visual change that results from the existing rural landscape and the presence of existing infrastructure limits the degree of visual change and the potential for adverse visual impacts.

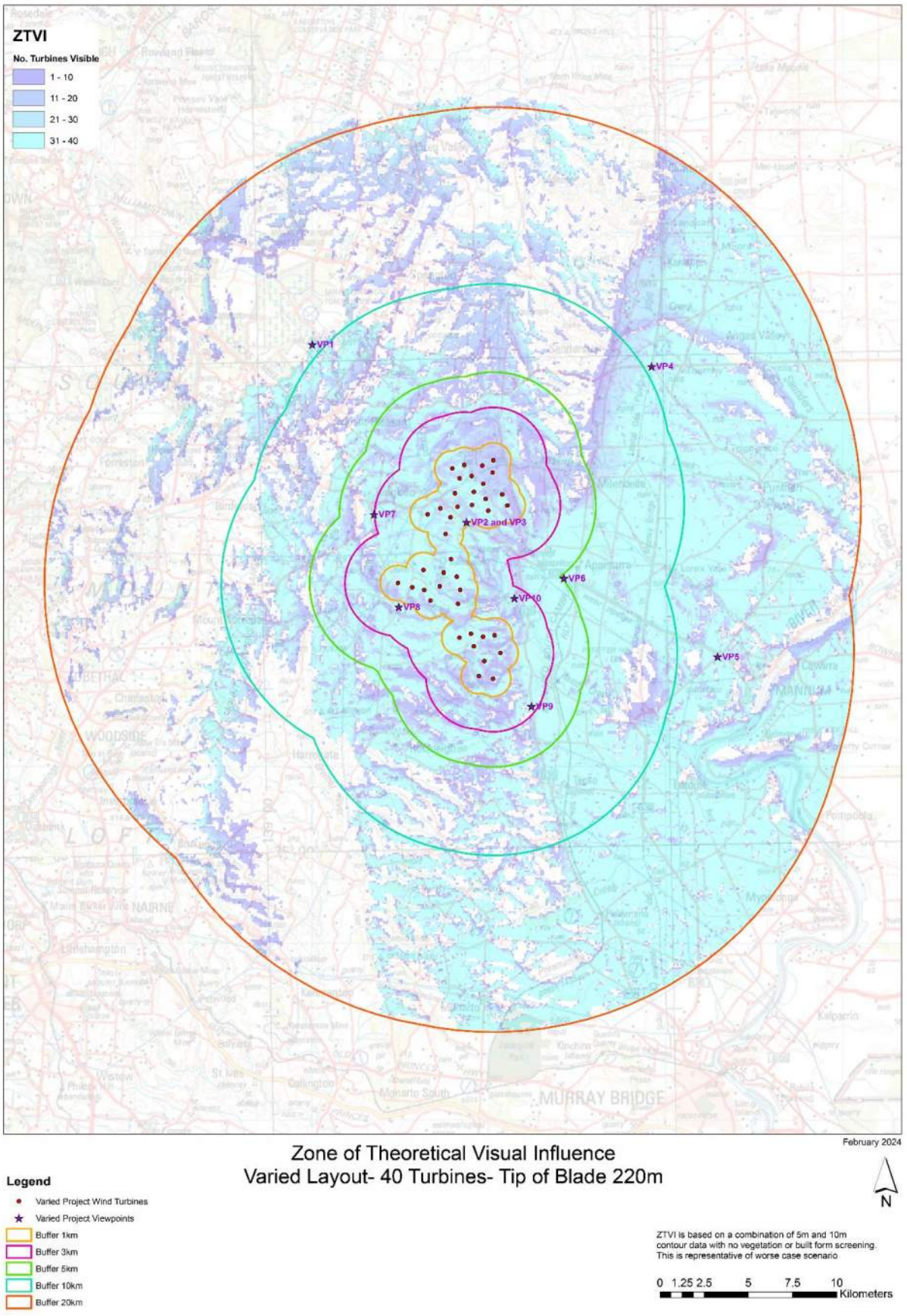


Figure 52: Theoretic Zones of Visual Effect based on Visual Assessment (Varied Project)

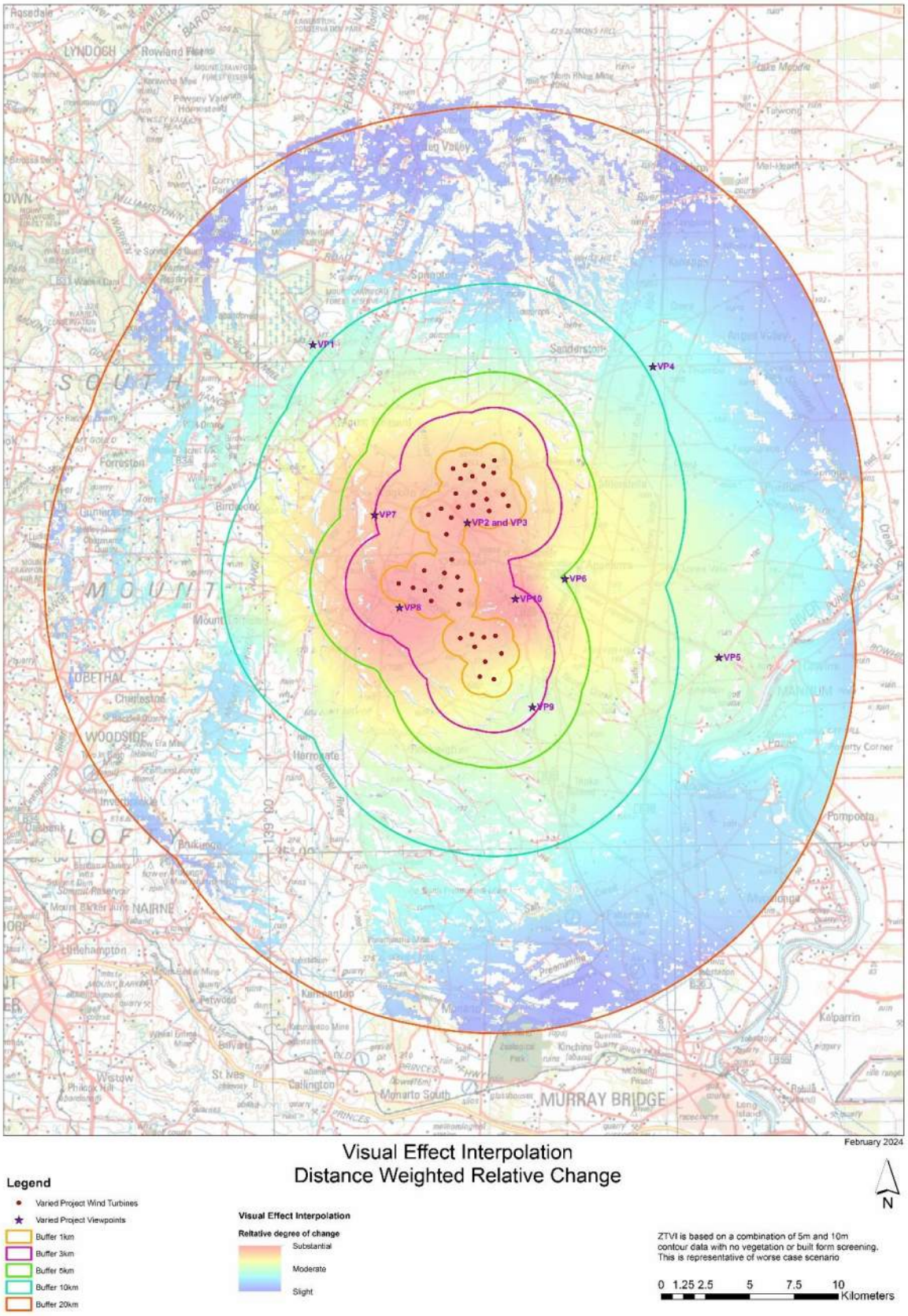


Figure 53: Visual Effects Interpolation based on Visual Assessment (Varied Project)

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.1 Comparative Visual Assessment

7.1.1 To understand the potential differences in the visual effect associated with the Varied Project when compared to the Approved Project, a detailed comparative visual assessment was undertaken.

7.1.2 The visual assessments for both the Approved and Varied Projects were based on 10 viewpoints that represented a range of locations and landscape characters to the north, east, south and west of the wind farm.

7.1.3 Each viewpoint was selected to illustrate locations that are publicly accessible, representative of typical views of the landscape character units and where a large number of wind turbines will be visible in the landscape. In this regard, each viewpoint represents the greatest probable degree of visual change within the locality that will be experienced as a result of the Approved and Varied Projects.

7.1.4 A review of the Approved Project and the development of the Varied Project led to a significant modification to the wind farm layout that resulted in the following changes;

- Reduction in wind turbine numbers from 103 to 40, resulting in the removal of Area A to the north of the original Project Area
- Adjustment in the position of wind turbines within Areas B and C
- Increase in the wind turbine tip height from 165m to 220m

7.1.5 Due to the changes in the project scope from the Approved Project to the Varied Project, the 10 original viewpoints used to assess the Approved Project were reviewed, and the locations either remained or were relocated, altered or substituted to reflect the Varied Project's proposed extent (Areas B and C) and the associated visual effect (refer Figure 54).

7.1.6 A site visit was undertaken to confirm the adjustments to the viewpoints and to assess whether there had been changes in the character, land use or amenity of the viewpoints. This assessment resulted in six (6) viewpoints (1, 4, 5, 6, 8, and 10) remaining in the exact or similar locations to the Approved Project assessment. Four (4) viewpoints (2, 3, 7, and 9) were relocated to reflect the layout and potential visual impacts associated with the Varied Project

7.1.7 A summary of the viewpoint location review is included in Table 13.

7.0 Comparative Visual Assessment of Approved and Varied Projects

Table 13: Review of Viewpoint Locations between the Approved Project LVIA and the Varied Project LVIA

Approved Project Viewpoints	Varied Project Viewpoints	Comment
VP1	VP1a	Minor modification of the Varied Project viewpoint to reflect the removal of Area A and increased focus towards Areas B and C. Location also avoids screening by the growth of forestry trees in the locality. The viewpoint is located on the Mount Pleasant Summit Trail and the Kidman Trail.
VP2	VP2a (Lookout)	Substitution of the viewpoint. The Approved Project viewpoint was located to the north of Area A and was no longer required as no turbines would be visible for the Varied Project at the original viewpoint. The Varied Project viewpoint represents the visual effect that is anticipated on the main road between Tungkillo and Palmer.
VP3	VP3a (Lookout)	Substitution of the viewpoint. The Approved Project viewpoint was located to the north of Area A and was no longer required as no turbines would be visible for the Varied Project at the original viewpoint. The Varied Project viewpoint represents the visual effect that is anticipated on the main road between Tungkillo and Palmer.
VP4	VP4a	Minor adjustment of the Varied Project viewpoint to focus on the visibility Areas B and C as Area A has been deleted for the Varied Project.
VP5	VP5a	Minor relocation of the Varied Project viewpoint to reflect the residential development that has occurred near the viewpoint over the last ten years.
VP6	VP6a	The viewpoint remains relevant, and no change is required to the location. New base photography is required to reflect changes in land use and the development of the Palmer Solar Farm over the last ten years.
VP7	VP7a	Minor relocation of the Varied Project viewpoint to the southern edge of Tungkillo. The Varied Project viewpoint location is at a higher elevation, providing a more direct view towards the wind turbines and captures several new residential properties which will be developed along Memorial Drive.
VP8	VP8a	The viewpoint remains relevant, and no change is required to the location. New base photography was required to reflect changes over the last ten years.
VP9	VP9a	Reorientation of the field of view for the viewpoint to capture the layout of the Varied Project. The field of view for this viewpoint was reoriented towards the Varied Project to ensure the complete project was captured. The location on Reedy Creek Road reflects a highly trafficked area.
VP10	VP10a	The viewpoint remains relevant, and no change is required to the location. New base photography was required to reflect changes in land use and tree growth over the last ten years.

7.0 Comparative Visual Assessment of Approved and Varied Projects

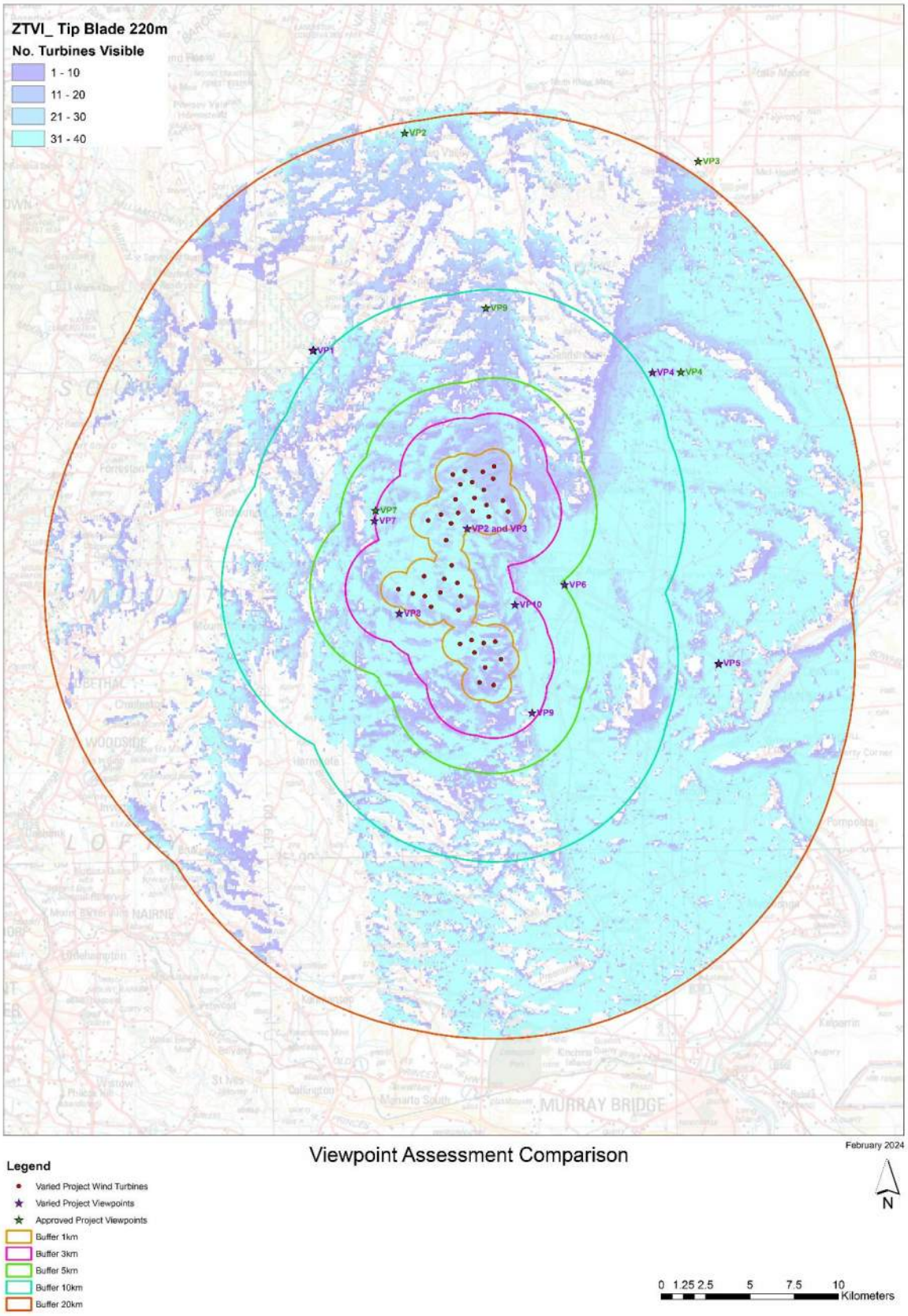


Figure 54: Viewpoint locations for Approved Project and Varied Project

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.1.8 The following section undertakes a comparative assessment of the anticipated visual effects of the Varied Project when compared to the Approved Project. The comparative assessment uses three different processes to illustrate the differences in the potential visual effects between the Approved and Varied Projects. A description of the three assessment processes is provided below;

- GrimKe Matrix Assessment
  A comparative assessment using the GrimKe Matrix for viewpoints 1, 4, 5, 6, 8, and 10 was used. The positions of these viewpoints did not change, and direct comparisons of the assessment values that were recorded for each viewpoint can be assessed. This includes the degree of visual change values as well as potential variations in the baseline assessments.
- Visual Effect Interpolation
  The relocation of viewpoints 2, 3, 7, and 9 means that a direct comparison of the visual effects from these viewpoints cannot be made between the Approved and Varied Projects. However, a review of the Visual Effect Interpolation mapping can be used to provide a qualitative assessment of the Approved and Varied Projects.
- Comparative Photomontage Assessment
  In order to provide a complete picture of the potential visual effects associated with the Varied Project in comparison to the Approved Project, a series of photomontages were produced for the 10 viewpoints used for the detailed visual assessment of the Varied Project. These provide a direct comparison of how the Approved Project and the Varied Project would appear, relative to the viewpoints used in Section 6. For each viewpoint, a photomontage and a brief description of the differences in visual effect have been provided.

7.2 GrimKe Matrix Assessment

7.2.1 The following tables and discussions provide a comparative visual assessment of the degree of visual change for viewpoints 1, 4, 5, 6, 8, and 10 between the Approved Project and Varied Project using the GrimKe Matrix.

7.3 Viewpoint 1: Summit of Mount Pleasant (west – sub-regional)

7.3.1 Viewpoint 1 is located adjacent to the summit of Mount Pleasant. This viewpoint is located approximately 10 kilometres from the nearest turbine. It demonstrates the probable visual effect that will be experienced from elevated locations within the Barossa, Adelaide Hills and Mount Crawford Forest landscape areas to the west of the proposed wind farm.

7.3.2 The base photography for viewpoint 1 (refer Figure 55), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 56), and the photomontage for the Varied Project (refer Figure 57) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 55: Viewpoint 1 base photography

7.0 Comparative Visual Assessment of Approved and Varied Projects



Figure 56: Approved Project Photomontage Viewpoint 1



Figure 57: Varied Project Photomontage Viewpoint 1

7.3.3 The values identified using the GrimKe method for the Approved Project[5] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 14.

Table 14: Comparative Visual Impact Assessment - Viewpoint 1

Assessment	Approved Project Value	Varied Project Value
Relief	3	3
Vegetation Coverage	4	4
Infrastructure and Built Form	5	5
Cultural and Landscape Value	3	3
Landscape Character	**15**	**15**
Landscape Absorption	1	2
Horizontal	5	2

[5] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

7.0 Comparative Visual Assessment of Approved and Varied Projects

Assessment	Approved Project Value	Varied Project Value
Vertical	1	1
Distance	3	3
Visual Assessment	**10**	**8**
Degree of Visual Change	**38%**	**30%**
Description of Visual Effect	**Moderate**	**Moderate**

Viewpoint 1 Discussion

7.3.4 The level of landscape absorption associated with the viewpoint has increased over the last ten years due to the forestry plantation growth of the local vegetation. In addition, the removal of the northern cluster of wind turbines (Area A) has reduced the horizontal spread of the Varied Project in comparison to the Approved Project.

7.3.5 While the wind turbines associated with the Varied Project are larger than those proposed for the Approved Project, the spread of the Varied Project across the escarpment is likely to be seen as a less visually complex series of infrastructure elements on the horizon line of the viewpoint. This is due to the reduction in the number of wind turbines. Consequently, the degree of visual change is reduced for the Varied Project compared to the Approved Project

7.4 Viewpoint 4: Angas Valley Road and Ridley Road Intersection (east – sub-regional)

7.4.1 Viewpoint 4 at the intersection of Angas Valley Road and Punthari Road represents a major tourist and community road corridor and provides panoramic views of the proposed development site across the Murray Plain towards the Southern Mount Lofty Ranges escarpment.

7.4.2 The base photography for viewpoint 4 (refer Figure 58), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 59), and the photomontage for the Varied Project (refer Figure 60) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 58: Viewpoint 4 base photography



Figure 59: Approved Project Photomontage Viewpoint 4



Figure 60: Varied Project Photomontage Viewpoint 4

7.4.3 The values identified using the GrimKe method for the Approved Project[6] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 15.

Table 15: Comparative Visual Impact Assessment - Viewpoint 4

Assessment	Approved Project Value	Varied Project Value
Relief	2	2
Vegetation Coverage	2	2
Infrastructure and Built Form	5	5
Cultural and Landscape Value	1	2
Landscape Character	**10**	**11**
Landscape Absorption	4	3
Horizontal	5	2
Vertical	3	2
Distance	4	3
Visual Assessment	**16**	**10**
Degree of Visual Change	**40%**	**28%**
Description of Visual Effect	**Moderate**	**Moderate**

Viewpoint 4 Discussion

7.4.4 The removal of the wind turbines in Area A from the Varied Project layout is likely to reduce the horizontal visibility from viewpoint 4 when compared to the Approved Project. Similarly, the proximity of Area A of the Approved Project to viewpoint 4 resulted in increased vertical assessment values. The increased distance between the viewpoint and the Varied Project reduces both the vertical and distance values.

7.4.5 The alteration of the Varied Project wind turbine locations in Area B also reduces the number of wind turbines that are located on the front face of the escarpment. This results in an increased level of landscape absorption, as a significant portion of the wind turbines are located behind the escarpment.

7.4.6 The degree of visual change assessed for the Approved Project was 40% whereas the degree of visual change for the Varied Project is 28%. Although the description of the visual effect remains moderate for both the Approved and Varied Projects, the degree of visual change has reduced by a third.

[6] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

7.5 Viewpoint 5: Adelaide to Mannum Road Intersection (southeast – regional)

7.5.1 The viewpoint is located at a busy intersection on the main D1 and B36 Mount Pleasant Road to Mannum transport corridor. The landscape character surrounding the viewpoint is typical of the Murray Plains area with a low lying topographic undulation creating local screening and small scale landform variations.

7.5.2 The base photography for viewpoint 5 (refer Figure 61), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 62), and the photomontage for the Varied Project (refer Figure 63) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 61: Viewpoint 5 base photography



Figure 62: Approved Project Photomontage Viewpoint 5



Figure 63: Varied Project Photomontage Viewpoint 5

7.5.3 The values identified using the GrimKe method for the Approved Project[7] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which

[7] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 16.

Table 16: Comparative Visual Impact Assessment - Viewpoint 5

Assessment	Approved Project Value	Varied Project Value
Relief	2	2
Vegetation Coverage	2	2
Infrastructure and Built Form	5	3
Cultural and Landscape Value	2	3
Landscape Character	**11**	**10**
Landscape Absorption	3	4
Horizontal	3	2
Vertical	2	4
Distance	3	3
Visual Assessment	**11**	**13**
Degree of Visual Change	**30%**	**33%**
Description of Visual Effect	**Moderate**	**Moderate**

Viewpoint 5 Discussion

7.5.5 The assessment of viewpoint 5 illustrates changes to both the Landscape Character and Visual Assessment Values. Over the past decade, significant residential development has taken place in the locality. The residents that now live in this area will experience the potential visual effects of the wind farm and this is reflected in an increase in the cultural and landscape value.

7.5.6 A comparison of the visual assessment indicates changes to the landscape absorption, horizontal and vertical assessment values. The landscape absorption has increased due to the increased setback of the Varied Project wind turbine layout from the escarpment when compared to the Approved Project. The horizontal assessment value has decreased due to the removal of Area A.

7.5.7 The proposed 220m wind turbine height associated with the Varied Project increases the vertical assessment. However, the increase in the wind turbines height represents a minor increase in overall degree of visual changes and the potential visual effect remains moderate.

7.6 Viewpoint 6: Outskirts of Palmer on Randell Road (east – sub-regional)

7.6.1 Viewpoint 6 is located on the outskirts of Palmer and represents an elevated location from which the surrounding topography, landscape character of Palmer and adjacent escarpment is visible. The viewpoint is typical of the foothills of the Murray Plains with expansive views of an agricultural landscape character to the east and the rising visual envelop of the Southern Mount Lofty Ranges escarpment to the west.

7.6.2 The base photography for viewpoint 6 (refer Figure 64), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 65), and the photomontage for the Varied Project (refer Figure 66) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 64: Viewpoint 6 base photography



Figure 65: Approved Project Photomontage Viewpoint 6



Figure 66: Varied Project Photomontage Viewpoint 6

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.6.3 The values identified using the GrimKe method for the Approved Project[8] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 17.

Table 17: Comparative Visual Impact Assessment - Viewpoint 6

Assessment	Approved Project Value	Varied Project Value
Relief	2	2
Vegetation Coverage	2	2
Infrastructure and Built Form	5	2
Cultural and Landscape Value	2	2
Landscape Character	**11**	**8**
Landscape Absorption	3	4
Horizontal	3	5
Vertical	2	5
Distance	3	4
Visual Assessment	**11**	**18**
Degree of Visual Change	**30%**	**36%**
Description of Visual Effect	**Moderate**	**Moderate**

Viewpoint 6 Discussion

7.6.4 The assessment of viewpoint 6 illustrates changes to both the Landscape Character and Visual Assessment Values. The value of the landscape character decreased due to several changes in land use. The development of a solar farm near Palmer and other smaller land use changes increases the impact of infrastructure, reducing the overall landscape value.

7.65 The Varied Project will be more visually prominent than the Approved Project due to the increase in the wind turbine heights. The vertical and horizontal assessment values increase as the wind turbines are more visible above and along the ridgeline of the escarpment. While the landscape absorption increased slightly, this was offset by the increased vertical scale of the Varied Project.

7.6.7 Overall, the increase in the degree of visual change between the Approved Project and the Varied Project is likely to be minor.

[8] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

7.7 Viewpoint 8: Brinkworth Road (west – local)

7.7.1 Viewpoint 8 is located on the Brinkworth Road approximately 4 kilometres south of Tungkillo. The viewpoint is representative of the landscape character and potential visual effect that will be experienced across the tablelands to the southwest of Varied Project.

7.7.2 The base photography for viewpoint 8 (refer Figure 67), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 68), and the photomontage for the Varied Project (refer Figure 69) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 67: Viewpoint 8 base photography



Figure 68: Approved Project Photomontage Viewpoint 8



Figure 69: Varied Project Photomontage Viewpoint 8

7.7.3 The values identified using the GrimKe method for the Approved Project[9] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which

[9] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 18.

Table 18: Comparative Visual Impact Assessment - Viewpoint 8

Assessment	Approved Project Value	Varied Project Value
Relief	3	3
Vegetation Coverage	2	2
Infrastructure and Built Form	5	5
Cultural and Landscape Value	1	2
Landscape Character	**11**	**12**
Landscape Absorption	4	4
Horizontal	5	5
Vertical	3	5
Distance	5	5
Visual Assessment	**17**	**19**
Degree of Visual Change	**47%**	**57%**
Description of Visual Effect	**Substantial**	**Substantial**

Viewpoint 8 Discussion

7.7.4 There is an increase in the degree of visual change between the Approved and Varied Projects. This is likely to result from the increased height of the wind turbines. While the number of wind turbines associated with the Varied Project is less, the height and spread of the wind turbines across the landscape are likely to increase the visual effect, with the degree of visual change increasing by 10%.

7.8 Viewpoint 10: Harrison Gorge, Mine Road (southeast – local)

7.8.1 Viewpoint 10 represents the potential visual affect that will be experienced in the locality of Harrison Gorge and around Mine Road to the south of Palmer. The viewpoint and general locality is important as it represents a pocket of natural landscape character. The vegetation cover and rocky outcrops provide a high degree of visual amenity in relation to natural features within the local area.

7.8.2 The base photography for viewpoint 10 (refer Figure 70), a reproduction of the photomontage for the Approved Project using 2023 base photography (refer Figure 71), and the photomontage for the Varied Project (refer Figure 72) has been included here for illustrative purposes. For larger reproductions of the photomontages refer to Appendix C.



Figure 70: Viewpoint 10 base photography



Figure 71: Approved Project Photomontage Viewpoint 10



Figure 72: Varied Project Photomontage Viewpoint 10

7.8.3 The values identified using the GrimKe method for the Approved Project[10] are reproduced in the table below, alongside the values identified using the same GrimKe method for the Varied Project which

[10] *Keates, W & Grimm, B (2014). Landscape Character and Probable Visual Effect for Palmer Wind Farm*

can be seen at Section 6 of this report. The resulting degree of visual change to the landscape from both the Approved Project and the Varied Project are placed side by side below in Table 19.

Table 19: Comparative Visual Impact Assessment - Viewpoint 10

Assessment	Approved Project Value	Varied Project Value
Relief	4	4
Vegetation Coverage	3	3
Infrastructure and Built Form	5	5
Cultural and Landscape Value	3	3
Landscape Character	**15**	**15**
Landscape Absorption	4	4
Horizontal	5	5
Vertical	1	1
Distance	5	5
Visual Assessment	**15**	**15**
Degree of Visual Change	**56%**	**56%**
Description of Visual Effect	**Substantial**	**Substantial**

Viewpoint 10 Discussion

7.8.4 The relative positions of the wind turbines associated with the Approved and Varied Projects result in little variation between the degree of visual change.

7.8.5 While the height of the Varied Project wind turbines is larger, the reduced number of wind turbines offsets the overall degree of visual change, and the assessed percentage of 56% for the Approved Project has not increased and remains the same for the Varied Project.

7.9 Visual Effect Interpolation

7.9.1 As mentioned at Section 2, due to the removal of wind turbines from Area A, 4 viewpoints from the Approved Project were no longer relevant and were relocated to focus on greater areas of visual effect from the Varied Project.

7.9.2 As set out in the methodology in Section 2; the findings of the visual impact assessment for each viewpoint were used to provide a percentage value to describe the degree of visual change. Each viewpoint was cartographically mapped in GIS, and the values were used in a weighted interpolation. The ZTVI was overlayed onto the visual effect interpolation map to define the extent of visibility. The combination of visual effect interpolation and ZTVI provided a map of the likely visual impact experienced in the regional locality as a result of the Varied Project. The map provided relativity to the possible experience of visual effect; this is displayed as a gradation of colour with slight shown as blue and substantial shown as red.

7.9.3 To understand the comparative visual effects of the Approved and Varied Projects from these relocated viewpoints, an assessment of the Visual Effect Interpolation mapping for the Approved and Varied Projects was used to provide a comparative qualitative assessment.

7.9.4 The following section uses the visual effect interpolation maps for both the Approved Project and Varied Project and discussion to illustrate the potential visual effects from the relocated viewpoints.

7.10 Viewpoints 2 and 3: Palmer lookout

7.10.1 The Approved Project viewpoints 2 and 3 were located to the north of Area A and were no longer required for the Varied visual impact assessment due to the removal of Area A. As such, the viewpoints were relocated for the Varied Project assessment to represents the visual effect that is anticipated on the main road between Tungkillo and Palmer.

Viewpoints 2 and 3 Discussion

7.10.2 The interpolated visual effect map for the Approved Project (refer Figure 73) shows that the visual effect experienced for the relocated viewpoints 2 and 3 is likely to be substantial.

7.10.3 The interpolated visual effect map for the Varied Project (refer Figure 74) shows that the visual effect experienced for viewpoints 2 and 3 is likely to be substantial.

7.10.4 Given the proximity, scale and number of wind turbines associated with both Projects, the potential visual effects for both the Approved and Varied Projects and viewpoints 2 and 3 is likely to be described as substantial based on the interpolative visual effect mapping.

7.0 Comparative Visual Assessment of Approved and Varied Projects

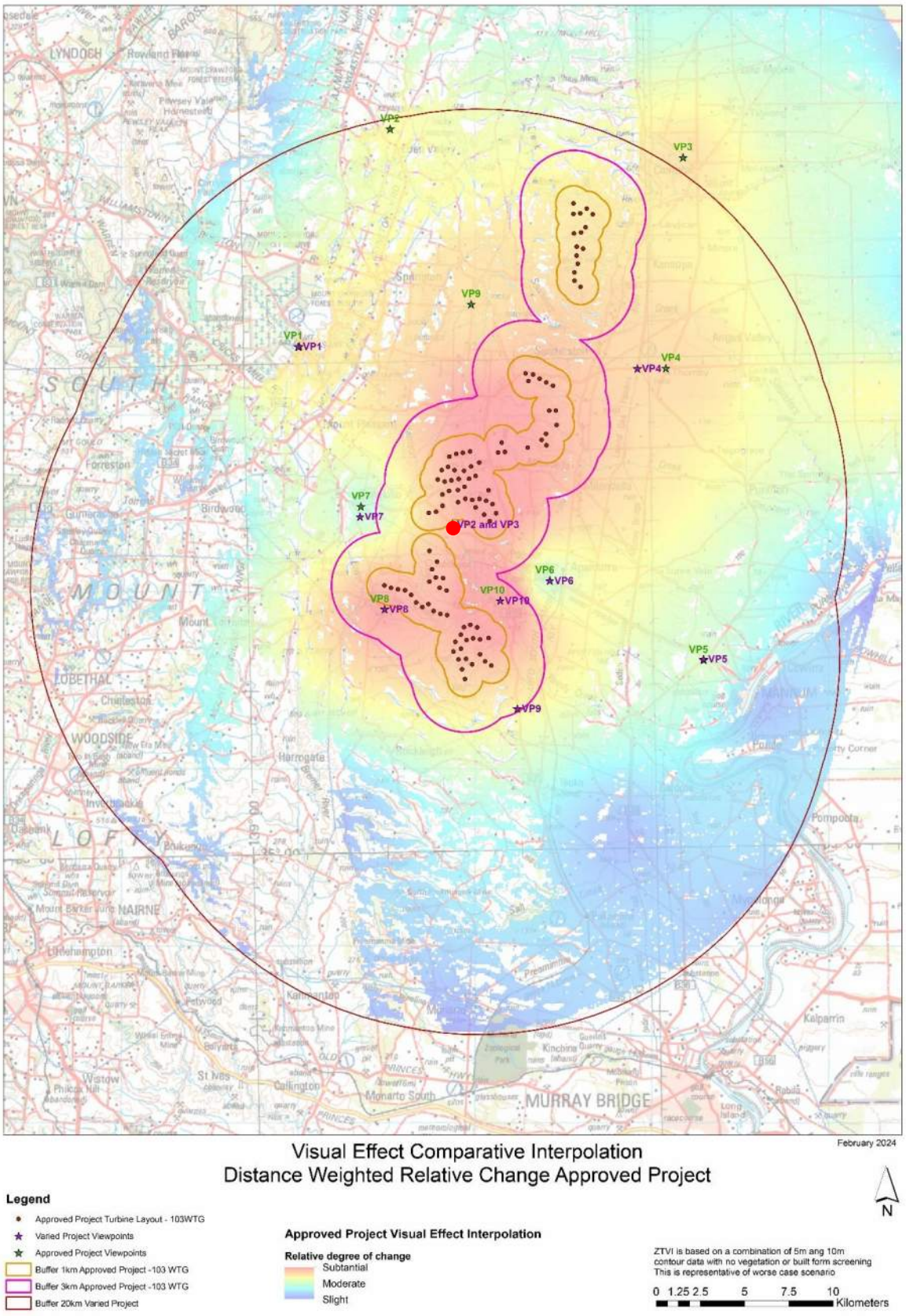


Figure 73: Approved Project Visual Effect Interpolation for Viewpoint 2 and 3 (red dot)

7.0 Comparative Visual Assessment of Approved and Varied Projects

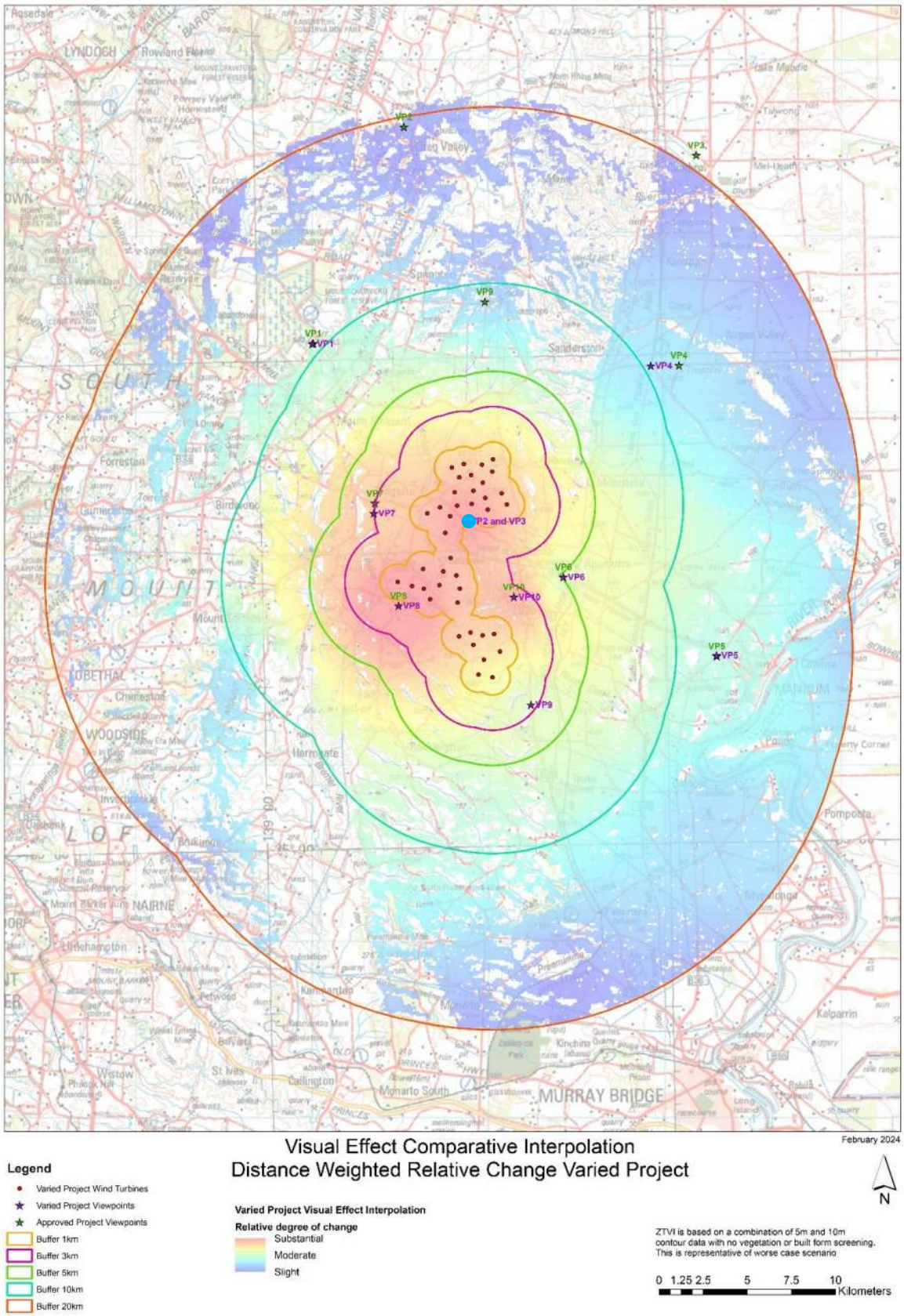


Figure 74: Varied Project Visual Effect Interpolation for Viewpoint 2 and 3 (blue dot)

7.11 Viewpoint 7: Tungkillo Township (west – local)

7.11.1 The Approved Project viewpoint capture Areas A, B and C. The removal of Area A allowed the Varied Project viewpoint to be relocated to the southern edge of Tungkillo. The Varied Project viewpoint location provide direct view towards the wind turbines and captures several new residential properties which will be developed along Memorial Drive.

Viewpoint 7 Discussion

7.11.2 The interpolated visual effect map for the Approved Project (refer Figure 75) shows that the visual effect experienced for the relocated viewpoint 7 is likely to be moderate.

7.11.3 The interpolated visual effect map for the Varied Project (refer Figure 76) shows that the visual effect experienced for viewpoint 7 is likely to be moderate to substantial.

7.11.4 The Approved Project had a larger number of wind turbines and the horizontal spread was greater when compared to the Varied Project. However, the height of the Varied Project wind turbines increased slightly the potential visual effects.

7.11.5 A comparative review of the interpolated visual effects of the Approved and Varied Projects indicates that increased height of the Varied Project wind turbines is likely to increase the visual prominence of the wind turbine. However, the interpolated mapping indicates that both the Approved and Varied Projects are likely to result in moderate visual effects.

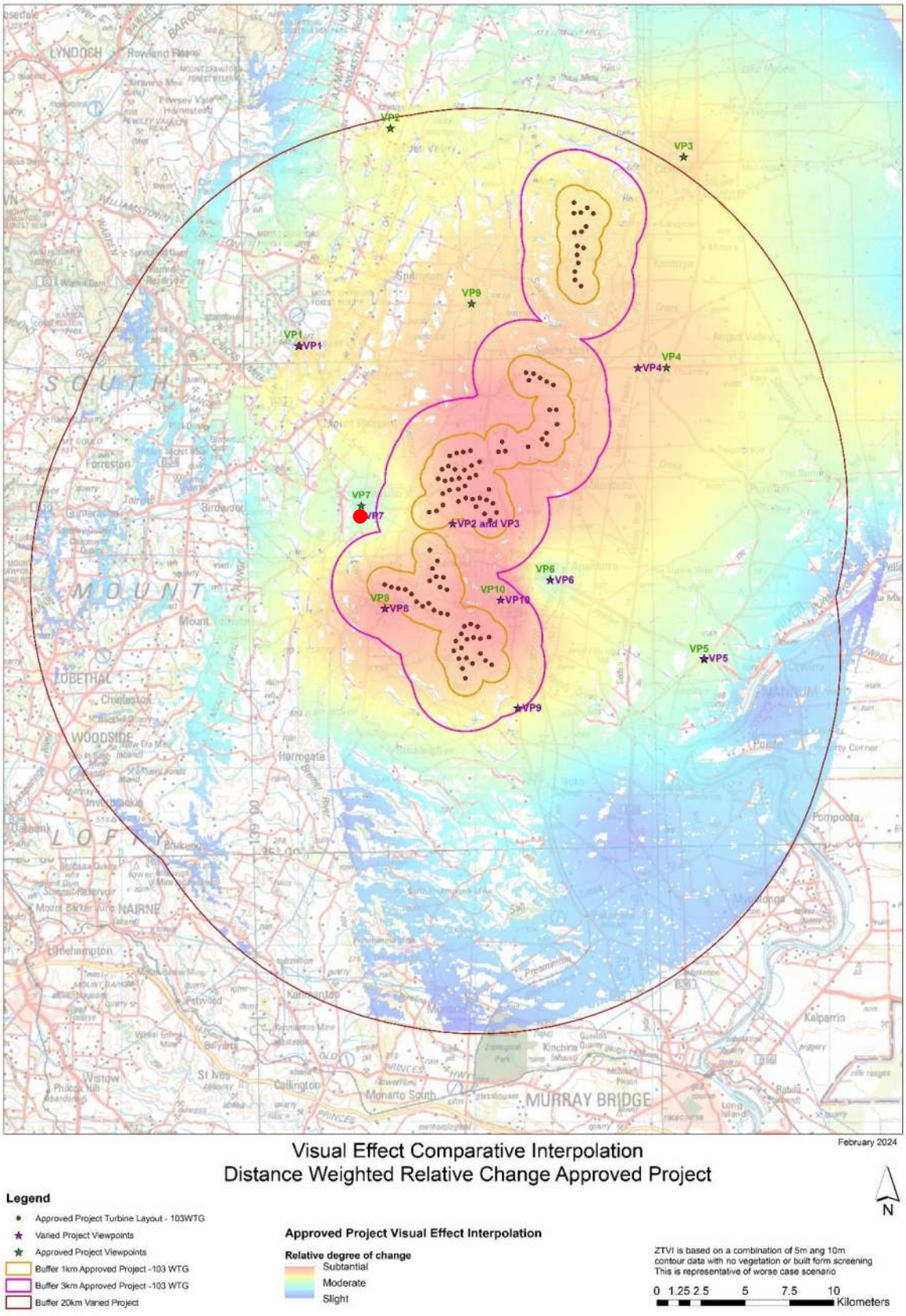


Figure 75: Approved Project Visual Effect Interpolation for Viewpoint 7 (red dot)

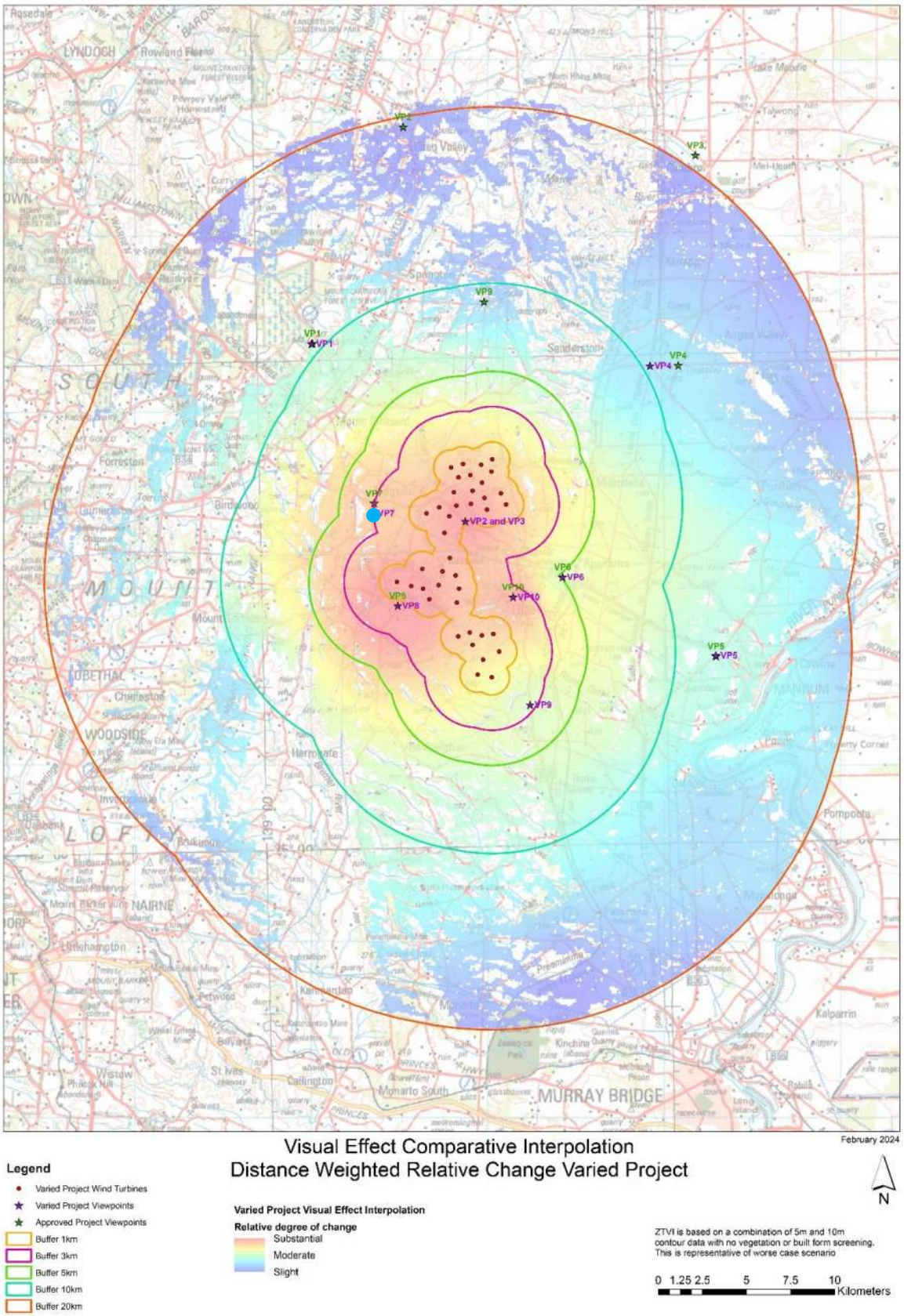


Figure 76: Varied Project Visual Effect Interpolation for Viewpoint 7 (blue dot)

7.12 Viewpoint 9: North of Church Road and Strachan Road Intersection (northwest – sub-regional)

7.12.1 The Approved Project viewpoint was located to the north of the locality. During the assessment of the Varied Project ZTVI, it was recommended viewpoint 9 be relocated to the south to capture the likely extent of visibility within the regional locality, given the visual effects to the north are significant reduced due to the removal of Area A.

7.12.2 The revised viewpoint 9 was deemed to represent an area that was likely to be frequently viewed by people travelling through the locality and representative of the visual effect that is experience to the south of the locality.

Viewpoint 9 Discussion

7.12.2 The interpolated visual effect map for the Approved Project (refer Figure 77) shows that the visual effect experienced for the relocated viewpoint 9 is likely to be moderate.

7.12.3 The interpolated visual effect map for the Varied Project (refer Figure 78) shows that the visual effect experienced for viewpoint 9 is likely to be slight to moderate.

7.12.4 The removal of Area A from the Varied Project layout, which reduces the horizontal spread of the wind farm, reduces the potential visual effects from locations to the south. Likewise, the reduction in the number of turbines from the Approved Project to the Varied Project is likely to reduce the visual effect.

7.0 Comparative Visual Assessment of Approved and Varied Projects

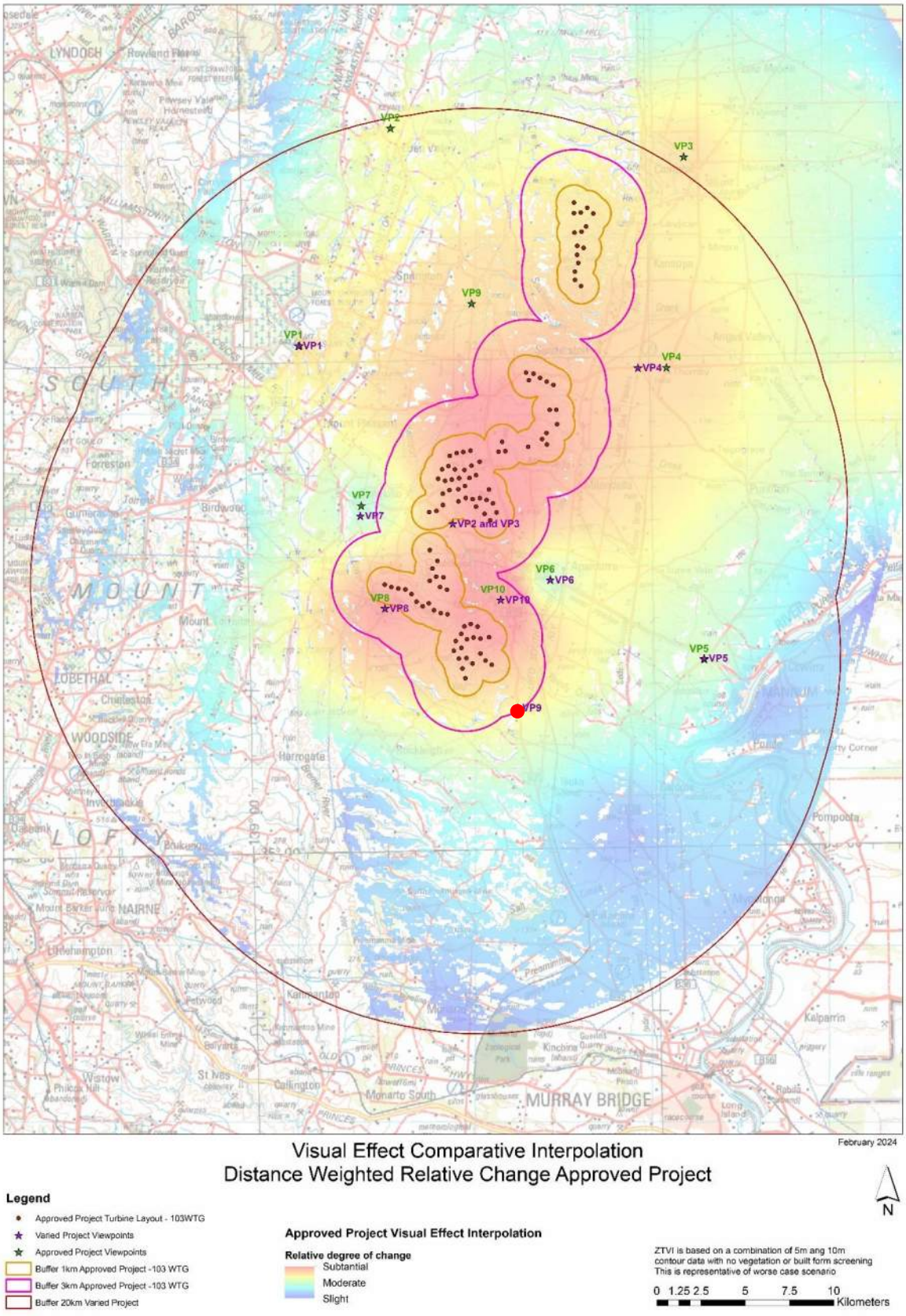


Figure 77: Approved Project Visual Effect Interpolation for Viewpoint 9 (red dot)

7.0 Comparative Visual Assessment of Approved and Varied Projects

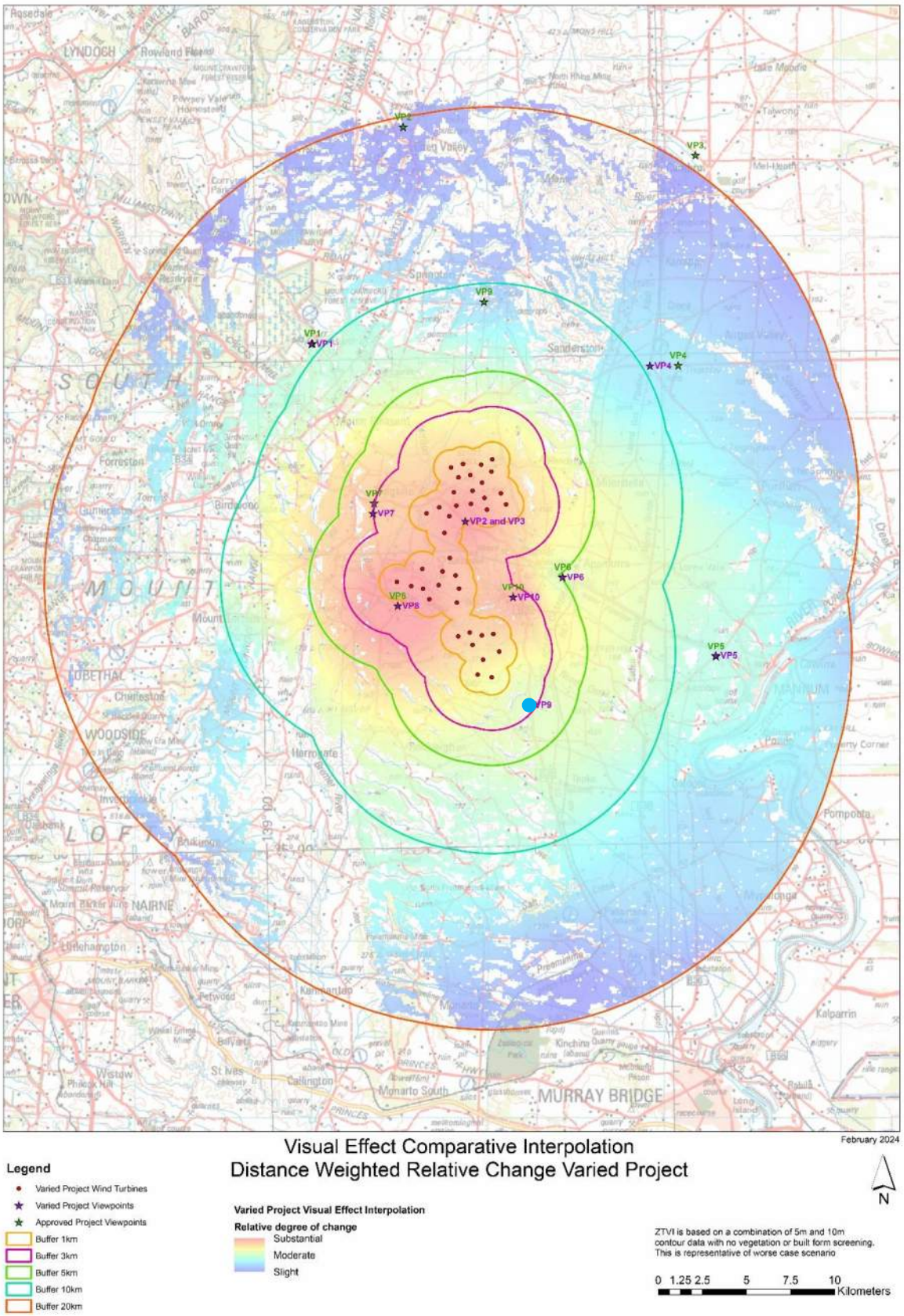


Figure 78: Varied Project Visual Effect Interpolation for Viewpoint 9 (blue dot)

7.13 Comparative Photomontage Assessment

7.13.1 The following is a review of the potential visual effects from each of the 10 photomontage locations that were used for the Visual Impact Assessment of the Varied Project (section 6). Photomontages for the Approved Project were developed using the Varied Project viewpoint locations and updated base photography from 2023, larger reproductions of the Photomontages are provided in Appendix C. These images provide a visual comparison of how both the Approved Project and the Varied Project would appear from each of these viewpoints.

7.14 Viewpoint 1: Summit of Mount Pleasant (west – sub-regional)



Figure 79: Approved Project Photomontage Viewpoint 1



Figure 80: Varied Project Photomontage Viewpoint 1

Discussion

7.14.1 The photomontage of the Approved Project (refer Figure 79) illustrates the spread and visual complexity of the wind farm layout. The proposed wind turbines of the Approved Project appear as a single cluster of infrastructure elements along the distant ridge of the Mount Lofty Ranges. By comparison, the wind turbines of the Varied Project (refer Figure 80) appear wider spaced which is likely to reduce the visual complexity.

7.14.2 The visible horizontal spread of both Projects is similar. While the height of the Varied Project wind turbines is larger, the distance between the viewpoint and the wind turbines is such that the relative height of the Approved and Varied Project wind turbines does not produce a difference in the visual effects.

7.14.3 Overall, the potential visual effect is likely to be similar based on a comparative assessment of the viewpoint photomontages for both the Approved and Varied Projects.

7.15 Viewpoint 2: Scenic Lookout (central looking north)



Figure 81: Approved Project Photomontage Viewpoint 2



Figure 82: Varied Project Photomontage Viewpoint 2

Discussion

7.15.1 As described in section 6, the proximity of the wind turbines to the viewpoint means that both the Approved and Varied Projects will have a substantial visual effect. Viewpoints 2 and 3 look north and south from the same location at the Palmer scenic lookout and illustrate the encircling visual context of the viewpoint.

7.15.2 The visual effect of the Approved Project at viewpoint 2 results from the spread and number of visible wind turbines. The Approved Project creates a defined cluster of infrastructure elements that spreads south (refer Figure 81).

7.15.3 While the height of the Varied Project is greater than the Approved Project, the number of visible wind turbines is less as shown in Figure 82. This reduces the visual complexity and offsets the increased visual impacts associated with the wind turbine height.

7.15.4 The reduction in the number of wind turbines reduces the visual complexity of the Varied Project. However, the visual effect increases due to the wind turbine height of the Varied Project. Overall, the potential visual effects for the Approved Project and the Varied Project are similar.

7.16 Viewpoint 3: Scenic Lookout (central looking south)



Figure 83: Approved Project Photomontage Viewpoint 3



Figure 84: Varied Project Photomontage Viewpoint 3

Discussion

7.16.1 As described in section 6, the number of wind turbines associated with the Approved Project is likely to create complex visual effects across the ridgeline of the escarpment. The Approved Project appears as a continuous belt of infrastructure elements with several wind turbines set behind one another, increasing the degree of visual complexity (refer Figure 83).

7.16.2 By way of comparison, the Varied Project includes less turbines than the Approved Project and results in a reduction in visual complexity from less turbines being sited across the ridgeline of the escarpment (refer Figure 84).

7.16.3 The wind turbines associated with the Varied Project do appear larger and more visually prominent. However, overall, the visual effect from the larger turbines is offset by the reduction in the number of turbines across the landscape. The resulting visual effect for the Approved Project and the Varied Project is similar.

7.17 Viewpoint 4: Angas Valley Road and Ridley Road Intersection (east – sub-regional)



Figure 85: Approved Project Photomontage Viewpoint 4



Figure 86: Varied Project Photomontage Viewpoint 4

Discussion

7.17.1 The Approved Project represents a greater number of wind turbines in the landscape, and the location of several wind turbines on the escarpment increases the visual effect (refer Figure 85).

7.17.2 The Varied Project represents a significant improvement in the visual effect from viewpoint 4 to the southeast. When viewed at distances in excess of 10 kilometres, the impacts of the larger wind turbines are reduced (refer Figure 86).

7.17.3 Overall, the Varied Project represents and reduced visual effect from viewpoint 4 when compared with the Approved Project.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.18 Viewpoint 5: Adelaide to Mannum Road Intersection (southeast – regional)



Figure 87: Approved Project Photomontage Viewpoint 5



Figure 88: Varied Project Photomontage Viewpoint 5

Discussion

7.18.1 The visual effect from viewpoint 5 is similar for both the Approved and Varied Projects. When viewed at distances in excess of 10 kilometres, the impacts of the larger wind turbines of the Varied Project are reduced (refer Figure 87). By contrast, the Approved Project has a greater visual complexity due to the number of wind turbines in the landscape and the location of several wind turbines on the escarpment (refer Figure 88).

7.18.2 Therefore, the Varied Project represents a reduced visual impact when compared to the Approved Project. This is due to the smaller number of turbines within the landscape and the wind turbines being located further than 10 kilometres away. At distances greater than 10 kilometres the increase in the height of the wind turbines is not noticeable.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.19 Viewpoint 6: Outskirts of Palmer on Randell Road (east – sub-regional)



Figure 89: Approved Project Photomontage Viewpoint 6



Figure 90: Varied Project Photomontage Viewpoint 6

Discussion

7.19.1 The spread of both the Approved and Varied Projects are similar from viewpoint 6. The main differences in the visual effect result from the comparative wind turbine heights and the degree of visual complexity.

7.19.2 The Approved Project creates prominent visual effects due to the number and arrangement of the wind turbines visible from the viewpoint (refer Figure 89). While the height of the Varied Project wind turbines increases the visual prominence, the reduced number of wind turbines and spacing significantly limits the complexity of the visual effect (Figure 90).

7.19.3 Consequently, the visual effect of both the Approved and Varied Projects from viewpoint 6 is similar.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.20 Viewpoint 7: Tungkillo Township (west – local)



Figure 91: Approved Project Photomontage Viewpoint 7



Figure 92: Varied Project Photomontage Viewpoint 7

Discussion

7.20.1 Further to the discussion provided for viewpoint 6, the spread of both the Approved and Varied Projects are similar from viewpoint 7. The main differences in the visual effect are likely to result from the relative wind turbine heights and the degree of visual complexity.

7.20.2 The potential visual effect of the Approved Project is likely to be prominent due to the number and layout of the wind turbines (refer Figure 91). In comparison, the height of the Varied Project wind turbines is likely to increase the visual prominence (refer Figure 92). However, the reduced number of wind turbines and spacing of the Varied Project offsets the potential visual complexity.

7.20.3 As such, the visual effect of both the Approved and Varied Projects from viewpoint 7 is similar.

7.21 Viewpoint 8: Brinkworth Road (west – local)



Figure 93: Approved Project Photomontage Viewpoint 8



Figure 94: Varied Project Photomontage Viewpoint 8

Discussion

7.21.1 Viewpoint 8 is located to the south along Brinkworth Road and is sited relativity close to the Palmer Wind Farm at a distance of 1.36 kilometres to the nearest wind turbines. Due to the close proximity of the viewpoint to the wind farm, the potential visual effect for both the Approved and Varied Projects is described as substantial.

7.21.2 There is a greater number of turbines clustered across the landscape in the Approved Project as shown in Figure 93, compared with the wind turbines in the Varied Project as shown in Figure 94. However, due to the taller turbines in the Varied Project and the location of the turbines, the visual effect of the Varied Project is slightly more prominent than the Approved Project.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.22 Viewpoint 9: North of Church Road and Strachan Road Intersection (northwest – sub-regional)



Figure 95: Approved Project Photomontage Viewpoint 9



Figure 96: Varied Project Photomontage Viewpoint 9

Discussion

7.22.1 The spread and visual complexity of the Approved Project are likely to create a prominent visual effect from viewpoint 9 to the south (refer Figure 95). The arrangement and larger number of wind turbines along the escarpment is likely to increase the visual impacts particularly when travelling along Reedy Creek Road.

7.22.2 While the height of the Varied Project wind turbines is greater, the removal of Area A to the north and the reduction in the number of wind turbines is likely to reduce the overall visual effect as seen in Figure 96. This was demonstrated in the comparative assessment of the Visual Interpolation Mapping. Overall, the visual effect associated with the Varied Project is reduced when compared to the Approved Project.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.23 Viewpoint 10: Harrison Gorge, Mine Road (southeast – local)



Figure 97: Approved Project Photomontage Viewpoint 10



Figure 98: Varied Project Photomontage Viewpoint 10

Discussion

7.23.1 The visual effect of both the Approved and Varied Projects from viewpoint 10 is similar as can be seen in Figure 97 and Figure 98.

7.23.2 The potential visual effect of the Approved Project is likely to be prominent due to the number and layout of wind turbines, creating a distinct belt of infrastructure elements across the underlying topography.

7.23.3 The height of the wind turbines in the Varied Project increases the visual prominence when compared to the Approved Project. The reduced number of wind turbines and spacing of the Varied Project reduces the visual complexity when compared to the Approved Project.

7.0 Comparative Visual Assessment of Approved and Varied Projects

7.24 Comparative Visual Effect Assessment of Approved and Varied Projects

7.24.1 The Varied Project is likely to result in a significant improvement in the potential visual effect. The overall extent of the Project Area has been reduced for the Varied Project, compared to the Approved Project which had a much larger Project Area. The wind turbines have been reduced from 103 wind turbines across three clusters (Areas A, B and C) to 40 wind turbines across two clusters (Areas Band C) while resulting in similar energy generation.

7.24.2 The removal of the Area A wind turbines reduces the overall locality which will experience a visual change as a result of the Varied Project, which can be seen in the comparative ZTVI mapping in Figure 19. As a result of the reduction of the Project Area from the Approved Project to the Varied Project, the impacts on several important landscape feature such as Saunders Gorge and Marne River are removed as well as impacts on scenic drives such as Pine Hut Road and Mount Pleasant Road.

7.24.3 The removal of Area A to the north also reduces impacts on the Barossa Valley Character Preservation District overlay by siting the wind turbines and associated wind farm infrastructure more than 3 kilometres away from the southern boundary of the Barossa Valley Character Preservation District, which is defined by Angas Valley Road.

7.24.4 There is an increase in the visual effect that is likely to be produced by the Varied Project in the local area (up to 5 kilometres away from the Project Area) due to the increase in the height of the wind turbines and the reduced ability of the local landforms and vegetation to provide screening.

7.24.5 However, this localised increase is offset by a decrease in the visual effect across the sub-regional and regional areas (5-10km) due to a reduction in the number of wind turbines compared to the Approved Project, therefore resulting in a reduction in the visual complexity of the Varied Project.

8.0 Review of Planning and Design Code

8.1 Introduction

8.1.1 The Planning and Design Code (the Code) has been used to assess the suitability of the Varied Project in relation to the anticipated effect on the landscape and visual character of the relevant Zones and Overlays and the General Provisions relating to Infrastructure and Renewable Energy Facilities and the potential management of the visual impacts.

8.2 Proposed Development

Table 20: Planning and Design Code Details relevant to the Varied Project

Planning and Design Code Details	
Zone:	Rural
Overlays:	• Dwelling Excision • Hazards (Bushfire - Medium Risk) • Heritage Adjacency • Hazards (Flooding - Evidence Required) • Key Outback and Rural Routes • Limited Land Division • Murray-Darling Basin • Native Vegetation • Prescribed Water Resources Area • River Murray Tributaries Protection Area • State Heritage Place (16315) • State Significant Native Vegetation • Water Resources
Local Variations:	Minimum Site Area (Minimum site area is 200 ha) Minimum Dwelling Allotment Size (Minimum dwelling allotment size is 36 ha)
Proposed Development:	Wind Farm
Assessment Pathway	Code Assessed – Performance Assessed
Planning Authority	DTI PLUS (State Planning Commission)

8.3 Planning Zone

Table 21: Rural Zone planning policies considered as part of the LVIA

Policy Reference	Description
DO 1	A zone supporting the economic prosperity of South Australia primarily through the production, processing, storage and distribution of primary produce, forestry and the generation of energy from renewable sources.

8.0 Review of Planning and Design Code

Policy Reference	Description
DTS/DPF 1.1	Development comprises one or more of the following: (s) Renewable energy facility
PO 9.1	Renewable energy facilities and ancillary development minimises significant fragmentation or displacement of existing primary production.

8.3.1 DTS/DPF 1.1 of the Rural Zone clearly envisages wind farms and the associated infrastructure. PO 9.1 requires that renewable energy facilities and ancillary development minimises significant fragmentation or displacement of existing primary production. While the turbines represent large pieces of infrastructure, the wind farm has limited impact on the existing rural land use and the footprint of each wind turbine and the associated infrastructure is relatively small when compared with the total site area.

8.3.2 The visual assessment (Section 6) highlights that the underlying landscape character that surrounds the Varied Project is not affected by the development and the environmental qualities associated with the rural landscape will remain in and around the proposed turbines.

8.4 Planning Overlays

Table 22: Planning Overlays considered as part of the LVIA

Overlay	Ref	Description
Heritage Adjacency Overlay	**DO 1**	Development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places
	PO 1.1	Development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.
State Heritage Place Overlay	**DO 1**	Development maintains the heritage and cultural values of State Heritage Places through conservation, ongoing use and adaptive reuse consistent with Statements of Significance and other relevant documents prepared and published by the administrative unit of the Public Service that is responsible for assisting a Minister in the administration of the Heritage Places Act 1993.
	PO 1.1	The form of new buildings and structures maintains the heritage values of the State Heritage Place.
	PO 1.2	Massing, scale and siting of development maintains the heritage values of the State Heritage Place.

Overlay	Ref	Description
	PO 1.6	New buildings and structures are not placed or erected between the primary and secondary street boundaries and the façade of a State Heritage Place.

8.4.1 The Code identified several Overlays that are relevant to the Rural Zone. The Heritage Adjacency Overlay and the State Heritage Place Overlay were considered as part of the LVIA for the Varied Project. Of particular note is the Heritage Adjacency Overlay associated with the Granite Boulders Area Geological Site (16315) and Kitticoola Mine (16299), both of which are classed as being of State Heritage significance.

8.4.2 DO 1 of the Heritage Adjacency Overlay requires that development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places and PO 1.1 requires development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.

8.4.3 The Varied Project Area intersects with the CT of the Granite Boulders Area Geological Site and a Heritage Impact Statement (HIS) has been prepared. The HIS concludes that the proposed works will have minor impacts on the cultural values of the Granite Boulders Geological site. Increased access to and rehabilitation of the adjacent areas are likely to enhance the importance of the place to the community. A similar situation occurs in relation to the wind turbines to north of the Granite Boulders Area Geological Site.

8.4.4 While the underlying rural landscape character remains, the visual prominence and scale of the proposed infrastructure will alter the visual character of the locality that surrounds these State Heritage sites.

8.4.5 A more detailed Heritage Impact Assessment has been undertaken by Independent Heritage Consultants for the Varied Project. This should be referred to for a more detailed understanding of the impact of the Varied Project on sites of heritage importance.

8.5 General Provisions – Infrastructure and Renewable Energy Facilities

Ref	Description
DO 1	Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.
PO 2.1	The visual impact of above-ground infrastructure networks and services (excluding high voltage transmission lines), renewable energy facilities (excluding wind farms), energy storage facilities and ancillary development is minimised from townships, scenic routes and public roads by: utilising features of the natural landscape to obscure views where practicable siting development below ridgelines where practicable avoiding visually sensitive and significant landscapes

Ref	Description
	using materials and finishes with low-reflectivity and colours that complement the surroundings using existing vegetation to screen buildings incorporating landscaping or landscaped mounding around the perimeter of a site and between adjacent allotments accommodating or zoned to primarily accommodate sensitive receivers.
PO 2.2	Pumping stations, battery storage facilities, maintenance sheds and other ancillary structures incorporate vegetation buffers to reduce adverse visual impacts on adjacent land.
PO 2.3	Surfaces exposed by earthworks associated with the installation of storage facilities, pipework, penstock, substations and other ancillary plant are reinstated and revegetated to reduce adverse visual impacts on adjacent land.
PO 8.1	Visual impact of wind turbine generators on the amenity of residential and tourist development is reduced through appropriate separation.
DTS / DPF 8.1	Wind turbine generators are: set back at least 2000m from the base of a turbine to any of the following zones: Rural Settlement Zone Township Zone Rural Living Zone Rural Neighbourhood Zone set back at least 1500m from the base of the turbine to non-associated (non-stakeholder) dwellings and tourist accommodation
PO 8.2	The visual impact of wind turbine generators on natural landscapes is managed by: designing wind turbine generators to be uniform in colour, size and shape coordinating blade rotation and direction mounting wind turbine generators on tubular towers as opposed to lattice towers.

8.5.1 In relation to the potential visual effects of the Varied Project, DO 1, PO 2.1, PO 2.2, PO 2.3, PO 8.1, DTS / DPF 8.1 and PO 8.2 of the General Provisions – Infrastructure and Renewable Energy Facilities are considered relevant and discussion is provided below identifying how the Varied Project achieves the listed requirements.

8.5.2 PO 2.1 of the General Provisions – Infrastructure and Renewable Energy Facilities accepts the visual effect of wind farms and that this form of development will have visual impacts. While the Varied Project is likely to create a degree of visual change in the existing landscape character of the locality,

the Varied Project minimise impacting on landscapes that have greater scenic value or natural character by avoiding the siting of wind turbines near areas such as Saunders Gorge and the Marne River. Typically, the wind turbines are setback 8.6 kilometres from Saunders Gorge and over 16 Kilometres from the Marne River.

8.5.3 PO 8.1 and DTS / DPF 8.1 of the General Provisions – Infrastructure and Renewable Energy Facilities is achieved as the visual impact of wind turbines on the amenity of residential and tourist development is reduced through appropriate separations. In relation to the required setback, a buffer distance of 2,700 metres is required from any land zoned for Township, Rural Settlement, Rural Living, or Rural Neighbourhood based on a maximum turbine height (base to tip of blade) of 220 m. The siting of wind turbines for the Varied Project meets DTS 8.1(a).

8.5.4 Any dwellings within the 1500 m buffer of wind turbines are associated with the Varied Project.

8.5.5 PO 8.2 of the General Provisions – Infrastructure and Renewable Energy Facilities is achieved as the operational rotation, design and material finish of individual turbines will be consistent to ensure that all turbines express a degree of uniformity in terms of colour, size, shape and movement. In addition, the turbines will be mounted on tubular towers, which is a requirement of item (c).

8.5.6 In relation to regular spacing, the turbines are located 600 to 800 metres apart. The spacing while not regular is consistent. The resulting positional consistency of the wind turbines responds to the undulating topography and local ridgelines that run across the site and results in a layout which responds directly to the underlying landforms.

8.5.7 Tilt will undertake the landscaping of substations, maintenance sheds and where appropriate other ancillary structures to mitigate the potential visual effect and satisfy PO 2.2 of the General Provisions – Infrastructure and Renewable Energy Facilities. Tilt will also undertake remediation works to surfaces exposed by earthworks associated with the installation of storage facilities, access tracks, substations and other ancillary plant and revegetate to reduce adverse visual impacts on adjacent land to satisfy PO 2.3.

9.0 Review of State Wide Landscape Scenic Quality Values

9.1 Introduction

9.1.1 In order to present a wider understanding of the landscape value associated with the existing landscape and impact of the proposed development, a review has been undertaken of a research study conducted by Dr Andrew Lothian in relation to landscape character, landscape value and the potential visual change created by wind farms.

9.2 State Wide Landscape Scenic Quality Values

9.2.1 Lothian (2000) measured and illustrated the scenic quality of South Australian landscapes. The study represents an objective based assessment of scenic beauty perceptions toward the State's various landscapes. The statistical analysis provided a basis for the scenic quality evaluation of different South Australian landscape typologies and the potential effect of any development forms (including wind farms) will have on them.

9.2.2 Referring to Lothian (2000), the biophysical landscape character of Southern Mount Lofty Ranges, Murray Plains and surrounding region has been classified as Agricultural plains, low ranges/ hills and Main Ranges, (Figure 99).

9.2.3 The assessment process conducted by Lothian (2000) measured public scenic beauty perception values of South Australian Landscapes. Scenes were rated out of 10.

9.2.4 The mean ratings for scenes within the Southern Agricultural Province were;

- Main Ranges 6
- Agricultural Hills and low ranges 4
- Coastal Plain 5

9.2.5 In addition, scenes were assessed with regards to land use and physical characteristics such as vegetation type and coverage, topographic variance, and the presence of water. Crops and pastures occupy the majority of the southern agricultural province. The mean of these scenes was 4.36. To be more specific, scenes of crops and pastures with ridgelines had a mean of 4.53 whereas flat terrain recorded a mean 3.97 and coastal areas had a median range of 6-6.99.

9.2.6 The pastoral landscape of the Mount Lofty Ranges received a moderate ranking in terms of scenic quality. Figure 100 illustrates the landscape quality variance of South Australia and the proposed wind farm represents a landscape quality value of 5 to 6. The values as a numerical representation of the existing landscape character are similar to the landscape character values recorded as part of the GrimKe assessment in Section 6.

9.2.7 A subsequent study was conducted by Lothian (2008), the objectives of which were to measure the scenic perceptions and visual effects of wind farms in the landscape. Using the South Australian landscape quality assessment as a baseline reference, the potential sensitivity of wind farms in particular geographic localities was interpolated in the study.

9.2.8 The findings of the 2008 study reported that inland scenes with a scenic quality of less than 5.1 would be improved by the presence of a wind farm. The trend correlation between existing landscape quality and visual sensitivity to wind farm developments is derived by an existing landscape quality rating of 5.1 at which point a lower valued landscape will not be devalued by the presence of a wind farm.

9.2.9 In some circumstances, the development has the potential to add qualities such as scale, form and/or a dynamic visual element within a modified and often denuded landscape. Consequently, scenic landscape ratings of less than 5.1 may be improved by the presence of a wind farm.

9.0 Review of State Wide Landscape Scenic Quality Values

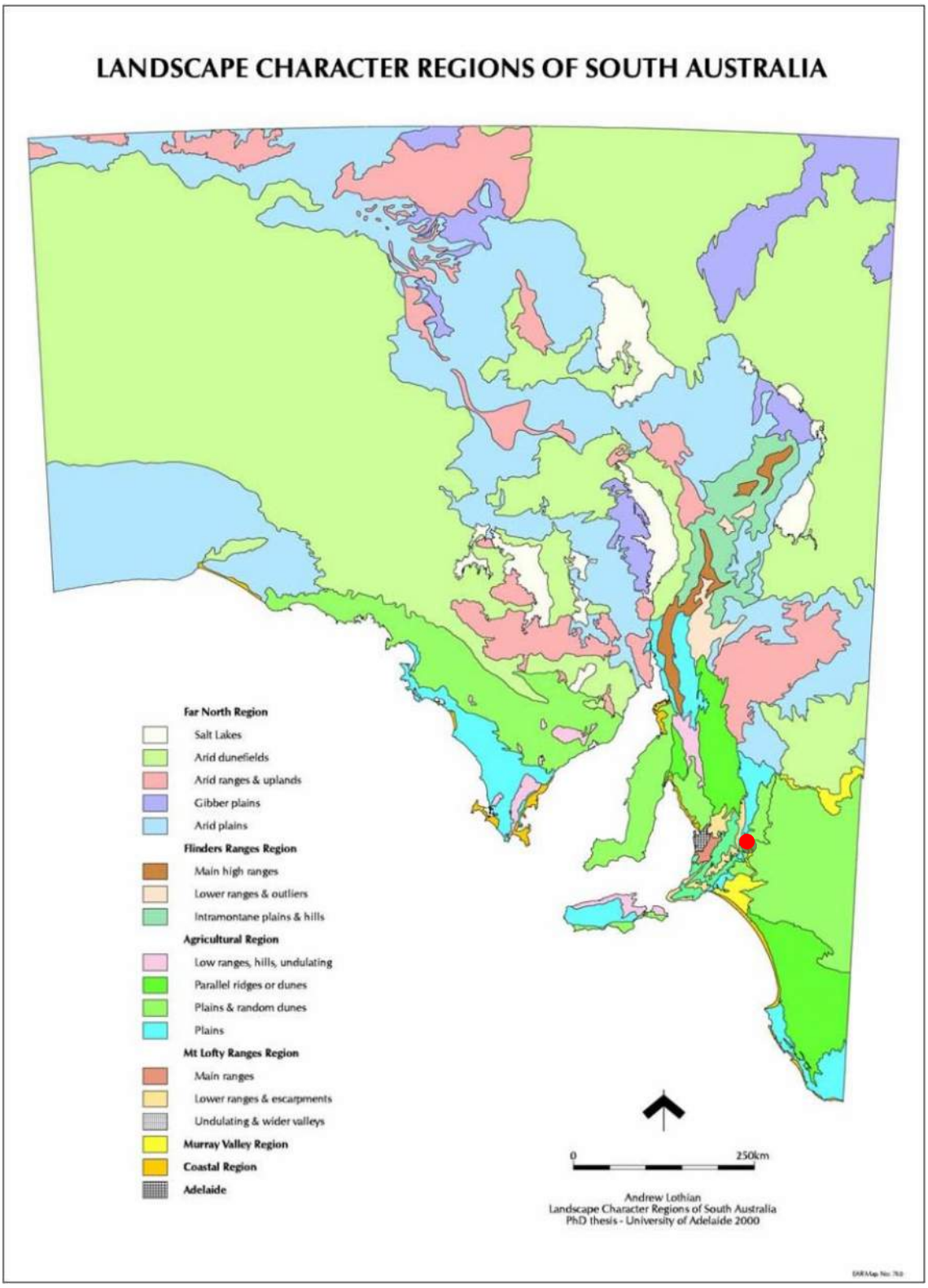


Figure 99: Landscape Character Regions of South Australia (Lothian, 2000 with red dot indicating wind farm location)

9.0 Review of State Wide Landscape Scenic Quality Values

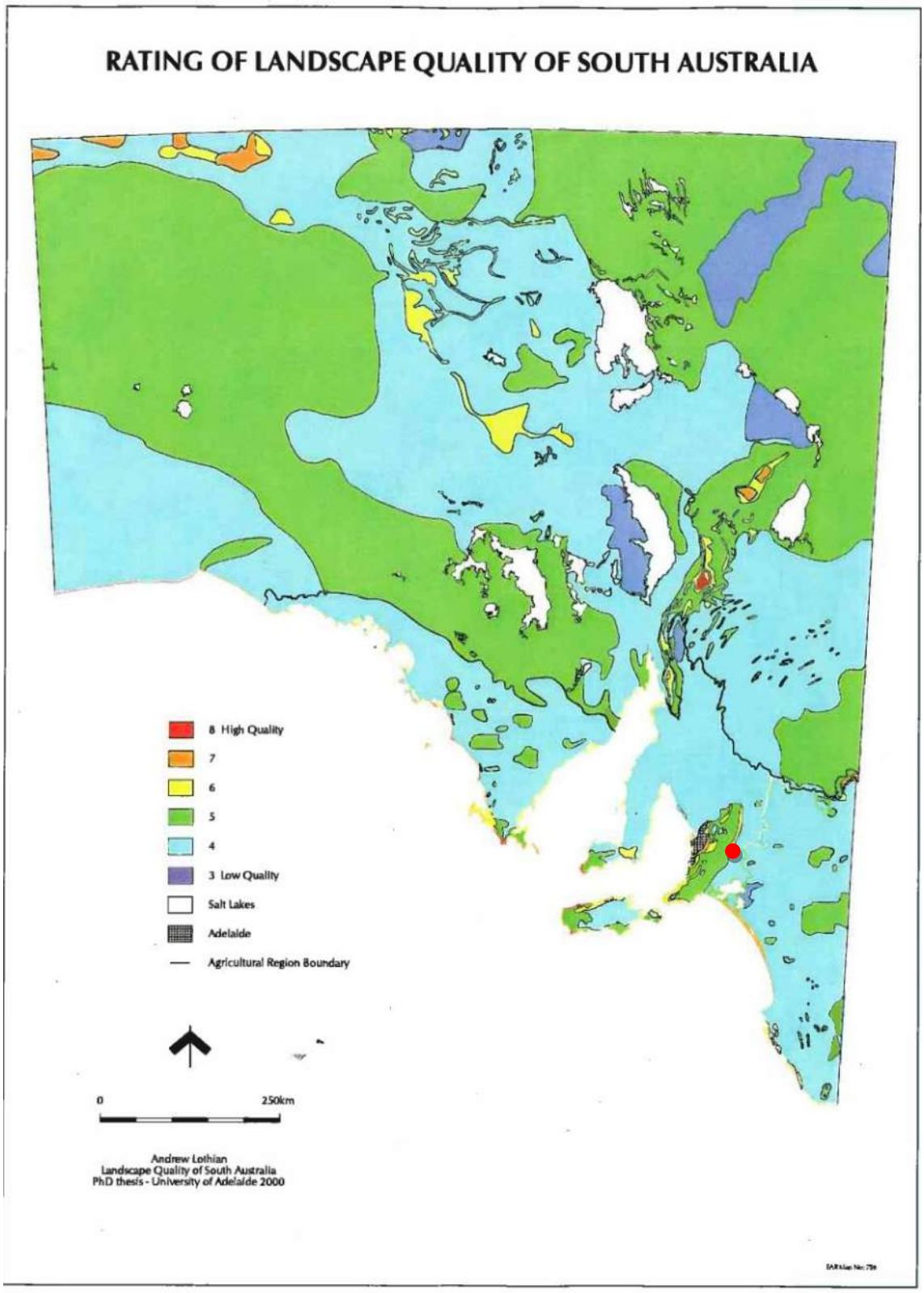


Figure 100: Landscape Quality of South Australia (Lothian, 2000 with red dot indicating location of wind farm)

10.0 Viewer Sensitivity

10.1 Discussion on Viewer Sensitivity

10.1.1 The assessment undertaken in Section 6 considered the visual effect of the Varied Project from various locations having regard to the existing landscape quality and the degree of visual change on the existing environment. It does not measure the extent to which a viewer's response or sensitivity to landscape changes and how this influences the perception of the visual effect.

10.1.2 The potential viewers of the wind farm and the possible sensitives is likely to vary significantly. Members of the public experiencing the associated visual effects may range from the eco-tourist, who may experience a devaluing of the landscape, to members of the local community, who might stand to benefit from the development or those that appreciate the visual connection to renewable energy generation. Given the wide variety of opinions regarding the potential impact on the visual amenity of an area, a diverse range of public responses can be expected.

10.1.3 Fundamental to the viewer's sensitivity is the degree to which visual change is perceived or experienced and whether this is seen as a positive or negative visual effect. Therefore, it is likely that local residents, who are most familiar with the landscape, will experience a greater degree of change than people occasionally visiting the area. However, whether the change is perceived as positive or negative will depend on the viewer's opinions.

10.1.4 It is evident that many people like the look of turbines considering them sculptural and majestic or positive signs of climate change action, while some view them as an industrial blight. By contrast, the majority of tourists may perceive no change and see the wind farm as part of the existing visual environment.

10.1.5 The reality may be that within all user groups, be they locals, tourists, walkers or weekenders, a spectrum of opinions can be expected based on differing views on the receiving landscape, the visual appeal of turbines and renewable energy itself. The final level of viewer sensitivity becomes the personal preference of the viewer as to whether the visual change is positive or negative. As an assessment of social or demographic groups can only be subjective, it does not form part of this discussion.

11.0 Conclusion

11.1 Conclusion

Method

11.1.1 The visual assessment considered the existing value of the landscape character and a review of the survey data that was collected as part of the Approved Project. These base line landscape character values enabled a detailed evaluation of numerous viewpoints within the locality to create a predictive model of the degree of visual change that is likely to occur in the landscape from the Approved Project and Varied Project.

Existing Landscape Character

11.1.2 The landscape that surrounds the Varied Project Area is defined by a series of landscape character units that relate to the underlying topography and vegetation of the region. To the west, the Mount Lofty Ranges forms an undulating topographic landscape with extensive areas of remnant woodland that provide a moderate to high degree of amenity and localised visual screening.

11.1.3 By contrast, the Southern Mount Lofty Ranges Tablelands has an open visual character with little or no vegetation. The eastern escarpment of the Mount Lofty Ranges produces a prominent landscape feature within the regional context of the Varied Project Area. From the ridgeline of the escarpment there are panoramic views across the Murray Plains.

11.1.4 The Murray Plains to the east represents a low-lying agricultural landscape, punctuated by belts of vegetation associated with the underlying creeks and the field boundaries.

Comparative Assessment

11.1.5 A comparative assessment, as described in Section 7, of the Approved and Varied Projects highlighted the potential reductions in the visual effect that the Varied Project is likely to achieve when compared with the Approved Project.

11.1.6 The removal of the wind turbines in Area A reduces the overall locality which will experience a visual change as a result of the Varied Project. Importantly, the impacts on scenic landscape feature such as Saunders Gorge, Marne River, and the Barossa Valley Character Preservation District are removed.

11.1.7 The proposed wind turbine height of 220m is likely to increase the visual impact associated with the Varied Project when compared with the Approved Project. However, the comparative assessment undertaken in Section 7 illustrates that the increase in visual impacts are likely to be contained to the local area (up to 5 kilometres away from the Varied Project Area) due to the reduced ability of the local landforms and vegetation to provide screening for the additional turbine height. This localised increase in visual impact is offset by a decrease in the visual effect across the sub-regional and regional areas (5-10km) due to a reduction in the number of wind turbines compared to the Approved Project and a reduction in the visual complexity of the Varied Project.

11.1.8 The visual assessment demonstrates the relative visual effect of the Varied Project within the landscape from a sub-regional and regional context. Within sub-regional and regional locations to the east within the Murray Plain, the horizontal scale of the existing landscape as well as the vertical scale of the topography has a capacity to absorb the verticality of the turbines on the prominent ridgeline.

11.1.9 In other words, the existing landscape horizontal scale coupled with the vertical scale of the topography, provides a degree of mitigation to the height of the proposed wind turbines scale.

11.1.10 An assessment of the viewpoint to the east of the Varied Project produces a degree of visual change described as moderate across an elevated and topographically prominent rural landscape.

11.1.11 To the west, the amount of vegetation cover and undulating topography provides significant screening and fragmentation of views. This limits both the number of locations from where the Varied Project will be visible and the degree of visibility of the wind farm. Furthermore, the qualitative assessment of this locality highlights a slightly elevated scenic amenity, thus increasing the sensitivity to change increasing the potential degree of visual change. Consequently, the degree of visual change is described as moderate increasing to substantial.

11.1.12 In many locations to the north, south and west, the wind turbines are screened. In this regard, the extent of the visual effect that may be experienced as a result of the Varied Project may be limited due to the absorption capacity of the landscape and the layout of the 40 wind turbines.

11.1.13 In addition, the layout of the 40 wind turbines and separation of the wind turbines into two areas provides additional visual mitigation which moderates the degree of visual effect within sub-regional and regional landscapes. Consequently, the extent to which all 40 wind turbines are likely to be visible will be significantly reduced due to the interrelation of the topography and vegetation containment that is provided in the surrounding rural landscape.

11.1.14 Whilst fragmentation of the visibility of the wind farm affects the degree of visual change, within 5 kilometres of the Varied Project the visual effect in general is described as moderate increasing to substantial. The height of the wind turbines and the relative scale of the infrastructure within the landscape limits the capacity of the existing landscape character to absorb the potential visual effect.

11.1.15 While the surrounding rural landscape has greater capacity to accommodate development due to the existing agricultural context and presence of infrastructure, specific areas such as Harrison Gorge and the Palmer Lookout represent areas of greater landscape value. The introduction of wind turbines increases the potential for visual contrast, in turn increasing the degree of visual change and the potential for adverse visual effects.

11.1.16 To the east, the elevation of the escarpment and the scale of the wind turbines increases the potential degree of visual change. This visual effect and visibility of the Varied Project is progressively mitigated by distance. At locations of greater than 10 kilometres from the Varied Project, the visual effect is likely to be slight and the wind turbines become recessive visual elements in the rural landscape.

11.0 Conclusion

11.1.17 In conclusion, the Varied Project for the majority of the regional landscape will be experienced as a moderate visual effect. Although areas of substantial visual effect were recorded, these effected locations occur within a locality region of 5 kilometres from the proposed wind turbines. Further to the north, south, and west the existing landscape is often well vegetated or topographically contained and views of the Varied Project are partially or completely screened.

11.1.18 Overall, the Varied Project is likely to have less visual effect on the locality than the Approved Project and it is our interpretation that while the existing landscape will be visually impacted, the underlying rural/agricultural character will be retained and the visual changes associated with the Varied Project are considered acceptable.



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Landscape Character and Probable Visual Effect Assessment - Appendices

for Palmer Wind Farm Variation Application

Prepared for Tilt Renewables

23 February 2024

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REVISION	DATE	AUTHOR	REVIEWER
C	23/02/2024	WK/BG	WK/CS/BG
B	15/02/2024	WK/BG	WK/CS/BG
A	12/02/2024	WK/BG	WK/CS

Appendix A
Assessment Mapping

Digital Terrain
Elevation
550 - 600
500 - 550
450 - 500
400 - 450
350 - 400
300 - 350
250 - 300
200 - 250
150 - 200
100 - 150
50 - 100
0 - 50
-5 - 0

Digital Terrain Model

February 2024

Legend

- Varied Project Wind Turbines
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

N

0 0.75 1.5 3 4.5 6
Kilometers

EDEN VALLEY
SPRINGTON
MOUNT PLEASANT
TUNGKILLO
MOUNT TORRENS
CAMBRAI
SANDERSON CREEK
ANGAS VALLEY
LOCAL RIDGE
PALMER
HARRISON CREEK
MANNUM
MURRAY BRIDGE

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Legend

- Varied Project Wind Turbines
- Varied Project Area
- Murray River
- 1 Mount Crawford Forest
- 2 Mount Pleasant/ Eden Valley Ridgeline
- 3 Barossa Valley
- 4 Table lands
- 5 Adelaide Hills
- 6 Escarpment
- 7 Murray Plain
- Local River Corridors
- Local Ridgelines
- Township

N

0 1.25 2.5 5 7.5 10 Kilometers

ZTVI_Tip of Blade 165m

No. Turbines Visible

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 103

VP1
VP2
VP3
VP4
VP5
VP6
VP7
VP8
VP9
VP10

February 2024

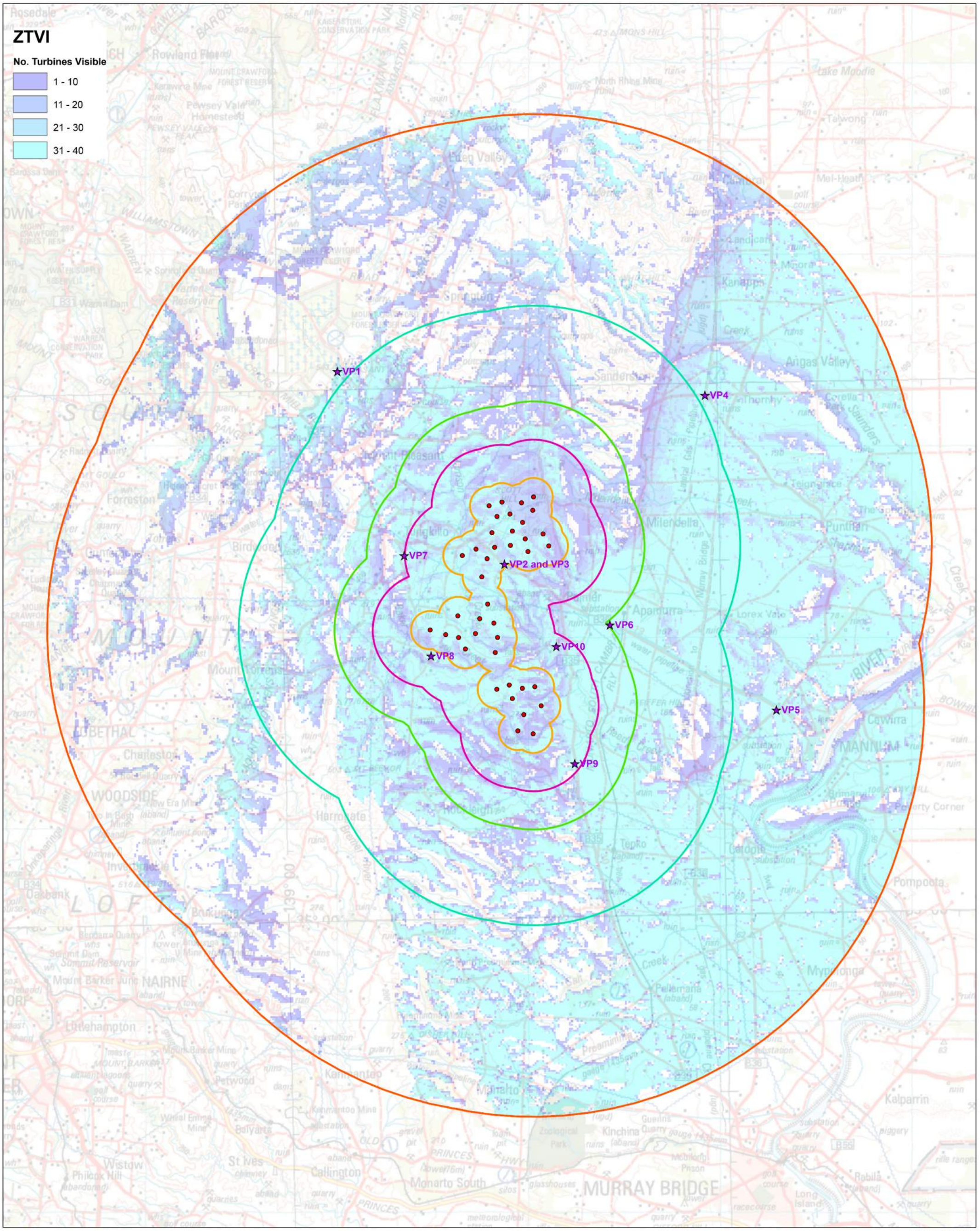
Zone of Theoretical Visual Influence
Approved Layout- 103 Turbines- Tip of Blade Height 165m

Legend

- Approved Project Turbine Layout - 103WTG
- Approved Project Assessment Viewpoints
- Buffer_1km_Approved_Project_Turbine_Layout_103WTG
- Buffer_3km_Approved_Project_Turbine_Layout_103WTG
- Buffer_5km_Approved_Project_Turbine_Layout_103WTG
- Buffer_10km_Approved_Project_Turbine_Layout_103WTG
- Buffer_20km_Approved_Project_Turbine_Layout_103WTG

N

0 1.5 3 6 9 12 Kilometers



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Zone of Theoretical Visual Influence
Varied Layout- 40 Turbines- Tip of Blade 220m

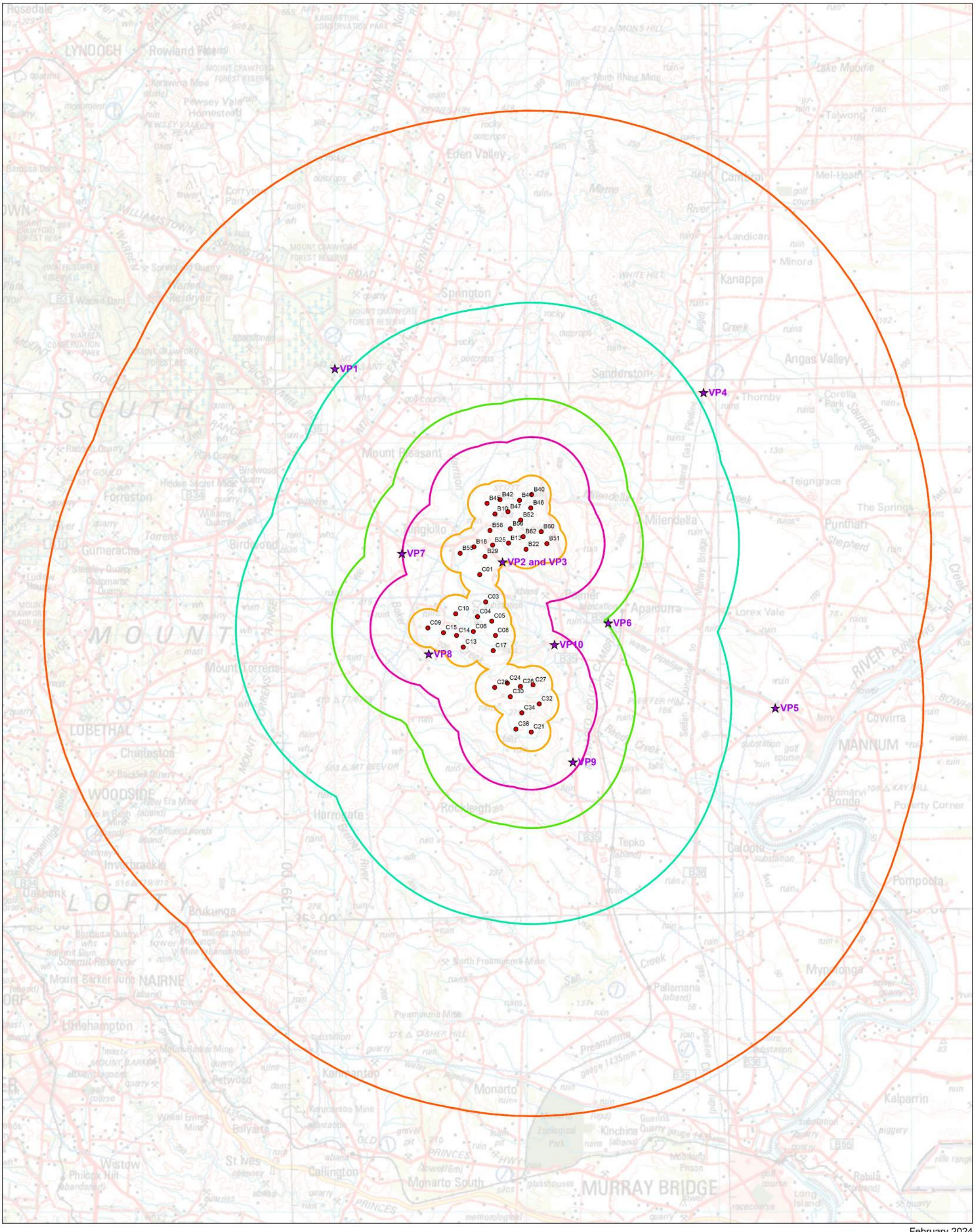
N

Legend

- Varied Project Wind Turbines
- Varied Project Viewpoints
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

ZTVI is based on a combination of 5m and 10m contour data with no vegetation or built form screening. This is representative of worse case scenario

0 1.25 2.5 5 7.5 10 Kilometers



February 2024

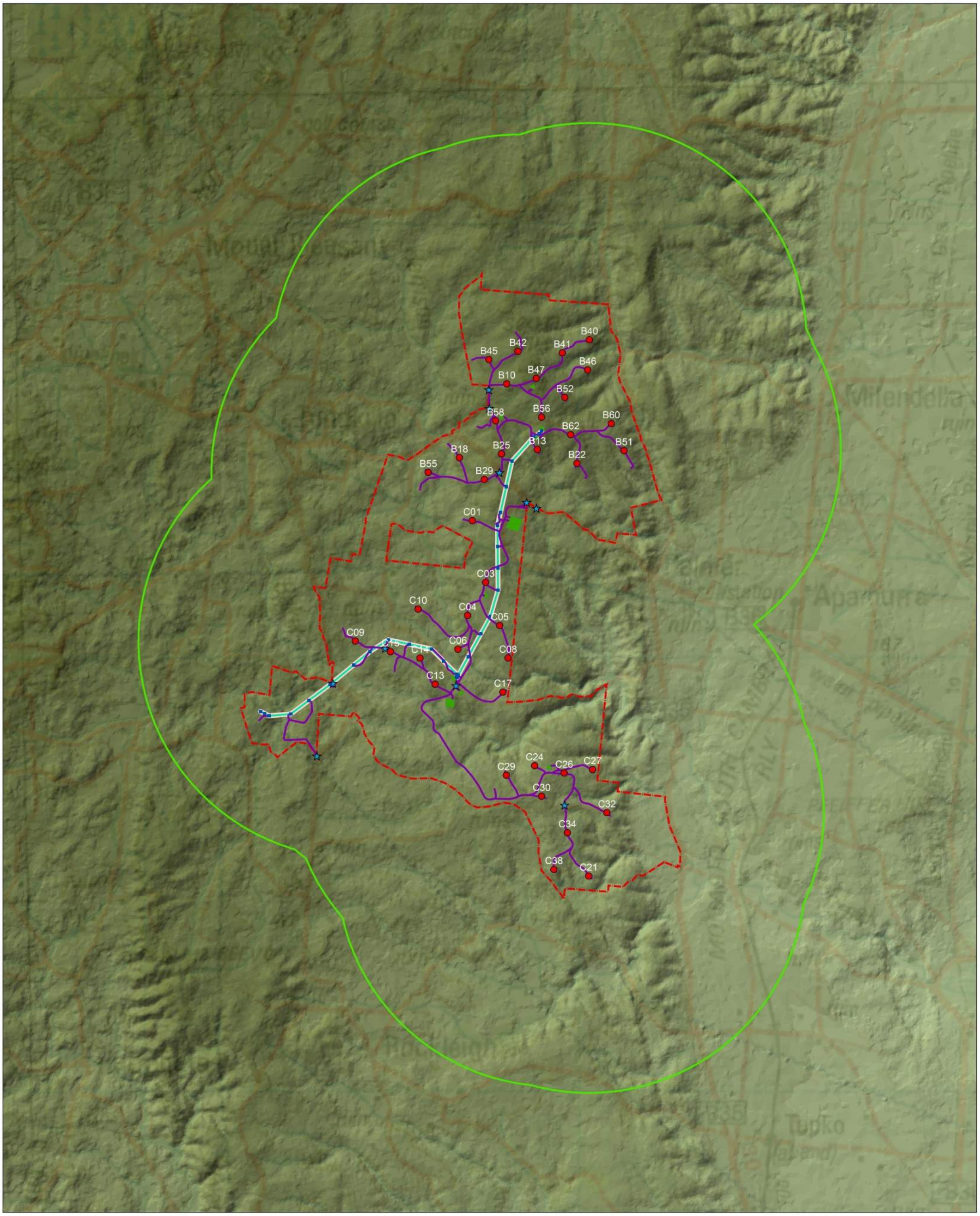
Viewpoints

Legend

- Varied Project Wind Turbines
- Varied Project Viewpoints
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

N

0 1.25 2.5 5 7.5 10 Kilometers



February 2024

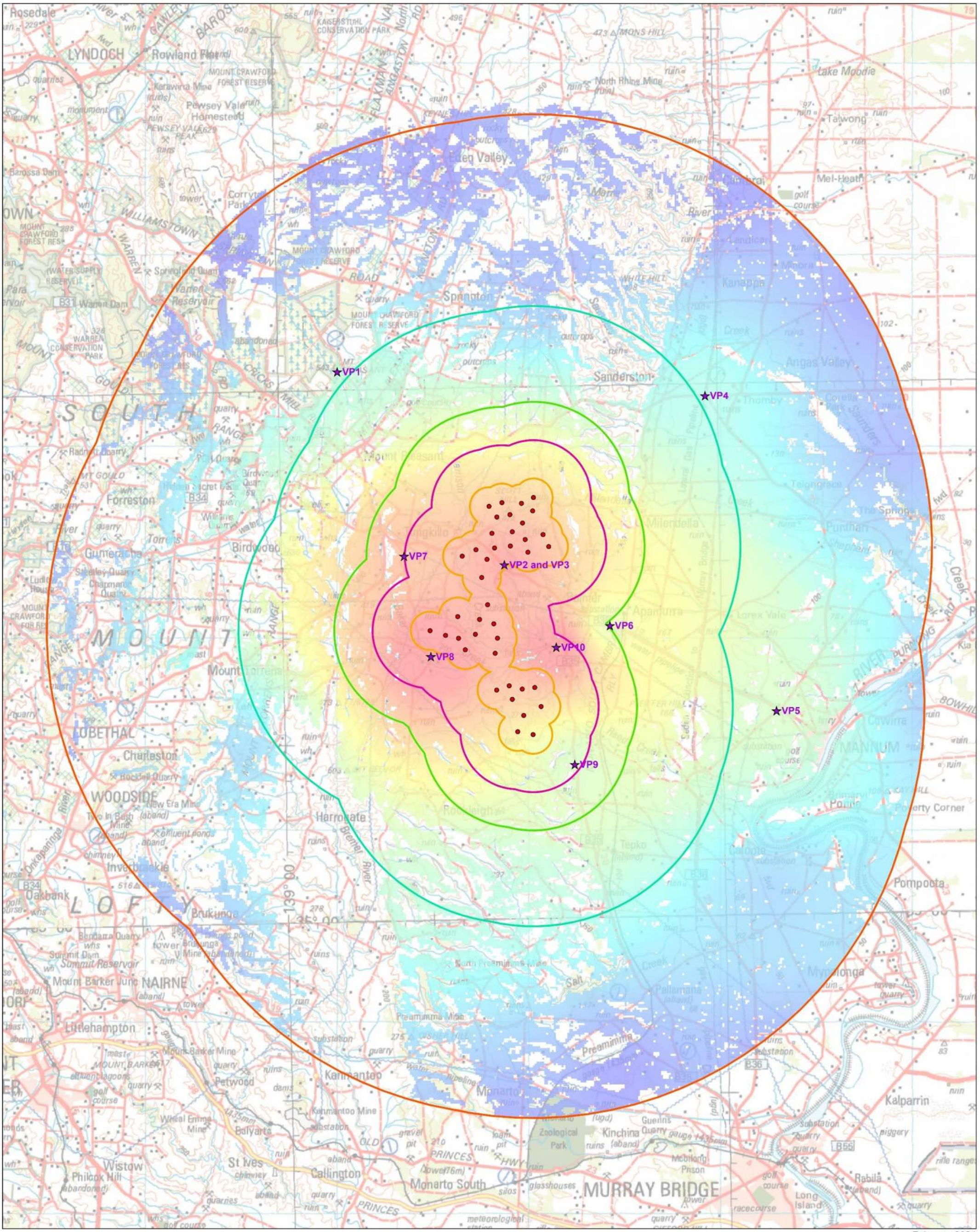
Site Infrastructure

Legend

- Varied Project Wind Turbines
- PMWF 275kV OHL Structures
- PMWF Site Access Points
- PMWF Access Tracks
- PMWF 275kV OHL Route
- Varied Project- Project Area
- PMWF Indicative_SS_CC_BP
- PMWF 275kV OHL Easement
- Buffer 5km

N

0 0.5 1 2 3 4 Kilometers



February 2024

Visual Effect Interpolation
Distance Weighted Relative Change

N

Legend

- Varied Project Wind Turbines
- Varied Project Viewpoints
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

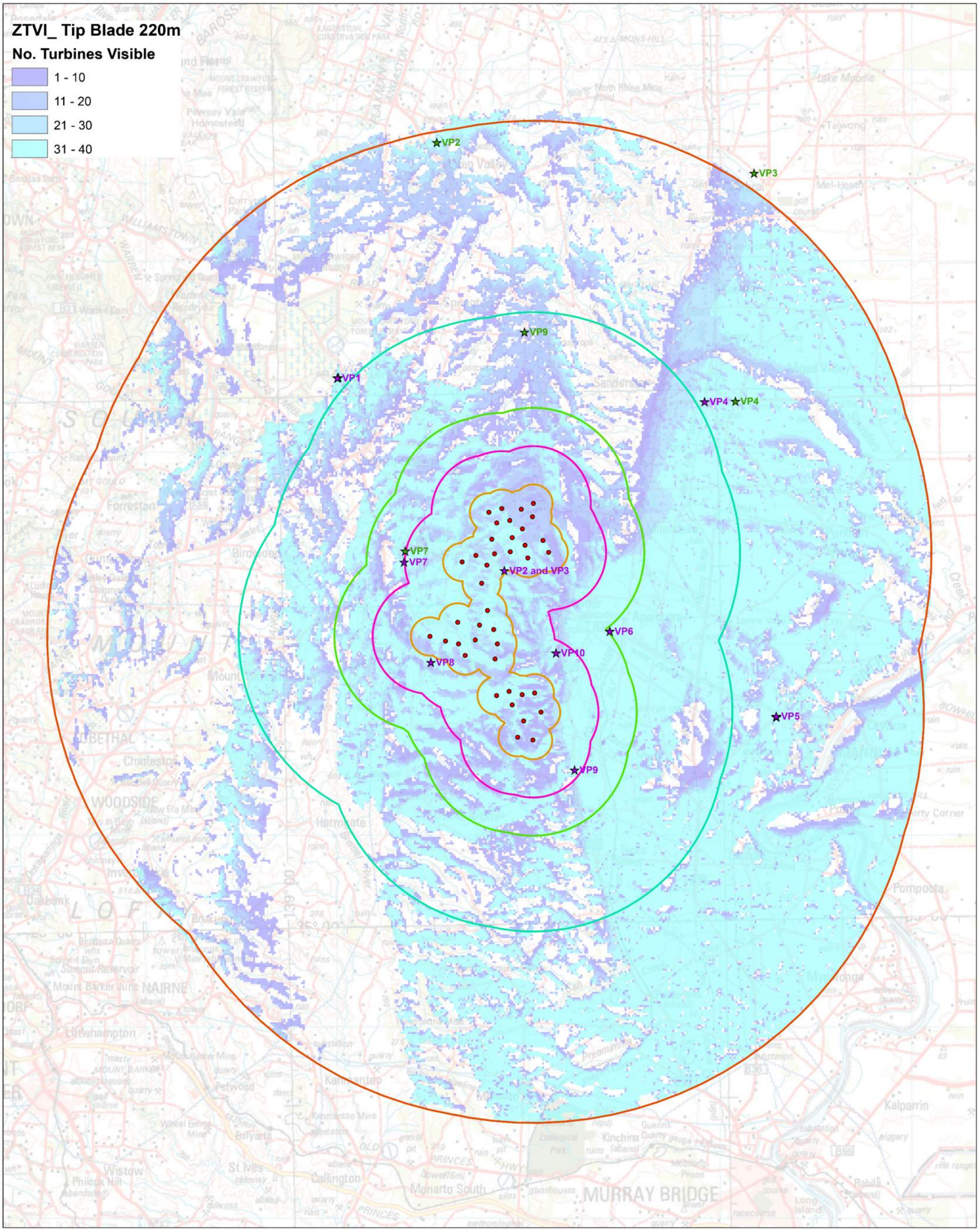
Visual Effect Interpolation

Reltative degree of change

- Substantial
- Moderate
- Slight

ZTVI is based on a combination of 5m and 10m contour data with no vegetation or built form screening. This is representative of worse case scenario

0 1.25 2.5 5 7.5 10 Kilometers



Viewpoint Assessment Comparison

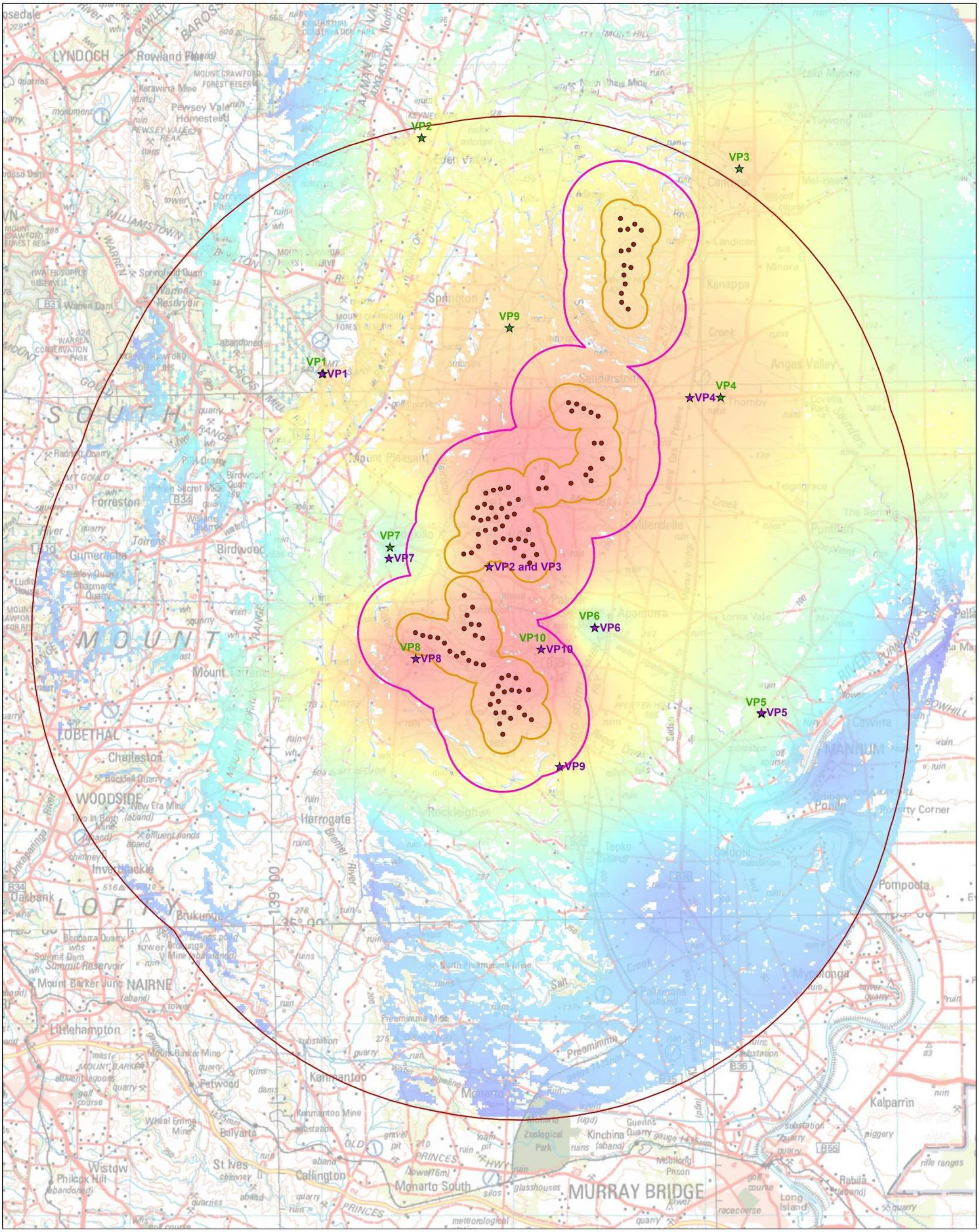
February 2024

Legend

- Varied Project Wind Turbines
- Varied Project Viewpoints
- Approved Project Viewpoints
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

N

0 1.25 2.5 5 7.5 10 Kilometers



February 2024

Visual Effect Comparative Interpolation
Distance Weighted Relative Change Approved Project

N

Legend

- Approved Project Turbine Layout - 103WTG
- Varied Project Viewpoints
- Approved Project Viewpoints
- Buffer 1km Approved Project -103 WTG
- Buffer 3km Approved Project -103 WTG
- Buffer 20km Varied Project

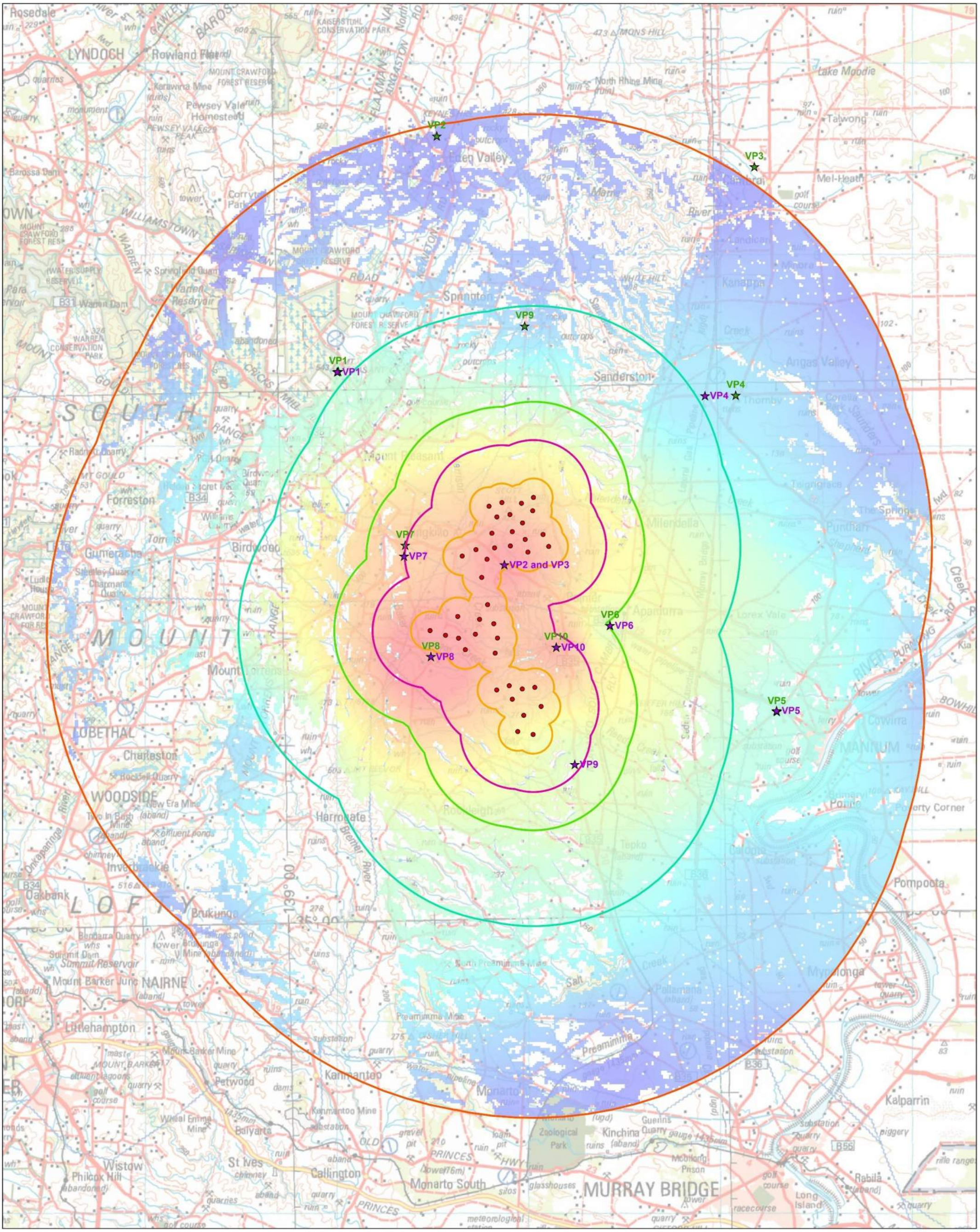
Approved Project Visual Effect Interpolation

Relative degree of change

- Subtantial
- Moderate
- Slight

ZTVI is based on a combination of 5m ang 10m contour data with no vegetation or built form screening
This is representative of worse case scenario

0 1.25 2.5 5 7.5 10 Kilometers



February 2024

Visual Effect Comparative Interpolation
Distance Weighted Relative Change Varied Project

Legend

- Varied Project Wind Turbines
- Varied Project Viewpoints
- Approved Project Viewpoints
- Buffer 1km
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

Varied Project Visual Effect Interpolation

Relative degree of change

- Substantial
- Moderate
- Slight

N

ZTVI is based on a combination of 5m and 10m contour data with no vegetation or built form screening. This is representative of worse case scenario

0 1.25 2.5 5 7.5 10 Kilometers

Appendix B
Photomontage Methodology (produced by Convergen)

The method consists of 6 stages. The following summarises the stages;

1. Viewpoints are identified using a Zone of Theoretical Visibility map, site assessment and in consultation with the client and residents in the area. The viewpoints are selected to represent the worse case scenario i.e. the maximum number of turbines visible within the field of view. The locations of viewpoints are typically representative of the regional landscape character units or identified by residents. The locations represent a diverse range of views from around the wind farm at a variety of directions and distances.

2. Photos are taken onsite using a 32mm lens digital SLR camera (50mm equivalent analogue). Numerous research papers have concluded that this is most representative of the human eye for depth of field. Photos are taken on a mounted tripod and the height recorded to eye level. In addition the elevation of the viewpoint is recorded Above Sea Level (ASL) using the barometric measure on a handheld GPS device. The weather and time of day are also recorded to enable computer model rectification in stage 4 and 6 of the process.

3. The centre of the field of view is equated onsite using a bearing compass and GPS to the projected centre of the development. A field of view of 60 degrees to either side of centre is established onsite to provide the full 120 degrees. The extent of the field of view is recorded and evaluated onsite using the GPS and bearing compass. 6 photos are taken for each viewpoint with 1/3 overlap of each to enable photo stitching. The bearing to centre of each photo is recorded to enable cross reference to the next phase of developing a computer model. During the site photography numerous fixed known visual markers are recorded with a GPS location and bearing from the viewpoint. These markers provide reference points within the computer modelling for due diligence.

4. To generate the panoramic photographs the individual photographs are stitched together using PTGui software.

5. The next stage of the process involves the computer generation of a wire frame perspective view of the wind farm, which incorporates the topography from each viewpoint. Using the Wind Farmer™ software the wire frame is produced using a digital terrain model with 10 metre contour intervals. This creates the topography and positions the turbines at the correct coordinates and elevation within the wire frame. The correct field of view is established by matching the viewing centre of the view angle to the camera and lens used for the photography with the wire frame. This ensures that the image size and angle of view of the wire line matches the photos taken. The wire line is then superimposed on the stitched panoramic photograph and matched in accordance to reference markers and landscape features.

6. A second site visit is conducted with the preliminary wire lines to certify the correct locations of the turbines using a GPS and bearing compass. Minor alterations are marked up on the drafts to mitigate the effects of photographic warping to the periphery of the stitched panorama. Ground truthing the turbine locations, provides rigour to the process. Typically if any amendments are required they are within 1-5 degrees.

7. Once the wire frame and photograph have been lined up the rendered image of the turbines are created. The rendered model is created in Wind Farmer™ using the correct sun angle for the date and time of the day that the photograph was taken. The rendered model is exported

to Photoshop™ for final matching with the photograph. The rendered image is edited, masking turbines or parts their off that are screened by vegetation and other elements to the foreground. Additional visual effects are applied to match the lighting effects of shadow imposed by vegetation etc.

Viewing of Photomontages

Given that the objectives of photography and photomontage are to produce printed images of a size and resolution sufficient for use in assessment work in the field, the exact dimensions of these images will depend on the characteristics of the field of view.

All photographs, whether printed or digitally displayed, have a unique, correct viewing distance - that is, the distance at which the perspective in the photograph correctly reconstructs the perspective seen from the point at which the photograph was taken. The correct viewing distance is stated for all printed or digitally displayed photographs and photomontages, together with the size at which they should be printed.

The viewing distance and the horizontal field of view together determine the overall printed image size.
Photographs and photomontages should be printed or published digitally at an appropriate scale for comfortable viewing at the correct distance, noting the limitations of the printing process particularly with regards to colour and resolution. Guidance is provided on viewing the image in order to best represent how the proposal would appear if constructed, such as the required viewing distance between the eye and the printed image. Panoramic images should be curved so that peripheral parts of the image are viewed at the same intended viewing distance. The 'before' photograph and the 'after' photomontage should be presented on the same page and/or at the same scale to allow comparison if practicable.

References

Landscape Institute Photography and photomontage in landscape and visual impact assessment (March 2011)

Landscape Institute and IEMA (2002) Guidelines for landscape and visual impact assessment (2nd ed). London: Spon.

Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance. Inverness: Scottish Natural Heritage. SNH report no. FO3 AA 308/2

Appendix C

Photomontages

VIEWPOINT 1: SUMMIT OF MOUNT PLEASANT (WEST – SUB-REGIONAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 1: SUMMIT OF MOUNT PLEASANT (WEST – SUB-REGIONAL)



APPROVED PROJECT PHOTOMONTAGE

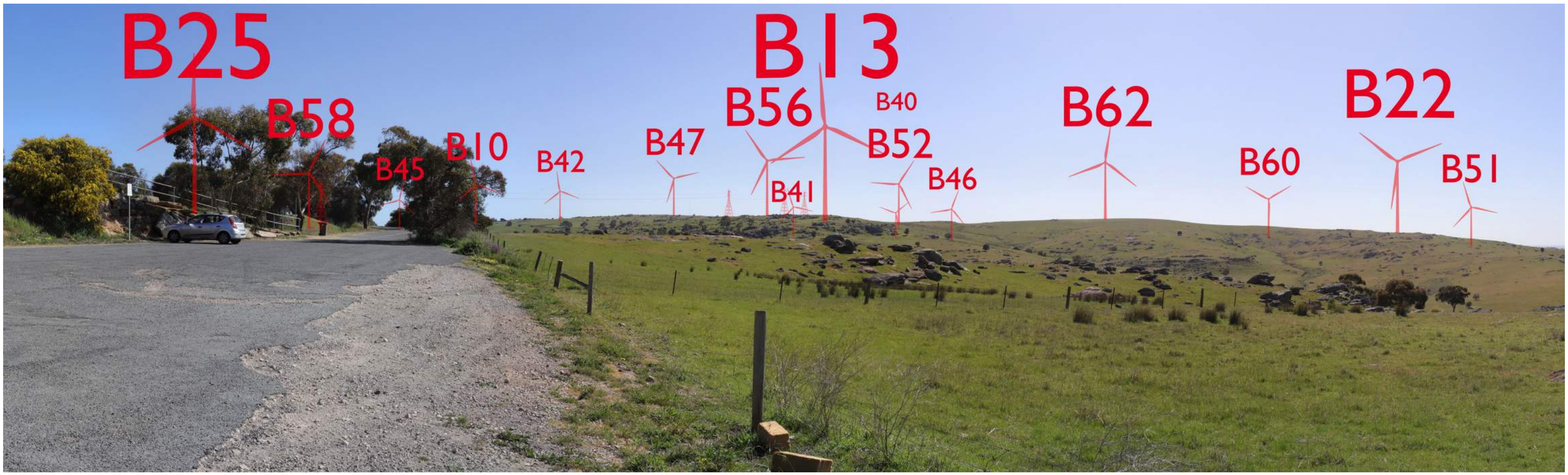


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 2: PALMER LOOKOUT (CENTRAL LOOKING NORTH)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 2: PALMER LOOKOUT (CENTRAL LOOKING NORTH)



APPROVED PROJECT PHOTOMONTAGE

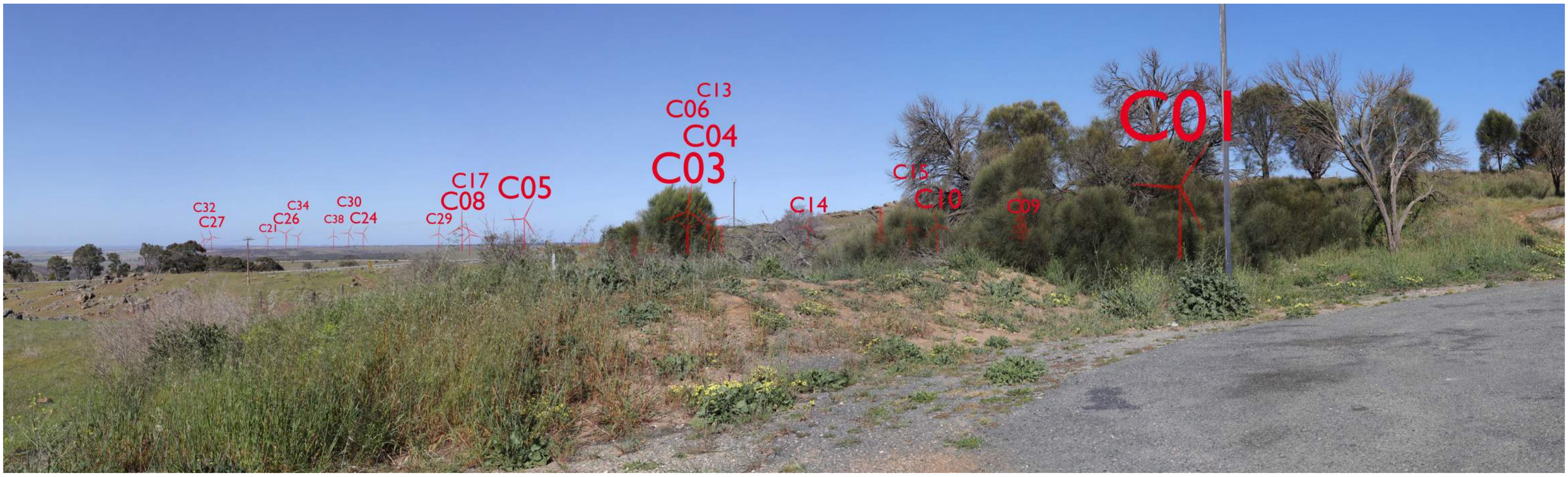


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 3: PALMER LOOKOUT (CENTRAL LOOKING SOUTH)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 3: PALMER LOOKOUT (CENTRAL LOOKING SOUTH)



APPROVED PROJECT PHOTOMONTAGE



VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 4: ANGAS VALLEY ROAD AND PUNTHARI ROAD INTERSECTION (EAST – SUB-REGIONAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 4: ANGAS VALLEY ROAD AND PUNTHARI ROAD INTERSECTION (EAST – SUB-REGIONAL)



APPROVED PROJECT PHOTOMONTAGE



VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 5: RANDELL ROAD AND MANNUM ROAD INTERSECTION (SOUTHEAST – REGIONAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 5: RANDELL ROAD AND MANNUM ROAD INTERSECTION (SOUTHEAST – REGIONAL)



APPROVED PROJECT PHOTOMONTAGE

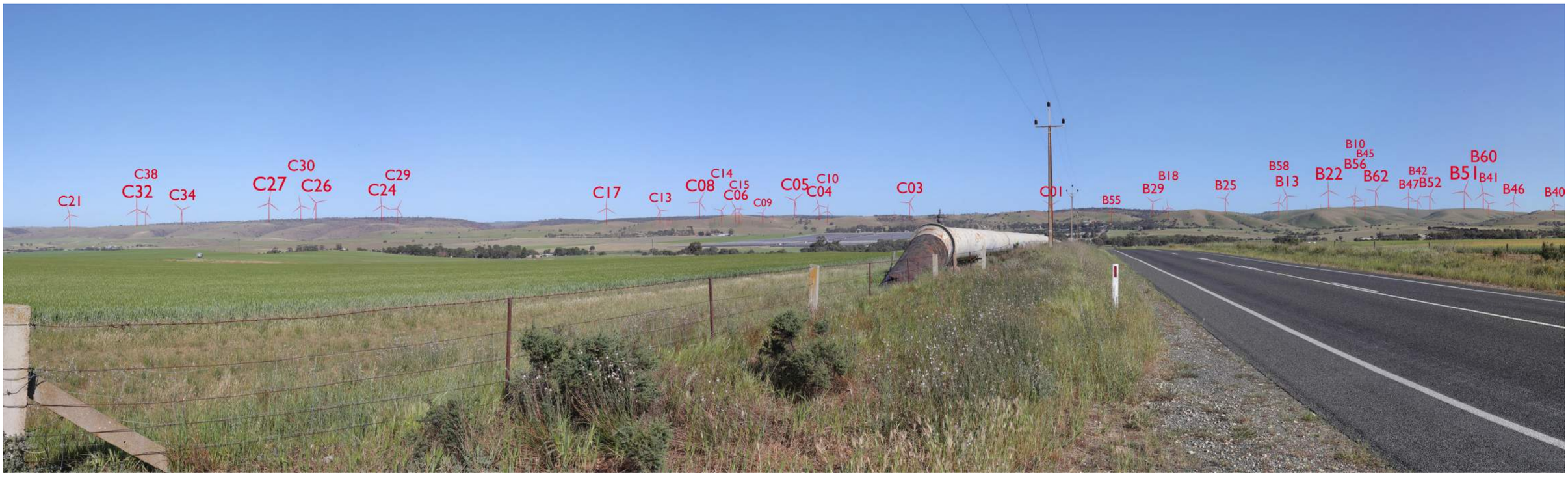


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 6: OUTSKIRTS OF PALMER ON RANDELL ROAD (EAST – SUB-REGIONAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 6: OUTSKIRTS OF PALMER ON RANDELL ROAD (EAST – SUB-REGIONAL)



APPROVED PROJECT PHOTOMONTAGE

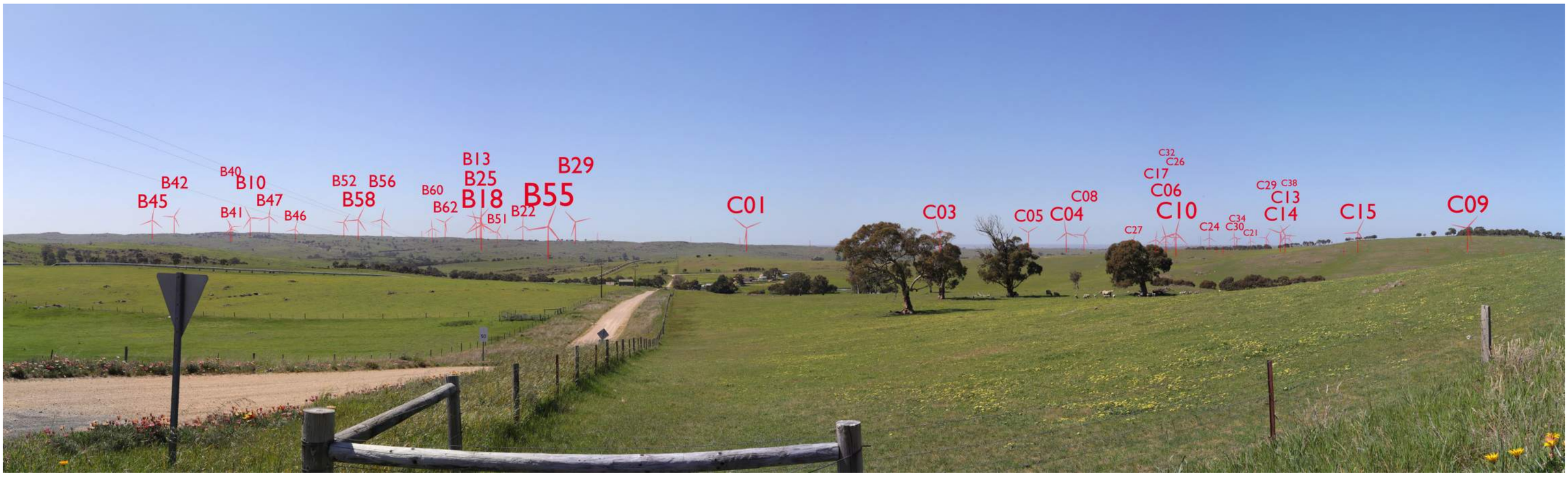


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 7: BRINKWORTH ROAD AND MEMORIAL DRIVE TUNGKILLO TOWNSHIP (WEST – LOCAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 7: BRINKWORTH ROAD AND MEMORIAL DRIVE TUNGKILLO TOWNSHIP (WEST – LOCAL)



APPROVED PROJECT PHOTOMONTAGE

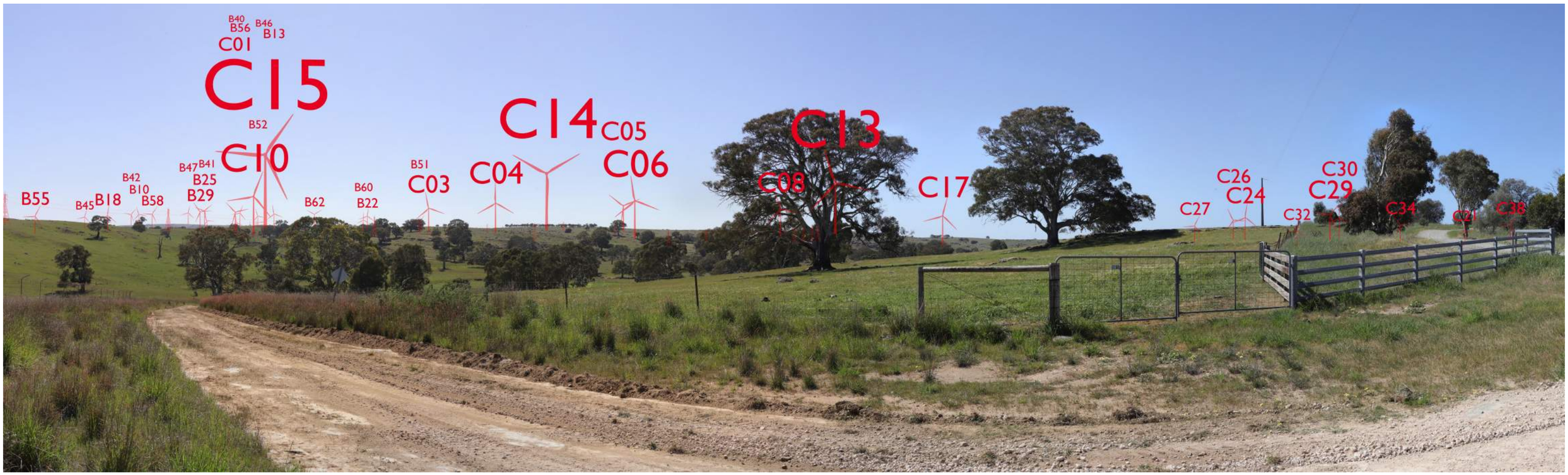


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 8: BRINKWORTH ROAD AND HENTSCHKE ROAD (WEST – LOCAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 8: BRINKWORTH ROAD AND HENTSCHKE ROAD (WEST – LOCAL)



APPROVED PROJECT PHOTOMONTAGE

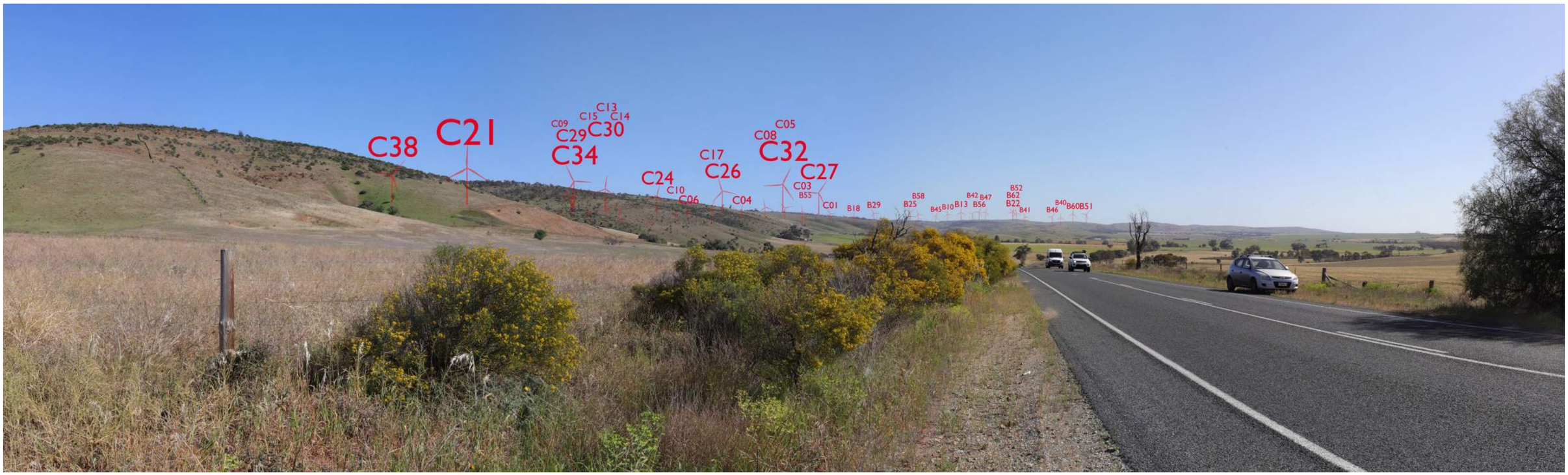


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 9: REEDY CREEK ROAD (SOUTH – SUB-REGIONAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 9: REEDY CREEK ROAD (SOUTH – SUB-REGIONAL)



APPROVED PROJECT PHOTOMONTAGE

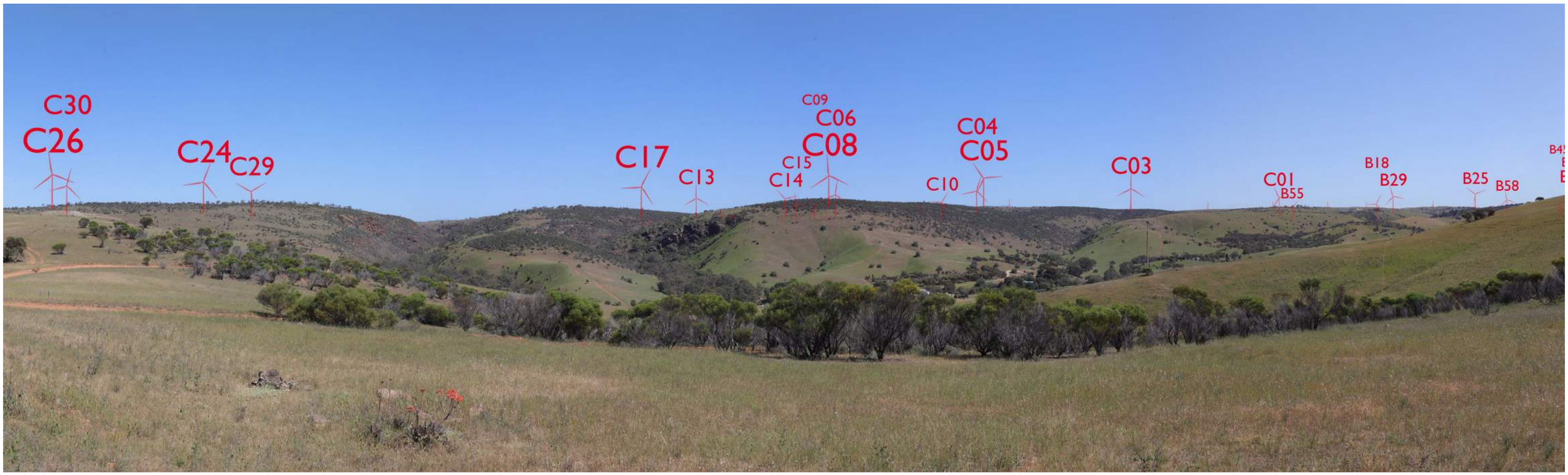


VARIED PROJECT PHOTOMONTAGE

VIEWPOINT 10: HARRISON GORGE, MINE ROAD (SOUTHEAST – LOCAL)



2023 BASE PHOTOGRAPHY



VARIED PROJECT WIRE LINE

VIEWPOINT 10: HARRISON GORGE, MINE ROAD (SOUTHEAST – LOCAL)



APPROVED PROJECT PHOTOMONTAGE



VARIED PROJECT PHOTOMONTAGE

Appendix D
Community Landscape Values Survey and Mapping

transient panoramic views towards development.

Legend

- Turbines_BGLA_revb
- Buffer_of_Turbines_BGLA_1km
- Buffer_of_Turbines_BGLA_5km

0 1.25 2.5 5 7.5 10 Kilometers

N

Palmer Wind Farm - Landscape Character Values Survey

Trust Power invite you to participate in a landscape character and scenic values survey of the Palmer regional landscape. The findings of this survey will inform the detailed landscape character and visual assessment study being undertaken by WAX Design in association with BGLA.

The objectives of the survey are to ascertain the communities values and perceptions of the existing landscape characteristics. Values and perceptions of the landscape are subjective, thus can be considered in the eyes of the beholder. This survey seeks to evaluate any common themes with reference to perceived land use, natural qualities, scenic quality, recreational use and historic and cultural values.

Question 1

Using the 5 coloured dots provided, mark on the attached map landscape features or areas that you feel best represent the classifications of;

- Rural and Agriculture
- Natural
- Scenic beauty
- Recreation
- History and Culture

(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

....lavender...trail...,Old..ruins..around..the..area,,lovely...areas.....
...with...Scenic...view?..This..all..add..value..and..natural...beauty
to the area.

Question 3

From which roads do you enjoy views of the landscape?

.....G.Ayres..Road...our..home/..Camelhump.Rd.....

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

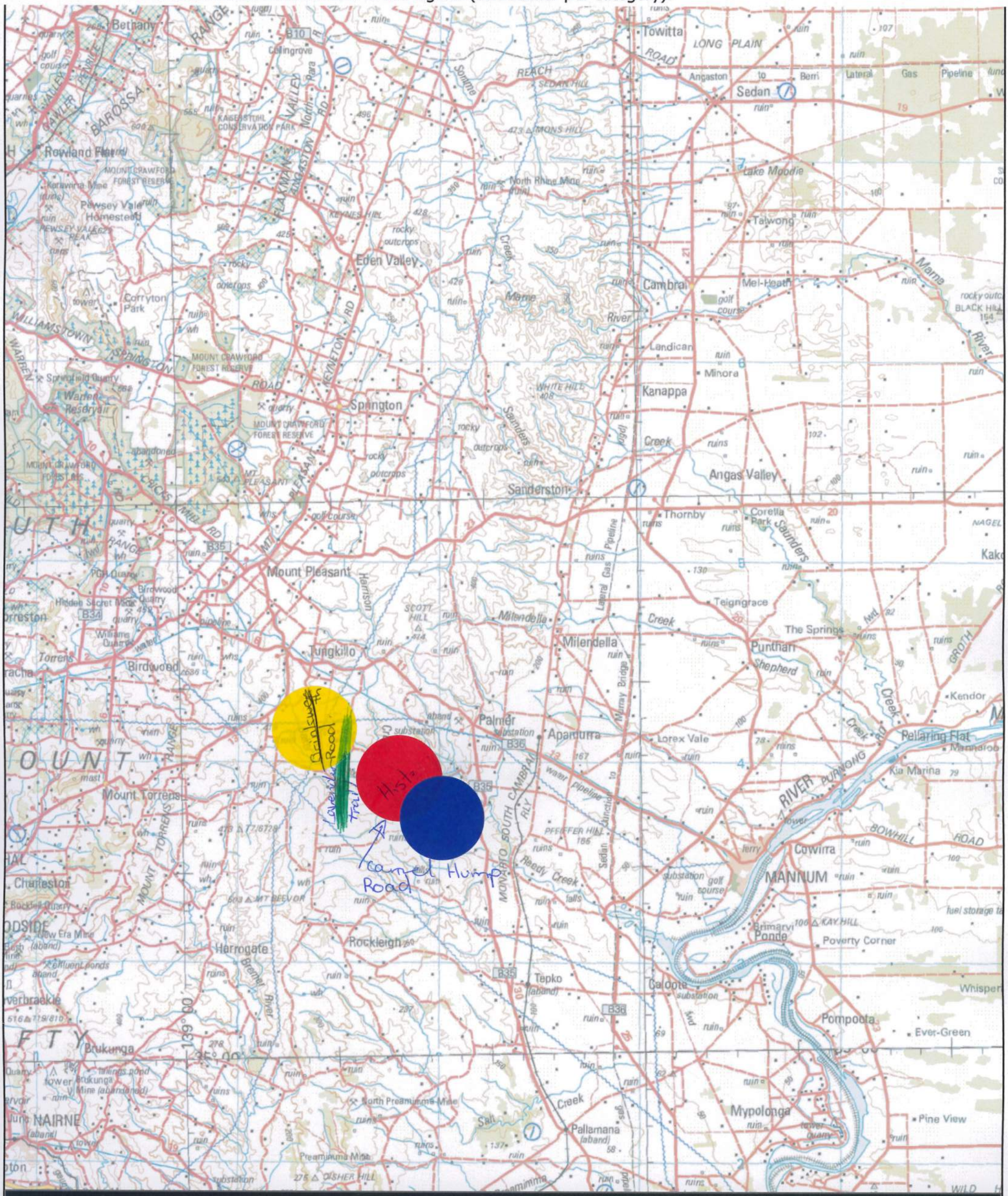
.....open..hill..view..to..the..murray..with..rolling..tree.....
..landscape..and..the..view..of..our..animals.....
.....

4b. Can you describe the character of this area?

.....open..view,..and..the..quite..area.....
...that..it..is..at..present.....
.....

Question 1

Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).



Landscape Character Values Mapping

0 1 2 4 6 8 Km

October 2013

N

Legend

- **Rural and Agricultural** (areas of farming with grazing cropping, vineyard land uses)
- **Natural** (locations where farming and human interaction is not prominent e.g. rivers, woodland, rocky outcrops)
- **Scenic** (locations or viewpoints that are picturesque or could be seen as beautiful e.g. lookouts, creek lines, natural features, hill tops)
- **Recreation** (areas used by the community for leisure, sport and other past times e.g. ovals, trails, community halls, memorial sites)
- **History and Culture** (locations of historic or cultural significance that are recognised by the community e.g. churches , ruins, burial sites)

Trust power

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Question 1

Using the 5 coloured dots provided, mark on the attached map landscape features or areas that you feel best represent the classifications of;
- Rural and Agriculture
- Natural
- Scenic beauty
- Recreation
- History and Culture

(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

BAKERS CREEK, DAIRY CREEK

Question 3

From which roads do you enjoy views of the landscape?

BRINKWORTH RD, BLACK HEATH RD, PEBBLY RANGE RD, BRINKWORTH'S RANGE RD, COLLINS RD.

Question 4

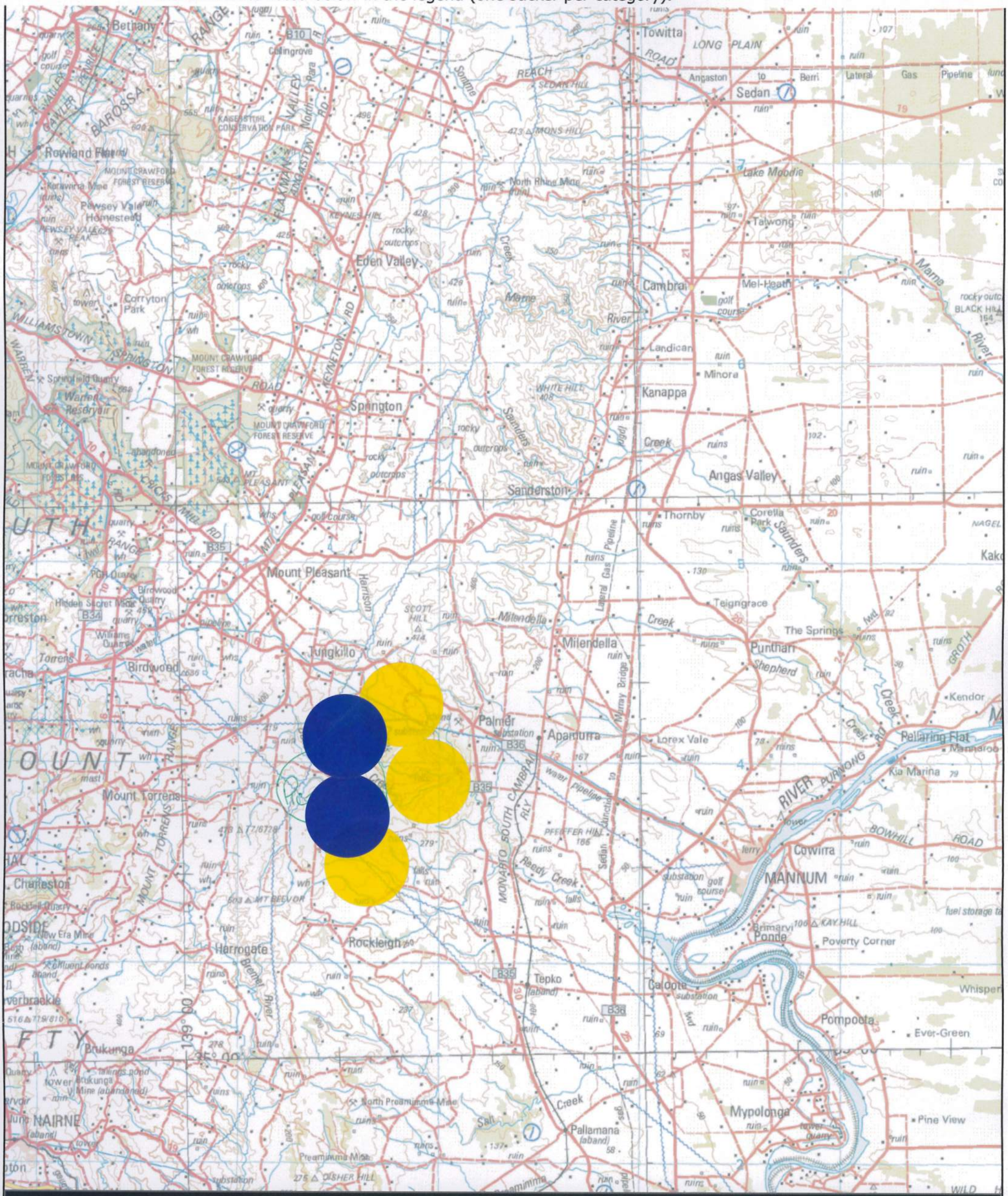
4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

4b. Can you describe the character of this area?

PEACEFUL RURAL, LARGELY UNSPOILT, ROCKY OUTCROPS LOTS OF BIRDS, LOTS OF REVEGETATION.

Question 1

Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).


Bethany
Towitta
LONG PLAIN
ROAD
Angaston to Berri Lateral Gas Pipeline
Sedan
REACH
SEDAN HILL
BAROSSA
RANGE
B10
Collingrove
Sturt Highway
KAISERSTUHL CONSERVATION PARK
North Para Rd
FLAKMAN VALLEY
ANGASTON
MONS HILL
Rowland Flat
MOUNT CRAWFORD FOREST RESERVE
Kerawirra Mine
Pewsey Vale Homestead
PEWSEY VALE
KEYNES HILL
Lake Moodie
North Rhine Mine
Talwong
Eden Valley
rocky outcrops
Creek
Marne
River
Cambrai
Mel-Heath
golf course
Corryton Park
tower
WILLIAMSTOWN
ASPHINGTON
WARREN
Springfield Quarry
Warren Reservoir
MOUNT CRAWFORD FOREST RESERVE
REYNETON RD
Springton
ROAD
Landican
Minora
Kanappa
WHITE HILL
Saunders
Sanderston
Angas Valley
Thornby
Corella Park
Saunders
Pipeline
Lateral Gas
Mount Pleasant
Harrison
Birdwood Quarry
Hidden Secret Mine
B34
Williams Quarry
Teignngrace
Milendella
Punthari
The Springs
Shepherd
Tungkillo
Birdwood
Palmer
substation
Apamurra
B35
Lorex Vale
Pellaring Flat
Mannaroo
Kia Marina
RIVER PURNONG
Mount Torrens
TORRENS
MOUNT
Charleston
Rockleigh
Tepko (aband)
Cadgote
substation
B36
BOWHILL ROAD
Cowirra
MANNUM
Poverty Corner
Ponde
Brimaryi
Pompoota
Ever-Green
Whispering
Brukunga
Brukunga Mine (abandoned)
tailings pond
tower
NAIRNE
Preamimma Mine
North Preamimma Mine
Pallamana (aband)
Mypolonga
Pine View
Creek
Reedy Creek
Sedan
MONARTO SOUTH
CAMBRAI
RLY
PFEFFER HILL
SCOTT HILL
MT PLEASANT
KAY HILL
FISHER HILL
MT BEEVOR
Harrogate
Brukunga
Kendor
Creek Rd
GROTH
Murray Bridge
Pipeline
Sall
Creek
Saunders
Creek
Reedy Creek
Creek
Creek

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Question 1

Using the 5 coloured dots provided, mark on the attached map landscape features or areas that you feel best represent the classifications of;
- Rural and Agriculture
- Natural
- Scenic beauty
- Recreation
- History and Culture

(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

MAGNIFICENT VIEW OF HILLS EASTERN SIDE

Question 3

From which roads do you enjoy views of the landscape?

MOST.

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

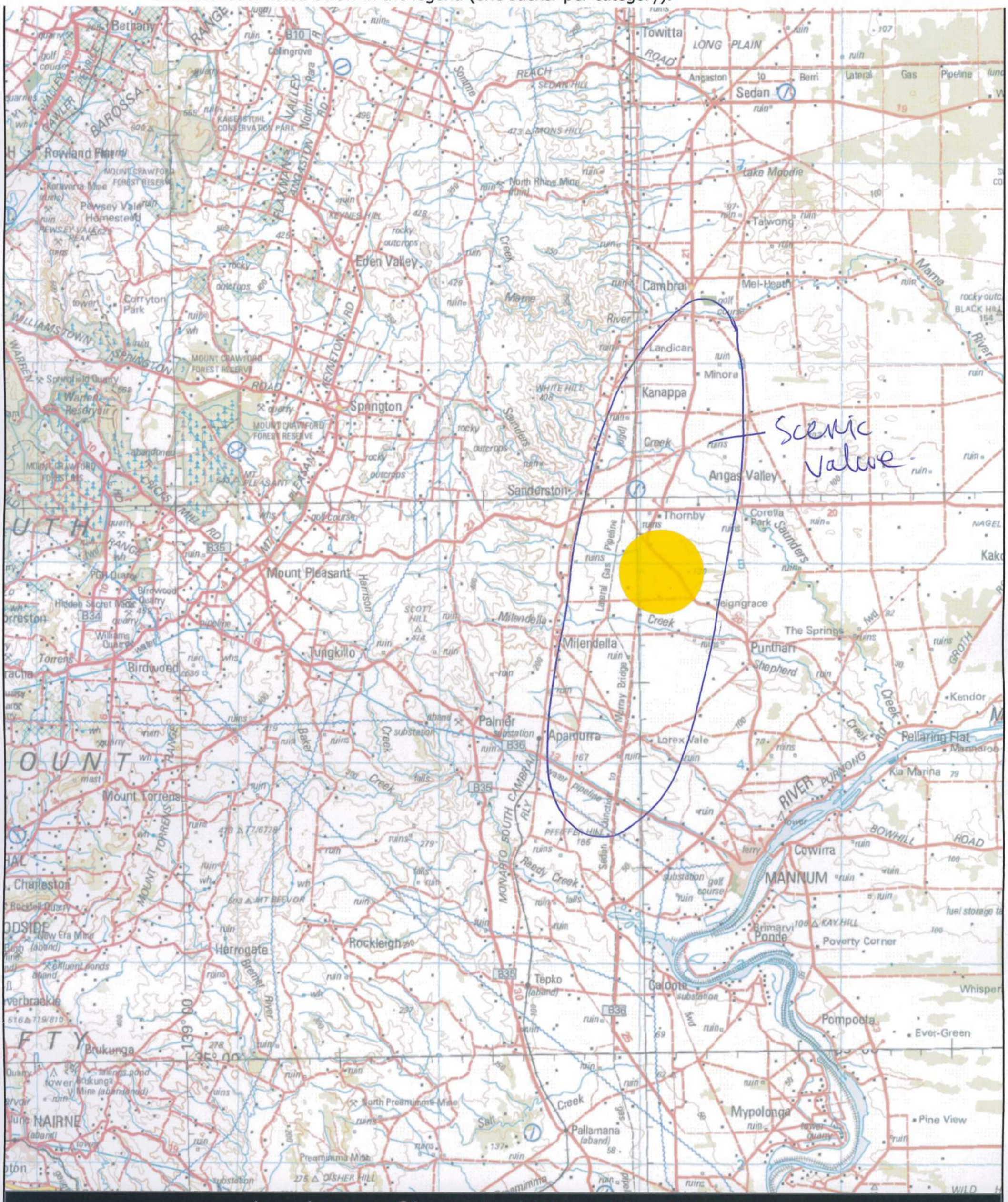
NATURAL BEAUTY.

4b. Can you describe the character of this area?

RURAL UNTOUCHED

Question 1

Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).



Legend

- **Rural and Agricultural** (areas of farming with grazing cropping, vineyard land uses)
- **Natural** (locations where farming and human interaction is not prominent e.g. rivers, woodland, rocky outcrops)
- **Scenic** (locations or viewpoints that are picturesque or could be seen as beautiful e.g. lookouts, creek lines, natural features, hill tops)
- **Recreation** (areas used by the community for leisure, sport and other past times e.g. ovals, trails, community halls, memorial sites)
- **History and Culture** (locations of historic or cultural significance that are recognised by the community e.g. churches , ruins, burial sites)

0 1 2 4 6 8 Km

October 2013

N

Trust power

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- Natural
- Scenic beauty
- Recreation
- History and Culture

(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

RIVER MARKE

Question 3

From which roads do you enjoy views of the landscape?

SAMPLESTON RD

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

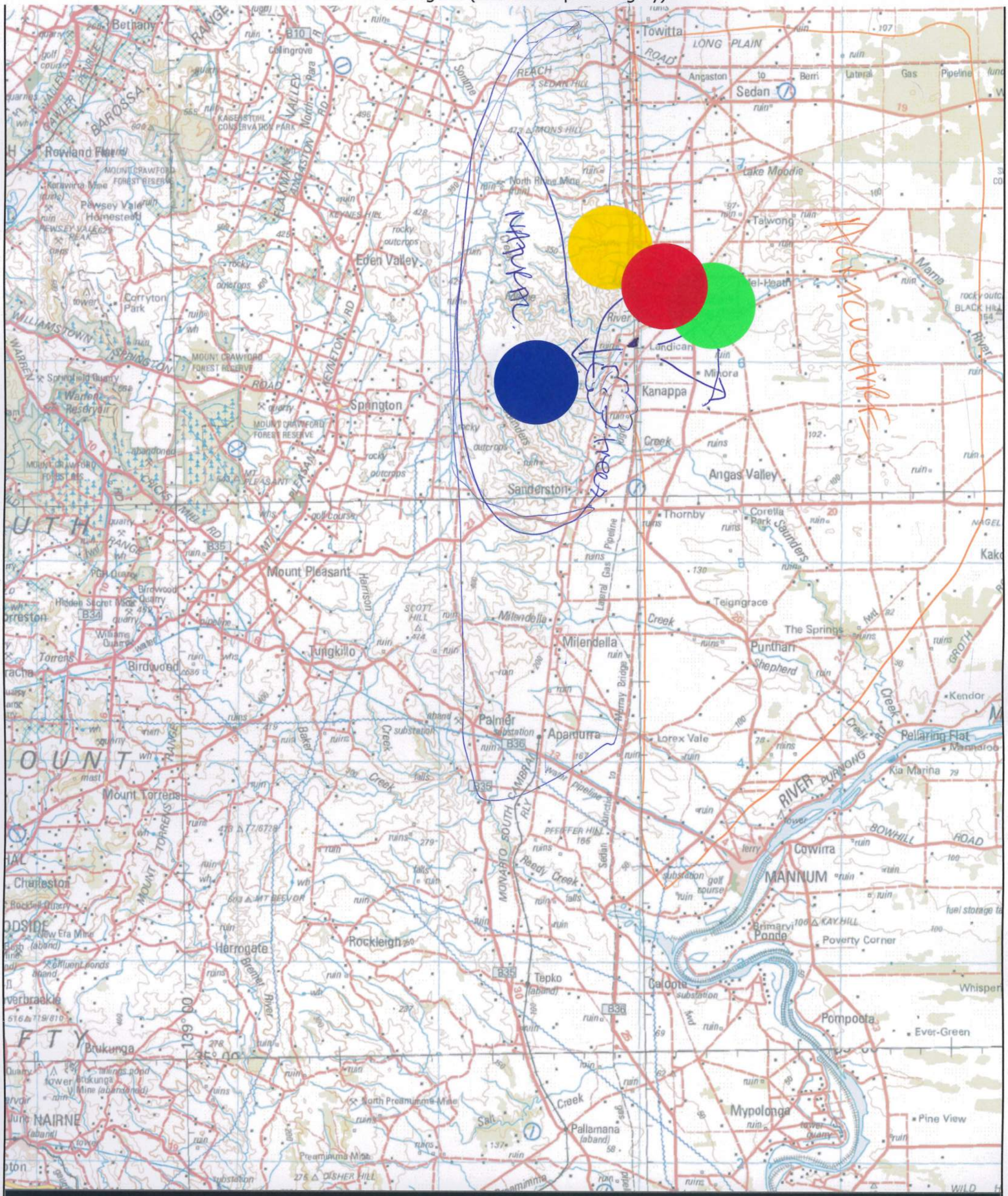
GOOD VIEWS

4b. Can you describe the character of this area?

PLEASANT VIEWS

Question 1

Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).



Landscape Character Values Mapping

Legend

- **Rural and Agricultural** (areas of farming with grazing cropping, vineyard land uses)
- **Natural** (locations where farming and human interaction is not prominent e.g. rivers, woodland, rocky outcrops)
- **Scenic** (locations or viewpoints that are picturesque or could be seen as beautiful e.g. lookouts, creek lines, natural features, hill tops)
- **Recreation** (areas used by the community for leisure, sport and other past times e.g. ovals, trails, community halls, memorial sites)
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Trust power

Palmer Wind Farm - Landscape Character Values Survey

Trust Power invite you to participate in a landscape character and scenic values survey of the Palmer regional landscape. The findings of this survey will inform the detailed landscape character and visual assessment study being undertaken by WAX Design in association with BGLA.

The objectives of the survey are to ascertain the communities values and perceptions of the existing landscape characteristics. Values and perceptions of the landscape are subjective, thus can be considered in the eyes of the beholder. This survey seeks to evaluate any common themes with reference to perceived land use, natural qualities, scenic quality, recreational use and historic and cultural values.

Question 1

Using the 5 coloured dots provided, mark on the attached map landscape features or areas that you feel best represent the classifications of;

- Rural and Agriculture
- Natural
- Scenic beauty
- Recreation
- History and Culture

(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

Yes, area near our property.....

.....

Question 3

From which roads do you enjoy views of the landscape?

Burns road, Groths road, Angus valley Road, Palmer - Cockes Hill Rd.....

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

very beautiful.....

.....

.....

4b. Can you describe the character of this area?

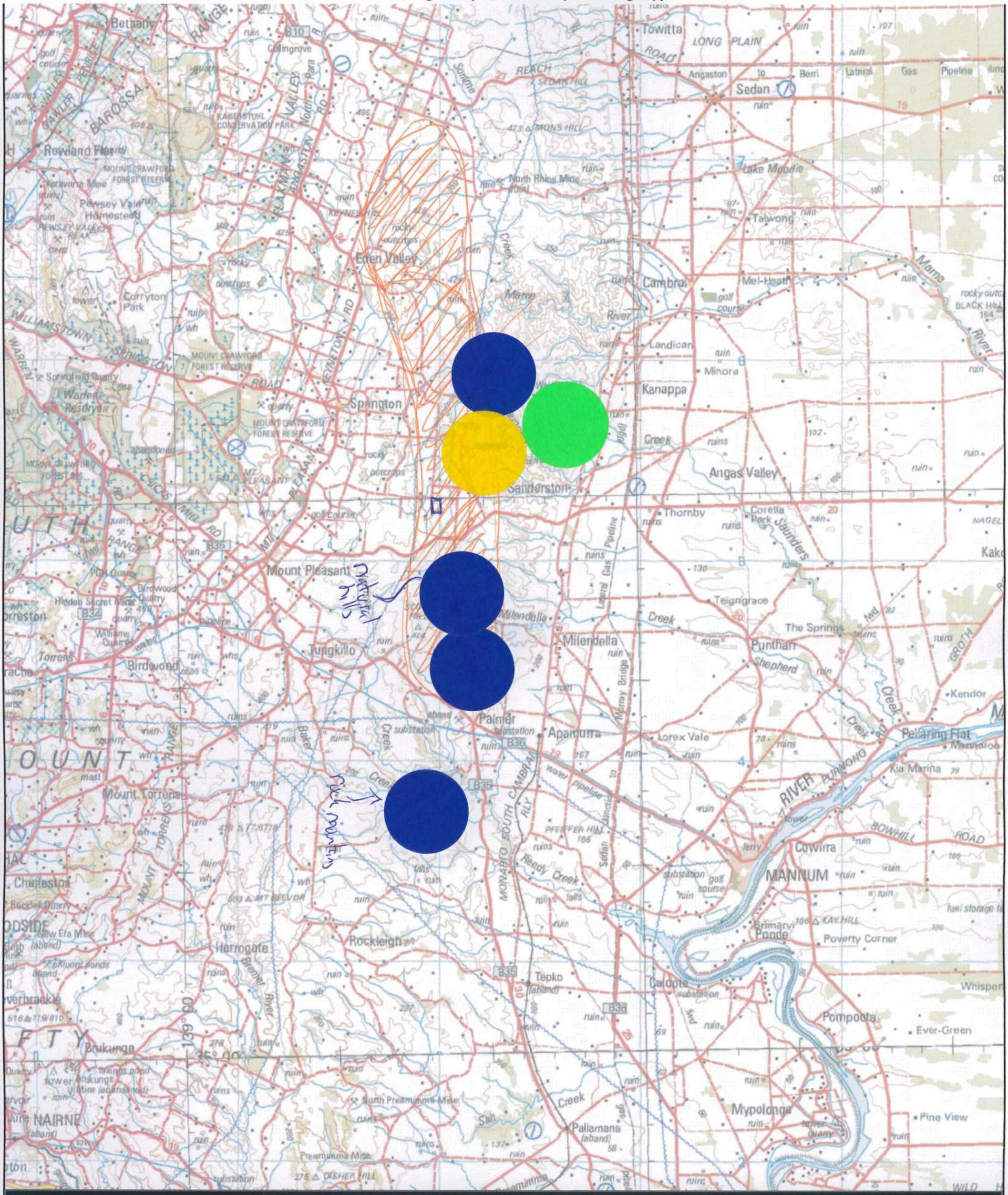
natural, unspoilt farming area & popular for tourists.....

.....

.....

Question 1

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0 1 2 4 6 8 Km

October 2013

N

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(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

Harrison Gorge area - Very valuable - no turbines there. Too valued. Elsewhere fine.

Question 3

From which roads do you enjoy views of the landscape?

View up Davenport Rd is great. Also M. Bridge to Palmer Rd - western side. From Palmers Hill Lookout - views of wind turbines don't bother me too much, except concedes Harrison Gorge.

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

Seems a "natural" area to put wind turbines. Very windy - but not above Harrison Gorge!

4b. Can you describe the character of this area?

Heavily cleared in many parts. Areas of veg that remain are highly valued.

Question 1

Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).

Landscape Character Values Mapping

0 1 2 4 6 8 Km

October 2013

N

Legend

- **Rural and Agricultural** (areas of farming with grazing cropping, vineyard land uses)
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- Natural
- Scenic beauty
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(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

HARRISON GORGE ... KITTICOOLA MINE ... "THE GAP"
↳ SURROUNDING AREAS WITH REMNANT NATIVE VEGETATION

Question 3

From which roads do you enjoy views of the landscape?

REEDY CREEK ROAD ... TEA TREE GULLY-MANNUM ROAD
COOKES HILL ROAD.

Question 4

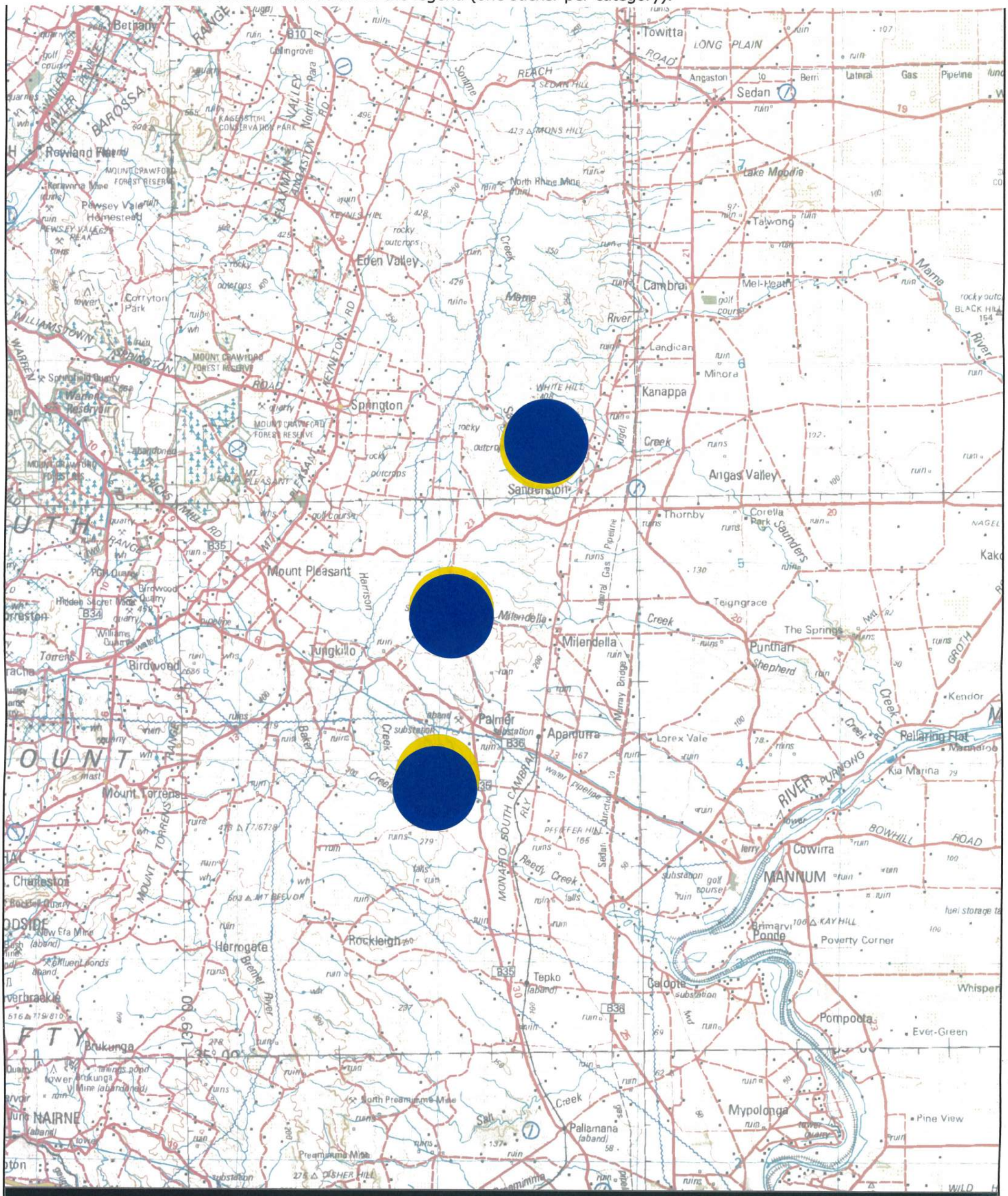
4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

SOME HAS BEEN DEGRADED BY OVER-CLEARING.
OTHER AREAS ARE WORTHY OF CONSERVATION/PRESERVATION IE
HARRISON GORGE, THE GAP AND AREAS OF REMNANT VEGETATION WHICH ARE THE LAST STANDS OF PINK GUM IN THE AREA.

4b. Can you describe the character of this area?

RUGGED. COMPARABLE TO FLINDERS RANGES.

Question 1 Using the coloured dot stickers provided please mark on the plan areas you feel best identify the characteristics listed below in the legend (one sticker per category).



Legend

- **Rural and Agricultural** (areas of farming with grazing cropping, vineyard land uses)
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0 1 2 4 6 8 Km

October 2013

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(You can encircle areas surrounding the coloured dots to represent the extent of characteristic)

Question 2

Are there any particular landscape features or areas that have specific importance to you? If so why? (you can mark up on overleaf map with annotations).

.....

.....

Question 3

From which roads do you enjoy views of the landscape?

.....

Question 4

4a. Do you have any comments with regards to the visual amenity and landscape character of your local area?

.....

.....

.....

4b. Can you describe the character of this area?

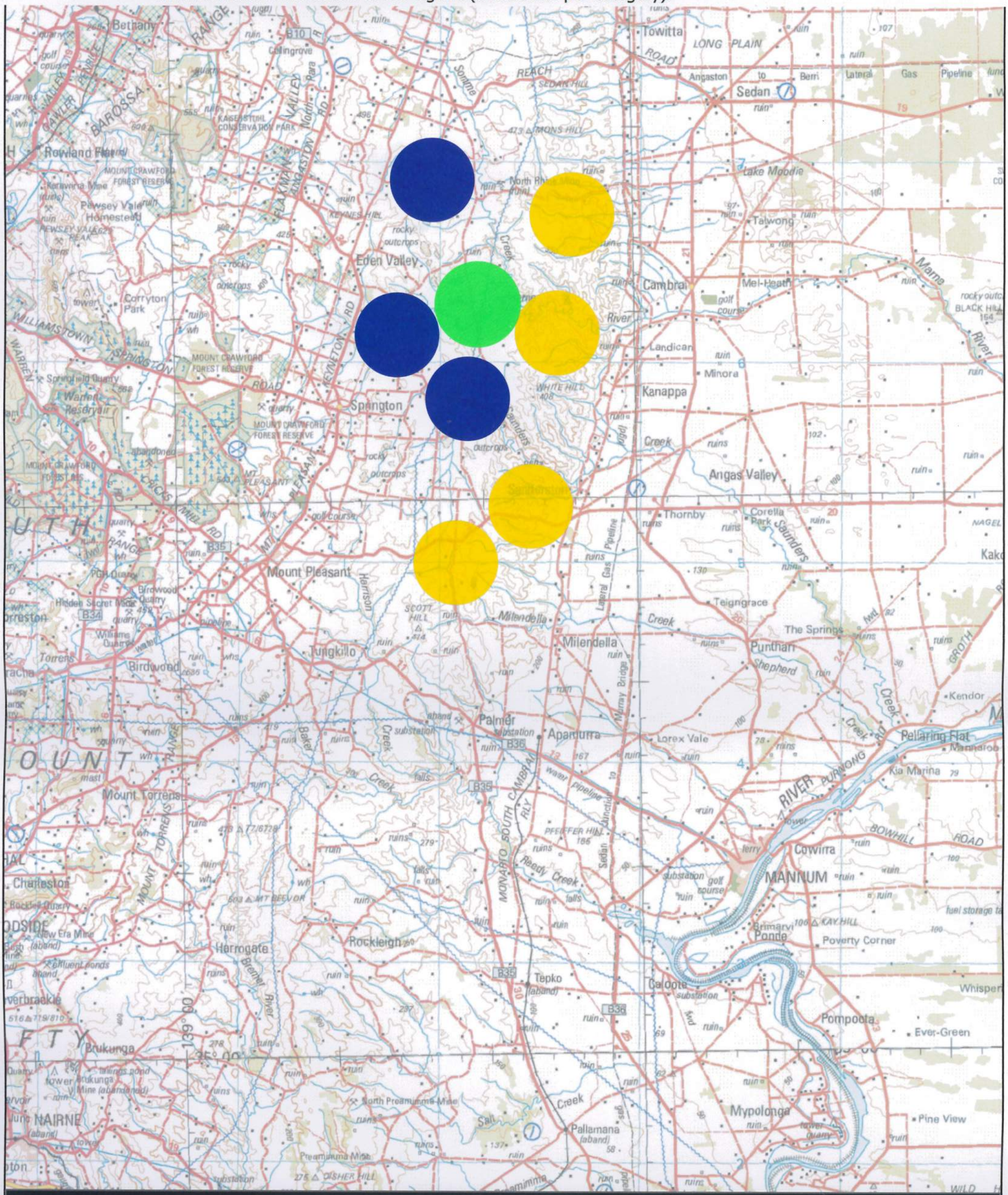
.....

.....

.....

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Landscape Character Values Mapping

0 1 2 4 6 8 Km

October 2013

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Legend

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Appendix E
GrimKe Assessment Matrix

The GRIMKE Matrix has been based on the WAX (2006) and HASSELL Matrix (2005), and with reference to The Visual Management System (VMS) produced by Litton (1968) primarily used for the U.S. Forest Service (1973) and the US Bureau of Land Management (1980). These models are based on a professional consultant (Landscape Architect) quantifying potential changes to landscape composition through “forms, lines, colours and textures and their interrelationships”1. Other factors such as compositional qualities, dominance, variety, animation and sensitivity to potential receptors are also considered.

The extent of visual impact was identified on site, using a GPS with a Wide Area Augmentation System (WAAS) that provides positional accuracy to within 3 metres.i Using the GPS, the location and extent of the development was plotted as 'waypoints', using longitude and latitude, elevation and distances to provide geographic referenced data. The surrounding area was then surveyed with the GPS and a SILVAii bearing compass to calculate the bearing and distance between the viewpoint and the subject area. This methodology was used to assess where the development is in the landscape and whether it is visible.

The GrimKe Matrix considers two key aspects in terms of understanding visual impact and the resulting visual assessment. The initial assessment is a quasi-objective measurement, where a landscape architect considers the landscape character of the site and particularly in relation of this landscape to the viewpoints that have been selected as part of the assessment criteria. Each viewpoint is then assessed in terms of:

- Relief (the complexity of the land that exists as part of the underlying landscape character)
- Vegetation Cover (the extent to which vegetation is present and its potential to screen and filter views)
- Infrastructure and Built Form (the impact of development on landscape and visual character)
- Cultural and Landscape Value (quantification of recognised planning overlays)

Assessing each viewpoint and the regional context (cultural and landscape value) a quantified value is generated for landscape character. This value then forms the baseline assessment value, which will be modified by the impact of the development within the landscape, which in turn will be measured as part of the visual assessment.

This two-tiered assessment methodology ensures the degree of visual impact is assessed against a quantified landscape character value enabling, the GrimKe Matrix to accurately quantify the degree of visual impact that is experienced as a result of implementing the development.

The assessment considers the landscape as three distinct zones based on the distance from the proposed development. The three zones were defined as; local (0-1km), sub-regional (1-5km) and regional (5-30km). (Planning South Australia, 2002). Specific landscape characters are also identified to provide a complete assessment of the landscape context.

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[1] *Daniel, T C & Vining, J (1980) p49*

1. Landscape Character Assessment

1.1 Relief

This is an assessment of the landscape complexity in terms of the underlying topography. The relationship of relief assists in defining the landscape and the visual character of an area. This is relevant in terms of the position and elevation of a proposed development within the landscape and the viewpoint.

The topography is assessed both on site (from each viewpoint) and as part of a desktop review (topography mapping). The assessment considers the topographical complexity in terms of local, sub-regional and regional. Within each zone an assessment is made of the topography and the complexity of landscape features.

The assessment is concerned with landscape complexity and how it impacts on the visual character. The assessment considers landform patterns, dominant elements and other distinguishing topographical features that will impact on the visual context.

Relief (expressed as percentage)	Value	Description of Landscape Relief
80-100%	5	Substantial landscape relief. The landscape possesses significant topographic variations, features and prominent elements creating a dynamic landscape context.
60-79%	4	Increasing relief. Due to the scale of the topography and frequency of features.
40-59%	3	Moderate relief. Medium level of change to the landscape. Occasional landscape features and topographic variation.
20-39%	2	Limited relief. Small amount of topographic variation in the landscape.
0-19%	1	No or minor relief within the landscape. The landscape is considered feature less, without noticeable elements or patterns.

1.2 Vegetation Coverage

Vegetation coverage is a measurement of the extent, character and frequency of vegetation that exists at each viewpoint and within the local, sub-regional and regional zones. The extent of vegetation provides the potential for screening and to reduce the visual effect of development. Conversely, a lack of vegetation results in an increase in the visual significance of a development.

This measurement responds to the potential visual absorption of the landscape as measured by the visual matrix. Again, this assessment considers the dominant vegetation patterns within each zone and in relation to each viewpoint.

Vegetation Coverage (expressed as percentage)	Value	Description of Vegetation Coverage
80-100%	5	Natural or non-harvested commercial forests. Significant areas of treed vegetation creating an arboreal landscape.
60-79%	4	Bushland or woodlands. Major areas of vegetation that define the landscape character of an area
40-59%	3	Tree groups, copse, screens, shelter belts. Defined areas of vegetation creating a layered landscape character.
20-39%	2	Sporadic trees producing a punctuated vegetation character.
0-19%	1	No trees scrub or low ground cover. Limited vegetation cover.

1.3 Infrastructure and Built Form

This assessment considers the interrelationship of landscape character and human development. The assessment considers how development and infrastructure can create a counterpoint to the existing landscape character (vegetation and topography). Alternatively, development within the landscape may assist with the assimilation of development.

Infrastructure and Built Form (expressed as percentage)	Value	Description of Infrastructure and Built Form
0-19%	5	No objects within the landscape. The landscape has a high natural or remote rural character.
20-39%	4	Isolated objects in the landscape. Single elements with limited visual impact on the landscape. Small farm building, telephone towers or houses.
40-59%	3	Small clusters of development. Increasing presence of development within the landscape.
60-79%	2	Medium scale linear infrastructure or development. More significant development within the landscape. Minor roads, culverts, warehouses, transmission lines and residential areas.

80-100%	1	Large scale infrastructure. The landscape is significantly affected by development. Freeways, power stations and opencast mining

1.4 Cultural Sensitivity Value

The cultural and landscape value assessment is a survey of the regional area around the development up to 20 kilometres. The measurement considers the recognised cultural, heritage, natural and social overlays that exist within the landscape. This assessment is predominantly a desktop survey and only measures recognised designations.

The measurement is then represented as a percentage based of the area of designation compare to the area occupied by the regional zone.

The landscape value is the aggregate value from each of the assessment criteria. Either, as a value for each viewpoint or as a baseline value for the landscape surrounding the development. This Landscape Value in then used to assess the percentage of visual change created by the introduction of development within the landscape.

Cultural and Landscape (expressed as percentage)	Value	Description of Cultural and Landscape Value
80-100%	5	Majority of regional zone is affected by planning designations or overlays. Highly valued culture, natural and social landscape.
60-79%	4	Planning designations impacts a significant area of the regional zone. Valued culture, natural and social landscape
40-59%	3	Moderate impact from planning designations. Valued community or social landscape
20-39%	2	Limited effect
0-19%	1	None to negligible effect of planning designations

1.5 Landscape Character Assessment

The aggregate of relief, vegetation, infrastructure and cultural sensitivity values determines the base line landscape character value. The following table summarises the definition of Landscape Character Values

Landscape Character Value	Value	Description of Landscape Relief
16-20	High	Landscape quality is of high value with significant areas of scenic quality provided by varied

		topography, large areas of natural beauty and obvious presence of cultural sensitivity to change.
12-16	Moderate to increasing	Moderate to increasing landscape character value experienced through a layered landscape of natural qualities, scenic beauty and cultural sensitivity.
8-12	Moderate	Moderate landscape character value experienced by small clusters of natural landscape and cultural sensitivity.
4-8	Limited	Limited landscape character value experienced. The landscape is monotonous with little visual interest through topography or vegetation and heavily modified.

2. Visual Assessment

Each viewpoint was then assessed with respect to the following aspects of visual effect

- Percent of landscape absorption (the landscape's ability to absorb and screen the development form).
- Horizontal visual effect (percentage spread of the development in the field of view).
- Vertical visual effect (height of the development as a percentage of the field of view).
- Distance of visual effect (distance between viewpoint and development).

Using the following GRIMKE matrix formula, the development was quantified and aggregated to provide an assessment of the visual effect for each viewpoint.

2.1 Percent of Visual Absorption (PVA)

This is an assessment of the landscape's ability to absorb or screen the visual effect. Due to the comprehension of the landscape and wind farm development being holistic, the area that is visually affected includes the space between the turbines.

Using photomontages of the proposed development and Adobe Photoshop™ the amount to which the landscape screens the development is described as a percent of pixel absorption. Foreground contrasting pixels are selected within the vertical and horizontal extents of the development (area A), figure 6. This area is divided by the total area occupied by the development within the active field of view (area B) and expressed as a percentage of visual absorption. The assessment takes into consideration, visual sky lining and screening from existing vegetation and other physical forms.



Figure 1 Photo with wire line model draped on top. Courtesy Wind Farm Developments (2004)

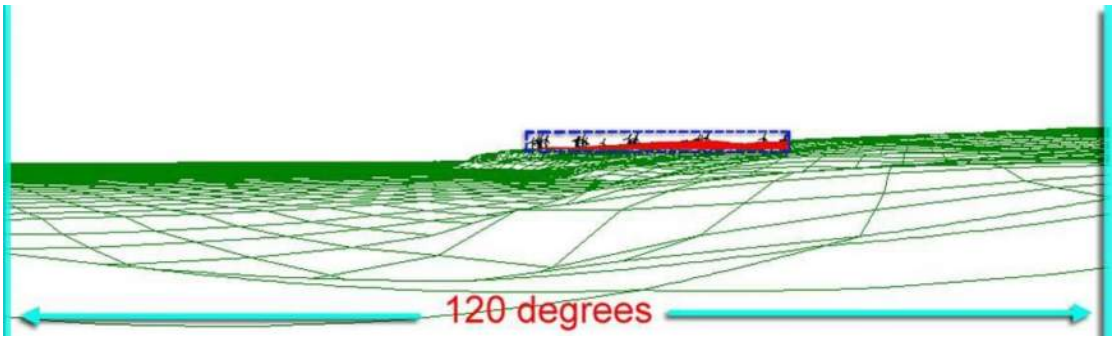


Figure 2 Wire line of showing extent of photomontage. Adapted from Wind Farm Development (2004)

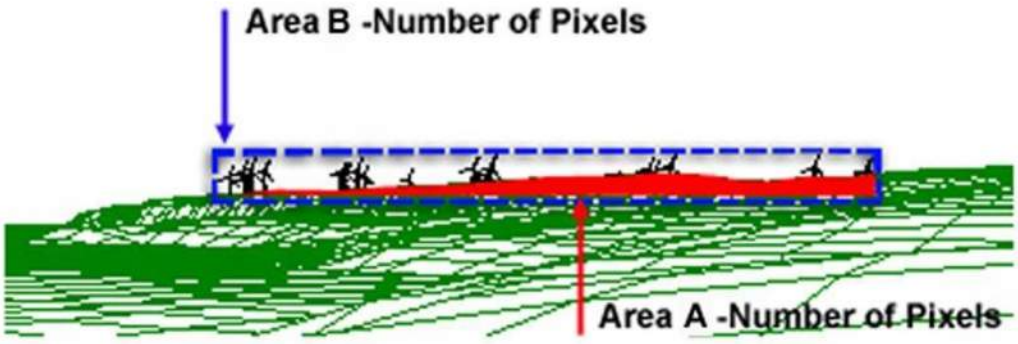


Figure 3 Detailed view of the landscape absorption (area A) and development extents (area B).

Adapted from Wind Farm Development (2004)

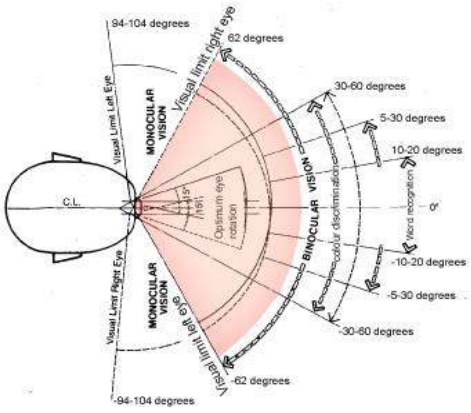
Percent of Visual Absorption (expressed as percentage of change)	Value	Description of Visual Absorption

80-100%	1	Substantial landscape absorption capacity. The landscape possesses sufficient vegetation and topography to screen any effect of the development, maintaining the visual character.
60-79%	2	Increasing absorption capacity. Due to the scale of the topography and density of vegetation the landscape is able to screen the development.
40-59%	3	Moderate absorption capacity. Medium level of change to the landscape. The landscape is less able to absorb change due to the scale, distance and extent of the development.
20-39%	4	Limited absorption. The development is noticeable within the landscape; however through vegetation and topography the landscape fragments and filters views of the development.
0-19%	5	No or minor absorption within the landscape. The development is considered to be prominent within the visual landscape.

2.3 Horizontal Visual Effect (HVE)

The field of vision (FOV) experienced by the human eye is described as an angle of 200-208 degrees horizontallyiii. This field of view includes the peripheral (monocular) vision, which is described as 40 degrees to each eye; within this zone colour and depth of field are not registered. For the purposes of the assessment the angle of peripheral vision has been subtracted from the field of view producing a binocular, 'active field of view' of 120 degrees.

Using this fixed visual reference, an assessment of the possible impact of development within this measurable area is undertaken. The centre of the development is established and an angle of 60 degrees each side is defined. The overall assessment is made of the entire development, rather than of the individual objects that may form the proposal. The angle is measured using a GPS and a bearing compass with known waypoints (geographic coordinates). Using GPS the extent of the horizontal visual field is calculated by the difference in bearing between the widest waypoints from a particular viewpoint. This measurement of effect is then described as a percentage of the 120 degrees active field of



VISUAL FIELD IN HORIZONTAL PLANE

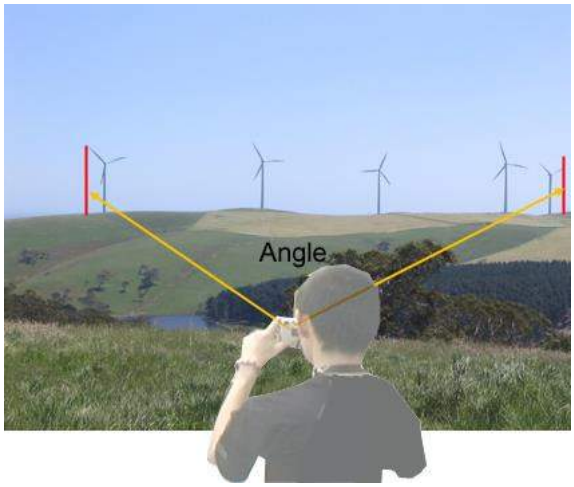


Figure 4 Active field of view is defined as the binocular field equating to 120-124 degreesiv. On the right is an illustration of horizontal measured angle as percent of active field 120 degrees. Photo Brett Grimm

Degree of Horizontal Visual Impact (expressed as an angle of impact and percentage of change)	Value	Description of Visual Modification
80-100% of the panorama measure at 120˚FOV)	5	Substantial horizontal visual impact. Visual impact throughout the entire active field of view.
60-80% of the panorama measure at 120˚FOV)	4	Increasing visual effect. A large proportion of the active field of view is affected.
40-60% of the panorama Measure at 120˚FOV	3	Moderate visual effect.
20-40% of the panorama measure at 120˚FOV)	2	Limited effect. The visual impact is a small part of the active field of view.
0-20% of the panorama measure at 120˚FOV)	1	No or minor visual effect.

2.4 Vertical Visual Effect (VVE)

The vertical visual effect evaluates the proportional scale of the development with reference to the vertical character of the existing landscape, as seen within the field of view of the assessed viewpoints.

The process of assessment is undertaken in 3 stages:

Stage 1:

The first stage of the process is to determine the vertical scale of the existing landscape. The baseline landscape scale is calculated using the photomontage viewpoint elevation (A) as a known reference height. The elevation of the viewpoint is recorded using a GPS. Using contour data, a second value (B) is recorded representing the highest topographic elevation within the field of view. Finally, the horizontal distance (C) between the viewpoint and the highest topographic feature is recorded. The vertical angle of view α_1 is then given as:

$\alpha_1 = \tan^{-1}((B-A)/C)$

as shown in Figure 6 below.

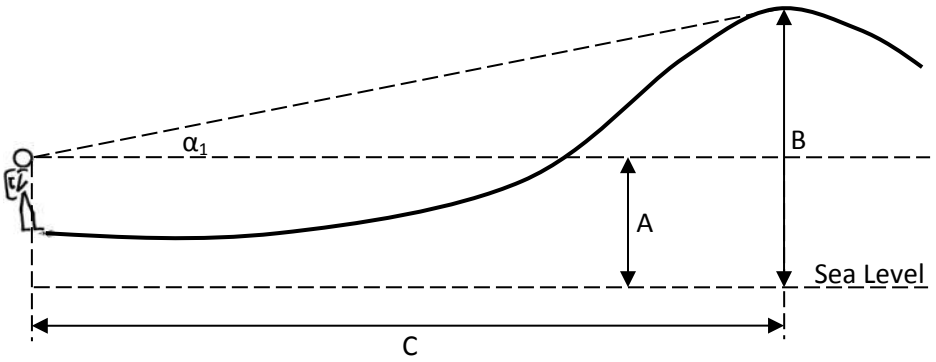


Figure 6: Vertical Scale of Existing Landscape

Stage 2:

The second stage of the process is to determine the vertical scale of the landscape modification, namely that of the apparent maximum turbine tip height as viewed from the viewpoint. Using the known turbine height (E), ground elevation (F) and its distance from the viewpoint (G), the vertical angle of view α_2 is then given by:

$\alpha_2 = \tan^{-1}((E+F - A)/G)$

as shown in Figure 7 below.

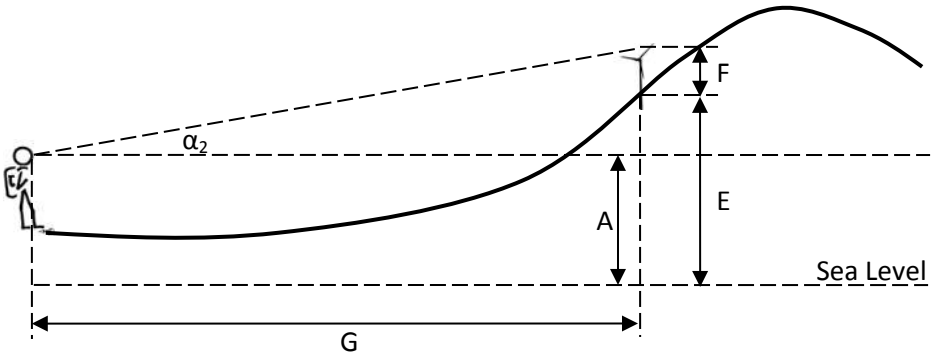


Figure 7: Vertical Scale of Landscape Modification

Stage 3:

The final stage of the process is to determine the overall proportion of the vertical scale of the development with reference to the existing landscape scale by taking the ratio of the two angles α_2 and α_1. Depending on the relative size of the vertical angles of view occupied by the existing and modified landscapes respectively, the ratio α_2 / α_1 will determine the nature and scale of the visual impact.

Depending on the relative scale of the angle of view occupied by the landscape and/or the development, the two vertical angles will depict whether there will be an increase in vertical visual impact created by the development ($\alpha_2 / \alpha_1 > 1$) or conversely the visual effect will be experienced as a vertical visual effect relative to the existing landscape scale ($\alpha_2 / \alpha_1 < 1$).

The vertical visual effect assessment will result in one of the following conditions:

- an increase in the overall vertical visual effect experienced from the viewpoint as a result of the combined vertical visual effect of the existing landscape character and the proposed development, or;

- a limited vertical visual effect as a result of the scale of the development being less than the existing landscape vertical scale when assessed from a viewpoint. This may be created by backdrop landforms or large ravines, valleys depicting a scale that within the field of view is greater than the development.

Either, the turbines or parts of the turbines are seen above ridgelines or landforms within the field of view and the effect will result in an increase in vertical visual effect, or the viewpoint contains large escarpments or deep valleys within the field of view and the vertical scale of the proposed wind turbines are likely to be seen as a proportion of the existing landscape scale resulting in a limited vertical visual effect.

In the first case (i.e. where $\alpha_2 / \alpha_1 > 1$), the proportional vertical visual impact should be assessed using Table 1 below. In the second case, the proportional vertical visual impact is considered minor and is assigned a value of 1.

Table 1 Proportional Vertical Visual Effect in existing landscape scale ($\alpha_2 / \alpha_1 > 1$)

Vertical Visual Impact (expressed as percentage increase (α_2 / α_1 - 1) x 100)	Value	Description of Visual Modification
80-100%	5	Substantial visual impact.
60-80%	4	Increasing visual impact
40-60%	3	Moderate visual impact.
20-40%	2	Limited impact
0-20%	1	No or minor visual impact within the landscape.

2.5 Distance of Visual Effect

This is a measurement of how visual impact is modified by distance. The effect of scale, topography, vegetation and weather, changes with distance, and in turn changes the degree of visual effect. The distance to the development from each viewpoint is recorded using the GPS. Standing onsite at each viewpoint the exact distance can be calculated by selecting the closest waypoint function (all the turbine locations are stored as waypoints in the GPS).

The distance categories outlined in the table below have been based on empirical research University of Newcastle (2002), Sinclair (2001), Bishop (2002).

Location of Development (from viewpoint)v	Value	Description
0 to 4 km (80-100%)	5	Adjacent: Dominant impact due to large scale, movement, proximity and number
4 to 8 km (60-80%)	4	Foreground: Major impact due to proximity: capable of dominating landscape
8 to 13 km (40-60%)	3	Middle ground: Clearly visible with moderate impact: potentially intrusive
13 to 18 km (20-40%)	2	Distant middle ground: Clearly visible with moderate impact becoming less distinct
18 km and greater (0-20%)	1	Background: Less distinct: size much reduced

2.6 Landscape Absorption Assessment

The aggregate of landscape absorption, horizontal and vertical effects and distance values determines the base visual impact value form the viewpoint. The following table summarises the definition of Visual Impact values

Visual Impact Value	Value	Description of Landscape Relief
16-20	High	High visual impact within the field of view
12-16	Moderate to increasing	Moderate to increasing visual impact within the field of view
8-12	Moderate	Moderate visual impact within the field of view
5-8	Limited	Limited visual impact within the field of view

3. Degree of Visual Impact (Percentage of Visual Change)

Degree of Visual Impact

The degree of Visual Impact is expressed as a coefficient of visual change to the baseline Landscape Value (general or viewpoint specific). This calculation directly expresses the effect of the development on the landscape, the change to the visual character and the reciprocal visual impact.

- Baseline Landscape Character : express as a value between 4 and 20)
- Coefficient of Visual Impact : calculated as the 20 divided by visual assessment value

Calculation of degree of Visual Impact

Coefficient x landscape character value expressed as a percentage = Visual Impact on Landscape Character

Example:

(a) Visual Impact Assessment

Horizontal visual effect	3
Vertical visual effect	1
Absorption capacity	3
Distance	2
Total visual effect	9 (0.45)

*9/20 equated to a coefficient of **0.45***

(b) Landscape Character Assessment

Relief	3
Vegetation coverage	3
Infrastructure built form	2
Cultural landscape overlays	2
Total landscape character	10

(c) 10 x 0.45 = 4.5

(d) 4.5/20 = 0.225

(e) 0.225 x 100 = 22.5% Visual Change to the Landscape

3.1 Final Aggregated Visual Effect

Percentage Value of Visual Change	Descriptive Qualification of Visual Effect	Comments
80-100%	Extreme	Extreme change in view: change very prominent involving total obstruction of existing view or change in character and composition of view through loss of key elements or addition of new or uncharacteristic elements which significantly alter underlying landscape visual character and amenity
60-80%	Severe	Severe change in view involving the obstruction of existing views or alteration to character through the introduction of new elements. Change may be different in scale and character from the surroundings and the wider setting. Resulting in a perceived increase in proportional change to the underlying landscape visual character.
40-60%	Substantial	Substantial change in view: which may involve partial obstruction of existing view or alteration of character and composition through the introduction of new elements. Composition of the view will alter. View character may be partially changed through the introduction of features.
20-40%	Moderate	Moderate change in view: change will be distinguishable from the surroundings whilst composition and underlying landscape visual character will be retained.
0-20%	Slight	Very slight change in view: change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.

Appendix F
Glossary

Active Field of View:	The field of view excluding peripheral vision, which is described as 40° to each eye, within this zone colour, shapes and forms are not registered. The active field of view removes the angle of peripheral vision from the field of view producing an angle of 120 - 160°
Assessment (landscape):	An umbrella term for description, classification and analysis of landscape.
Depth of Field:	The distance between the nearest point (viewpoint) and farthest objects (visual envelope) which is visible within the field of view.
Element:	A component part of the landscape or visual composition.
Effect (landscape or visual):	These occur as a broad culmination of one or more impacts, incorporating professional judgement to extrapolate and/or generalise on the nature of these.
Horizontal Visual Effect:	This term is used to describe the field of view occupied by the visible part of a wind farm.
Impact (landscape or visual):	Impacts occur to a particular element of the environment and they can be described factually by the nature and degree of change.
Landscape:	Human perception of the land conditioned by knowledge and identity with a place.
Landscape character:	The distinct and recognizable pattern of elements that occurs consistently in a particular type of landscape, and how people perceive this. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape.
Landscape feature:	A prominent eye-catching element, for example, wooded hilltop, isolated trees or grain silo.
Mitigation:	Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual impacts of a development project.
Panorama:	A view, covering a wide field of view.
Photomontage:	A visualisation based on the superimposition of an image onto a photograph for the purpose of creating a realistic representation of proposed or potential changes to a view. These are now mainly generated using computer software.
Sensitivity:	The extent to which a landscape or visual composition can accommodate of a particular type and scale without adverse effects on its character or value.
Visual Amenity:	The value of a particular area or view in terms of what is seen.
Visual Envelope:	Extent of potential visibility to or from a specific area, viewpoint or feature.

Appendix G
Endnotes

[i] The GPS used was a Garmin X12 which differential-ready 12 parallel channel receiver continuously tracks and uses up to twelve satellites to compute and update a position

[ii] The SILVA precision M80 with a parallax free prismatic magnification-bearing compass. A magnetic bearing compass with a ± 0.5˚ from true magnetic course.

[iii] Pirenne, M.H. (1967). Vision and the Eye. London: Chapman and Hall

[iv] Panero, J. & Zelnik, M. (1979) Human Dimension & Interior Space- A source Book of Design Reference Standards. The Architectural Press Ltd. London.

[v] The distance zones have been developed Sinclair Thomas Matrix, which has cited field observations of the visual extents. The classification zones have been based on projected 90-100m high turbines.

Palmer Wind Farm

Variation Application

Noise Impact Assessment

S4171C28

January 2024

sonus.

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1 INTRODUCTION

A noise impact assessment has been made for the varied Palmer Wind Farm Project (the **Varied Project**), located approximately 50km east of the Adelaide CBD. This assessment has considered the changes proposed in the Varied Project, primarily consisting of reducing the maximum number of wind turbines, increasing the maximum blade tip height, and optimising the location of civil and electrical components.

Noise criteria have been determined in accordance with the *Wind farms environmental noise guidelines (2021)* (the **Guidelines**). The criteria have been based on an analysis of contemporary and previous background noise measurements, with updates to the previous data to match the new hub height. Noise predictions have been conducted based on an indicative modern wind turbine and using the ISO 9613-2 noise propagation model. The predicted noise levels have been compared against the relevant criteria.

2 WIND FARM LAYOUT

The Varied Project will consist of 40 turbines, located as per the coordinates shown in Table 1. In addition, two substations will be located within the site area at the locations shown in Table 2.

Table 1: Turbine Coordinates

Turbine ID	Coordinates (UTM WGS84 54H)		Turbine ID	Coordinates (UTM WGS84 54H)	
	Easting	Northing		Easting	Northing
B10	328371	6146323	C03	327886	6141749
B13	329076	6144812	C04	327470	6140983
B18	327281	6144620	C05	328210	6140753
B51	331075	6144785	C06	327248	6140207
B22	329990	6144490	C08	328402	6140003
B25	328249	6144708	C09	324882	6140394
B29	327856	6144118	C10	326329	6141130
B40	330278	6147338	C13	326723	6139400
B41	329652	6147038	C14	326372	6140001
B42	328632	6147073	C15	325693	6140150
B46	330236	6146644	C17	328283	6139216
B47	329051	6146448	C21	330260	6134979
B45	327961	6146882	C24	329016	6137522
B52	329710	6146010	C26	329697	6137351
B55	326563	6144283	C27	330351	6137432
B56	329175	6145555	C29	328361	6137301
B58	328114	6145472	C30	329173	6136816
B60	330782	6145407	C32	330679	6136439
B62	329846	6145151	C34	329772	6135976
C01	327578	6143169	C38	329459	6135129

Table 2: Substation Coordinates

Substation Location	Coordinates (UTM WGS84 54H)	
	Easting	Northing
Northern Substation	329180	6145276
Southern Substation	327159	6139527

3 OPERATIONAL NOISE CRITERIA

As per the Guidelines, the operational noise from the wind farm must not exceed the following noise criteria for non-associated residences:

- 35 dB(A) at relevant receivers in localities which are primarily intended for rural living.

OR

- 40 dB(A) at relevant receivers in localities in other zones.

OR

- The background noise ($L_{A90,10}$) by more than 5 dB(A).

Whichever is the greater.

Reference is made to the zones in which the relevant receivers are located, which are provided in the South Australian Planning and Design Code (the **Code**). A full list of the nearby residences can be seen in Appendix A along with the zones they are located in, as per the Code. Zones primarily intended for rural living have also been noted in Appendix A.

An associated residence is considered to be a residence that is located within the site boundary of the wind farm and where there is an agreement in place between the landowner and the wind farm developer[1]. For these residences, the operational noise must not exceed:

- An internal level at night of no more than 30 dB(A) to prevent sleep disturbance.

AND

- An external level during the day of no more than 5 dB less than the relevant indicative noise level[2] for the zone the residence is in.

OR

- The background noise ($L_{A90,10}$) by more than 5 dB(A).

[1] The residences that are indicated as associated for the purposes of this report may differ from other technical assessments completed for the Varied Project, which reflects the fact that landowners around the wind farm may have entered into agreements with the wind farm developer acknowledging impacts from the Project for other related reasons (excluding noise).

[2] The indicative noise levels are those in Table 2 of the *Environment Protection (Commercial and Industrial Noise) Policy 2023*.

Based on typical building constructions, an external noise level of 45 dB(A) is expected to result in an internal noise level of 30 dB(A) with windows open. Therefore, an external noise level of 45 dB(A) at night will be adopted for all associated residences. The associated residences are all located within a Rural Zone of the Code, which will result in an external day time noise limit of 52 dB(A) (57 – 5). It is noted that these criteria may be increased where the background noise levels are high.

4 BACKGROUND NOISE MONITORING

Background noise monitoring has previously been conducted at a number of locations in the vicinity of the wind farm for the purpose of determining criteria. The results of this monitoring were summarised in the Sonus report with reference "S4171C12", dated August 2014.

Contemporary background noise measurements have recently been taken between September and November 2023 to determine any changes in the background noise environment since the original noise monitoring regime. Background noise measurements were taken at four sites, located in different directions from the wind farm, three of which are locations where noise measurements were previously taken. The background monitoring equipment was placed as close as practicable to the locations previously used. It was however noted that since the original background noise monitoring was conducted, additional trees were planted at R051, requiring the noise equipment to be placed in an alternate location, approximately 15m to the southwest. The fourth location was identified after the initial background noise measurements were conducted and is relatively close to the Varied Project. The locations where noise measurements were taken can be seen in Table 3 and visually in Figure 1. Photographs of the noise monitoring equipment at each location have been included in Appendix B.

Table 3: Background Measurement Locations

Measurement Location	Associated (YES/NO)	Coordinates (UTM WGS84 54H)	
		Easting	Northing
A77	NO	331795	6145539
R022	YES	328855	6143322
R042	NO	329047	6149504
R051	YES	325216	6138824

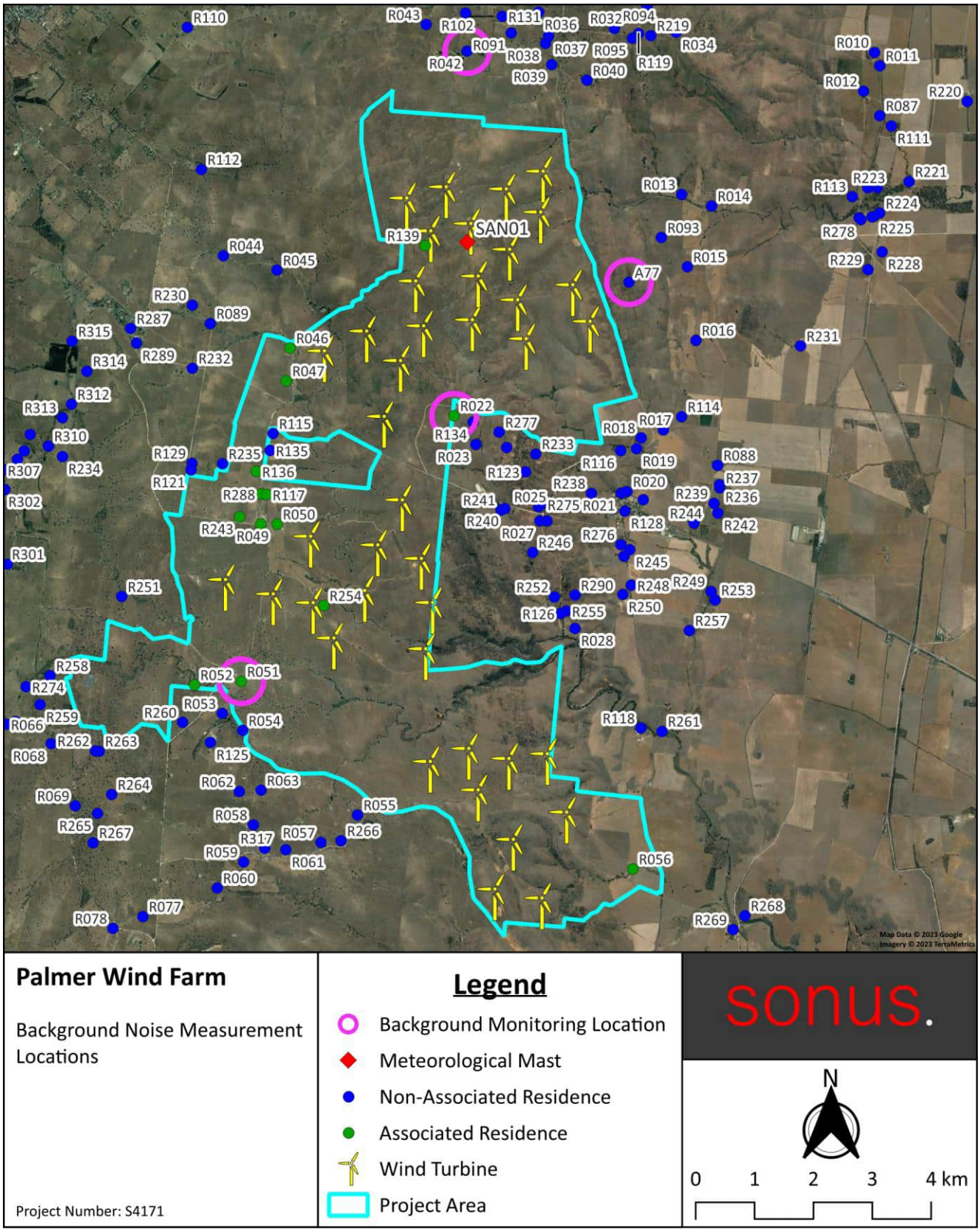


Figure 1: Background Noise Monitoring Locations

4.1 Equipment

The background noise was measured in 10-minute intervals using a combination of Rion Class 1 and Class 2 sound level meters with a noise floor of less than 20 dB(A), calibrated at the beginning and the end of the period with a Rion calibrator, with no significant drift observed. The microphones were positioned approximately 1.5m above ground level and fitted with Rion WS-15 double layer all weather windshields. An example of a typical on-site setup is shown in Figure 2. Care was taken to ensure that the sound of the anemometer spinning was not audible at the noise logger location.

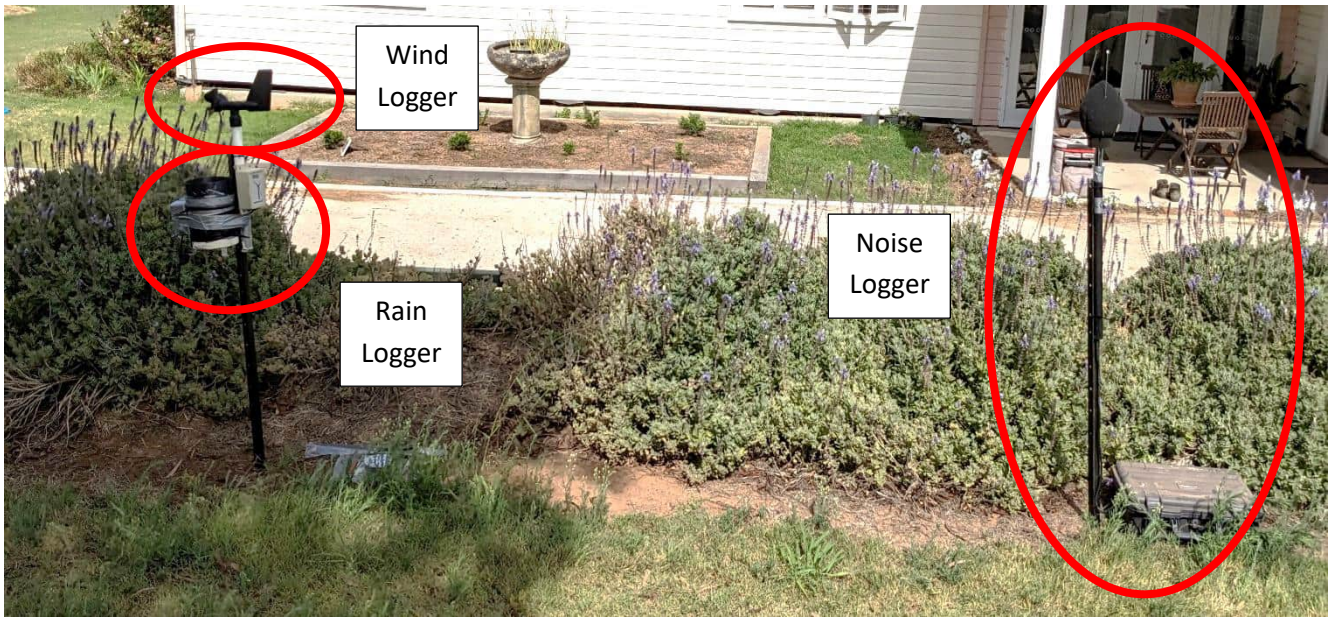


Figure 2: Typical Background Noise Monitoring Setup

4.2 Hub Height Wind Speed

During the background noise monitoring regime, the wind speed was measured in 10-minute intervals at one location on the wind farm site. The location of the wind speed measurement equipment has been provided in Table 4 and illustrated in Figure 1. It is noted that this location is consistent with that used for the previous background noise monitoring regime. The wind data were sheared to a hub height of 130m before being provided to Sonus.

Table 4: Wind Measurement Location

Measurement Location	Coordinates (UTM WGS84 54H)	
	Easting	Northing
SAN01	329066	6146262

4.3 Data Analysis

During the background monitoring period, local wind and rain at the microphone location (approximately 1.5m above ground level) were measured using "Rainwise" wind and rain loggers positioned at various locations around the wind farm site, as summarised in Table 5.

Table 5: Local Weather Measurement Locations

Measurement Location	Equipment Type	Coordinates (UTM WGS84 54H)	
		Easting	Northing
R042	Wind & Rain	329074	6149447
R051	Wind & Rain	325241	6138840

The rainfall and windspeed data were used to determine the periods when local weather may have affected the background noise measurements. Data were excluded when rainfall was measured in a period or the periods either side of the period in question, and/or when the measured wind speed at the microphone height exceeded 5m/s for more than 90% of the measurement period. For locations where local weather was not measured, the conditions at the nearest local weather monitoring location have been taken as representative.

Any data for wind speeds below the cut in wind speed and above the rated power of the turbine were also removed. As the final turbine model has not yet been selected, this has been based on a representative modern turbine, the Vestas V172-7.2MW. As such, any data for a wind speed less than 3m/s or greater than 13m/s has been removed. In addition, data points where equipment was being set up or collected have also been removed.

Following the data removal procedures, the following number of data points remained for each of the monitoring locations, as shown in Table 6.

Table 6: Valid Data Points at Monitoring Locations

Measurement Location	Total points	Valid Points	Downwind Points
A77	6000	5147	2015
R022	6000	5176	1959
R042	6000	5153	2512
R051	6000	5143	887

4.4 Background Noise Correlation

The background noise data collected at each monitoring location were correlated with the measured wind speed referenced to a hub height of 130m for each 10-minute period.

The correlated noise data were then split into wind speed bins as required by the Guidelines. Each wind speed bin is 1m/s wide and is centred on the integer wind speeds between cut in and rated power. The arithmetic average noise level for each wind speed bin was then determined to give the background noise level at each integer wind speed. The data and the resultant average noise levels are shown on the figures in Appendix C. Representative criteria have been provided on these figures for a baseline criterion of 40 dB(A).

Table 7 summarises the background noise level for each integer wind speed at a hub height of 130m between 3m/s and 13m/s.

Table 7: Measured Background Noise Levels ($L_{A90,15min}$), dB(A)

Measurement Location	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
A77	21	22	24	25	29	31	34	36	39	38	41
R022	26	26	27	27	27	29	30	31	35	36	39
R042	31	31	32	31	31	33	33	34	37	38	41
R051	34	32	33	31	31	33	33	33	34	35	38

4.5 Previous Background Noise Measurements

The background noise levels previously calculated for the Approved Project were determined in accordance with the previous version of the Guidelines for a hub height of 91.5m. In order to facilitate a comparison with the current background noise measurements, the previous noise data have been re-correlated to the current hub height of 130m and the assessment methodology updated to the bin analysis now required by the Guidelines. Based on this re-assessment, the background noise levels for the previous monitoring period can be seen in Table 8. The data and the resultant average noise levels are shown on the figures in Appendix D. Representative criteria have been provided on these figures for a baseline criterion of 40 dB(A).

Table 8: Re-Correlated Background Noise Levels ($L_{A90,15min}$), dB(A)

Measurement Location	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R003	22	21	23	24	25	25	26	27	27	27	27
R014	24	24	25	26	27	28	28	29	29	30	31
R022	31	30	31	31	32	34	33	33	34	36	38
R024	25	25	27	27	29	30	31	32	33	36	38
R028	25	24	26	26	26	27	26	26	26	27	28
R032	28	27	28	28	30	31	32	33	35	36	37
R034	23	24	25	24	26	28	30	31	34	36	37
R042	32	32	32	31	32	34	33	34	36	38	40
R043	25	24	27	28	30	32	33	34	36	38	37
R045	28	29	28	28	29	30	31	31	31	31	33
R051	27	27	28	27	29	30	30	30	32	34	35
R055	25	26	27	29	29	30	30	31	31	33	33
R090	29	29	29	30	31	33	34	35	38	40	39
R091	26	25	25	26	27	28	29	29	31	33	32
R094	25	26	26	25	27	28	29	29	30	31	33
R100	25	25	26	27	28	29	31	32	32	33	31
R116	29	29	29	28	28	30	30	30	31	33	33
R119	27	28	30	29	31	32	34	35	38	39	41

4.6 Resultant Noise Criteria

The resultant noise criteria determined in accordance with the Guidelines and based upon the background noise levels can be seen in Table 9 for the original monitoring regime and Table 10 for the contemporary monitoring regime. It is noted that the background noise levels measured at these residences may be used at other locations nearby. Therefore, to assist in facilitating a comparison of the noise criteria, the criteria have been determined as if all of the locations are non-associated residences.

Table 9: Original Monitoring Regime Noise Criteria, dB(A)

Measurement Location	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R003	35	35	35	35	35	35	35	35	35	35	35
R014	40	40	40	40	40	40	40	40	40	40	40
R022	40	40	40	40	40	40	40	40	40	41	43
R024	40	40	40	40	40	40	40	40	40	41	43
R028	40	40	40	40	40	40	40	40	40	40	40
R032	40	40	40	40	40	40	40	40	40	41	42
R034	40	40	40	40	40	40	40	40	40	41	42
R042	40	40	40	40	40	40	40	40	41	43	45
R043	40	40	40	40	40	40	40	40	41	43	42
R045	40	40	40	40	40	40	40	40	40	40	40
R051	40	40	40	40	40	40	40	40	40	40	40
R055	40	40	40	40	40	40	40	40	40	40	40
R090	40	40	40	40	40	40	40	40	43	45	44
R091	40	40	40	40	40	40	40	40	40	40	40
R094	40	40	40	40	40	40	40	40	40	40	40
R100	35	35	35	35	35	35	36	37	37	38	36
R116	40	40	40	40	40	40	40	40	40	40	40
R119	40	40	40	40	40	40	40	40	43	44	46

Table 10: Contemporary Monitoring Regime Noise Criteria, dB(A)

Measurement Location	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
A77	40	40	40	40	40	40	40	41	44	43	46
R022	40	40	40	40	40	40	40	40	40	41	44
R042	40	40	40	40	40	40	40	40	42	43	46
R051	40	40	40	40	40	40	40	40	40	40	43

4.7 Noise Criteria Comparison

The noise criteria resulting from the two monitoring regimes have been compared. Table 11 shows the change from the original monitoring regime to the contemporary monitoring regime. A positive number represents an increase in criteria.

Table 11: Difference Between Original and Contemporary Background Monitoring Regimes, dB(A)

Measurement Location	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R022	0	0	0	0	0	0	0	0	0	0	1
R042	0	0	0	0	0	0	0	0	1	0	1
R051	0	0	0	0	0	0	0	0	0	0	3

The results shown above indicate that there is no significant change in the criteria between the two monitoring regimes. As such, further contemporary background measurements are not considered to be required. It is therefore proposed that the criteria from the original noise monitoring regime be utilised except for where contemporary background noise measurements have been conducted. The consolidated criteria can be seen in Appendix E.

5 ASSESSMENT

As the proposed turbine is not yet known for the Varied Project, predictions have been made using an indicative modern turbine, the Vestas V172-7.2MW, based on the proposed 40 turbine layout. The sound power levels for this turbine can be seen in the below table.

Table 12: Vestas V172-7.2MW WTG Sound Power Levels, dB(A)

Sound Power Level (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height (130m) Wind Speed (m/s)										
	3	4	5	6	7	8	9	10	11	12	13
6.3 Hz	22.2	21.9	18.7	20.4	24.7	28.4	30	30.5	31.2	32.6	33.1
8 Hz	28.5	28.3	25.5	27.4	31.6	35.3	36.8	37.3	38	39.2	39.6
10 Hz	34.5	34.4	31.9	34.0	38.2	41.8	43.3	43.7	44.4	45.4	45.8
12.5 Hz	40.2	40.1	38.0	40.2	44.3	47.9	49.5	49.8	50.4	51.3	51.6
16 Hz	45.9	45.8	44.1	46.0	50.1	53.7	55.2	55.5	56	56.8	57.1
20 Hz	51.3	51.2	49.8	51.9	55.9	59.1	60.6	60.9	61.3	62	62.2
25 Hz	56.7	56.6	55.5	57.4	61.4	64.5	66	66.2	66.6	67.2	67.4
31.5 Hz	61.6	61.6	60.7	62.8	66.8	69.5	71	71.2	71.5	72	72.2
40 Hz	66.1	66.0	65.4	67.8	71.7	74.5	76	76.1	76.4	76.8	76.9
50 Hz	70.0	70.0	69.6	72.2	76.1	79.0	80.5	80.6	80.8	81.2	81.3
63 Hz	73.4	73.4	73.2	76.1	80.0	83.1	84.5	84.6	84.8	85	85.1
80 Hz	76.2	76.3	76.3	79.4	83.3	86.5	87.9	88	88.1	88.3	88.4
100 Hz	78.5	78.6	78.8	82.2	86.0	89.4	90.8	90.9	91	91.1	91.1
125 Hz	80.3	80.4	80.7	84.4	88.1	91.7	93.1	93.1	93.2	93.3	93.3
160 Hz	81.7	81.7	82.1	86.0	89.7	93.5	94.8	94.9	94.9	95	94.9
200 Hz	82.5	82.6	83.1	87.1	90.8	94.7	96	96	96.1	96.1	96.1
250 Hz	83.4	83.5	84.1	87.7	91.4	95.4	96.7	96.7	96.7	96.7	96.7
315 Hz	83.9	84.0	84.7	88.3	92.0	95.6	96.9	96.9	96.9	96.8	96.8
400 Hz	84.5	84.5	85.3	88.6	92.2	95.7	97.1	97	97	97	96.9
500 Hz	84.7	84.8	85.5	88.8	92.4	95.5	96.8	96.8	96.8	96.7	96.7
630 Hz	84.6	84.7	85.4	88.7	92.2	95.4	96.6	96.6	96.6	96.5	96.5
800 Hz	84.2	84.2	84.9	88.2	91.7	94.8	96.1	96.1	96	96	96
1 kHz	83.4	83.4	84.1	87.3	90.8	93.9	95.1	95.1	95.1	95.1	95.1
1.25 kHz	82.3	82.2	82.9	86.0	89.5	92.6	93.8	93.8	93.8	93.8	93.8
1.6 kHz	80.8	80.8	81.3	84.4	87.9	90.9	92.1	92.1	92.1	92.2	92.2
2 kHz	79.0	78.9	79.4	82.4	85.9	88.9	90.1	90.1	90.1	90.2	90.3
2.5 kHz	76.9	76.8	77.1	80.1	83.5	86.5	87.7	87.7	87.7	87.8	88
3.15 kHz	74.4	74.2	74.4	77.3	80.7	83.7	84.9	84.9	85	85.1	85.3
4 kHz	71.6	71.4	71.4	74.2	77.6	80.6	81.7	81.8	81.9	82.1	82.3
5 kHz	68.5	68.2	68.0	70.7	74.1	77.0	78.2	78.2	78.4	78.7	78.9
6.3 kHz	65.0	64.6	64.3	66.8	70.2	73.1	74.3	74.3	74.5	74.9	75.2
8 kHz	61.1	60.8	60.2	62.6	65.9	68.9	70	70.1	70.3	70.8	71.1
10 kHz	57.0	56.5	55.7	58.0	61.3	64.2	65.3	65.5	65.7	66.3	66.7
12.5 kHz	52.4	52.0	50.9	53.0	56.3	59.2	60.3	60.5	60.8	61.4	61.9
16 kHz	47.6	47.0	45.7	47.7	50.9	53.9	54.9	55.1	55.5	56.2	56.7
Sound Power Level (dB(A))	94.6	94.6	95.2	98.6	102.2	105.6	106.9	106.9	106.9	106.9	106.9

The predictions of noise from the substations have been made based on a transformer rating of 200MVA at each substation. The sound power levels for the transformers have been determined in accordance with the Australian/New Zealand Standard *AS/NZS 60076.10:2009, Power Transformers - Determination of Sound Levels (IEC 60076-10, Ed.1 (2001) MOD)* and can be seen in Table 13.

Table 13: Substation Transformer Sound Power Levels, dB(A)

Transformer rating	Sound Power Level per Octave Band Centre Frequency								Total SWL
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
200 MVA	77.3	85.4	92.9	95.3	87.5	84.7	77.5	73.4	98.2

The predictions of environmental noise from operation of the Wind Turbine Generators (**WTGs**) and substations have been made using the ISO 9613-2[3] noise propagation model as recommended by the Guidelines. The sound propagation model considers the following influences:

- sound power levels and locations of noise sources.
- separation distances between noise sources and receivers.
- topography of the area.
- influence of the absorption provided by the ground.
- air absorption.
- meteorological conditions.

ISO 9613-2 provides a methodology for predicting noise levels under meteorological conditions favourable to noise propagation. It is known as a downwind model, based on the conservative assumption of a residence being downwind (resulting in the highest noise level) of all WTGs simultaneously. To conservatively model the worst-case noise impact at residences, the following model inputs have been used in accordance with the *May 2013 UK IOA Good Practice Guide*, noting that the Guidelines consider these to be acceptable inputs:

- 10°C temperature.
- 70% relative humidity.
- 50% acoustically hard ground and 50% acoustically soft ground.
- barrier attenuation of no greater than 2 dB(A).
- 4m receiver height.
- application of a 3 dB(A) correction where a "concave" ground profile exists as defined by the *May 2013 UK IOA Good Practice Guide*.

[3] *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors*

6 RESULTS

The results of the noise predictions for the operation of the Varied Project, including both the wind farm and substation components, can be seen in Table 14 for all locations where a noise level of higher than 30 dB(A) is predicted. The predicted noise levels for the Varied Project have been compared against the relevant noise criteria. Noise level contours for the Project have been included in Appendix F. The highest predicted noise level for all residences can be seen on the full list in Appendix A.

Table 14: Predicted Noise Levels and Criteria

Residence ID	Associated	3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s		13m/s	
		Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion
A77	NO	30	40	30	40	30	40	34	40	37	40	41	40	42	40	42	41	42	44	42	43	42	46
R013	NO	<25	40	<25	40	<25	40	<25	40	29	40	32	40	33	40	33	40	34	40	34	40	34	40
R014	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R015	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	41	34	44	34	43	34	46
R016	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	41	34	44	34	43	34	46
R017	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	40	34	40	34	40	34	40
R018	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	40	34	40	34	40	34	40
R019	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R020	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R021	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R022	YES	29	45	29	45	29	45	33	45	36	45	40	45	41	45	41	45	41	45	41	45	41	45
R023	NO	26	40	26	40	26	40	30	40	33	40	37	40	38	40	38	40	38	40	38	41	38	43
R024	NO	26	40	26	40	27	40	30	40	34	40	37	40	38	40	38	40	39	40	39	41	39	43
R025	NO	<25	40	<25	40	<25	40	26	40	30	40	34	40	35	40	35	40	35	40	35	41	35	43
R026	NO	<25	40	<25	40	<25	40	27	40	30	40	34	40	35	40	35	40	35	40	35	41	35	43
R027	NO	<25	40	<25	40	<25	40	27	40	31	40	34	40	35	40	35	40	35	40	35	41	35	43
R028	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	35	40	35	40	35	40	35	40	35	40
R030	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	41	31	42
R031	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	41	32	42
R032	NO	<25	40	<25	40	<25	40	<25	40	28	40	32	40	33	40	33	40	33	40	33	41	33	42
R034	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	41	31	42
R036	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
R037	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	32	40	32	40	32	40	32	40	32	40
R038	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R039	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	40	34	40	34	40	34	40
R040	NO	<25	40	<25	40	<25	40	27	40	31	40	34	40	36	40	36	40	36	40	36	41	36	42
R042	NO	<25	40	<25	40	<25	40	<25	40	28	40	32	40	33	40	33	40	33	42	33	43	33	46
R043	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	41	32	43	32	42
R044	NO	<25	40	<25	40	<25	40	<25	40	29	40	32	40	33	40	33	40	33	40	33	40	33	40
R045	NO	<25	40	<25	40	<25	40	28	40	32	40	35	40	37	40	37	40	37	40	37	40	37	40
R046	YES	30	45	30	45	31	45	34	45	38	45	41	45	43	45	43	45	43	45	43	45	43	45
R047	YES	29	45	29	45	29	45	33	45	36	45	40	45	41	45	41	45	41	45	41	45	41	45
R049	YES	28	45	29	45	29	45	32	45	36	45	40	45	41	45	41	45	41	45	41	45	41	45
R050	YES	30	45	30	45	31	45	34	45	38	45	41	45	43	45	43	45	43	45	43	45	43	45
R051	YES	26	45	26	45	26	45	30	45	33	45	37	45	38	45	38	45	38	45	38	45	38	45

Residence ID	Associated	3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s		13m/s	
		Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion
R052	YES	<25	45	<25	45	<25	45	27	45	30	45	34	45	35	45	35	45	35	45	35	45	35	45
R053	NO	<25	40	<25	40	<25	40	27	40	30	40	34	40	35	40	35	40	35	40	35	40	35	43
R054	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	35	40	35	40	35	40	35	40	35	43
R055	NO	<25	40	<25	40	25	40	29	40	32	40	36	40	37	40	37	40	37	40	37	40	37	40
R056	YES	<25	45	<25	45	<25	45	27	45	31	45	35	45	36	45	36	45	36	45	36	45	36	45
R057	NO	<25	40	<25	40	<25	40	26	40	29	40	33	40	34	40	34	40	34	40	34	40	34	40
R058	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
R059	NO	<25	40	<25	40	<25	40	<25	40	26	40	29	40	31	40	31	40	31	40	31	40	31	40
R061	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	32	40	32	40	33	40	33	40	33	40
R062	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	43
R063	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	33	40	34	40	34	40	34	40	34	40
R088	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R089	NO	<25	40	<25	40	<25	40	<25	40	28	40	32	40	33	40	33	40	33	40	33	40	33	40
R090	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	43	31	45	31	44
R091	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R093	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	34	40	34	41	34	44	34	43	34	46
R095	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	43	32	44	32	46
R102	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	43	32	45	32	44
R112	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R114	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R115	NO	25	40	25	40	26	40	29	40	33	40	37	40	38	40	38	40	38	40	38	40	38	40
R116	NO	<25	40	<25	40	<25	40	<25	40	28	40	32	40	33	40	33	40	33	40	33	40	33	40
R117	YES	27	45	27	45	27	45	31	45	34	45	38	45	39	45	39	45	39	45	39	45	39	45
R118	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	34	40	34	40	34	40	35	40	35	40
R119	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	43	31	44	31	46
R121	NO	<25	40	<25	40	<25	40	27	40	30	40	34	40	35	40	35	40	35	40	35	40	35	43
R122	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	43	31	45	31	44
R123	NO	<25	40	<25	40	25	40	29	40	32	40	36	40	37	40	37	40	37	40	37	41	37	43
R125	NO	<25	40	<25	40	<25	40	<25	40	29	40	32	40	33	40	33	40	33	40	33	40	33	43
R126	NO	<25	40	<25	40	<25	40	26	40	30	40	34	40	35	40	35	40	35	40	35	40	35	40
R128	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R129	NO	<25	40	<25	40	<25	40	27	40	31	40	34	40	35	40	35	40	36	40	36	40	36	40
R131	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
R134	NO	28	40	28	40	28	40	32	40	35	40	39	40	40	40	40	40	40	40	40	41	40	44
R135	NO	26	40	26	40	26	40	30	40	33	40	37	40	38	40	38	40	38	40	38	40	38	40
R136	YES	25	45	26	45	26	45	29	45	33	45	36	45	38	45	38	45	38	45	38	45	38	45
R219	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	43	31	44	31	46
R230	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R232	NO	<25	40	<25	40	<25	40	25	40	29	40	33	40	34	40	34	40	34	40	34	40	34	40
R233	NO	<25	40	<25	40	25	40	28	40	32	40	36	40	37	40	37	40	37	40	37	41	37	43
R235	NO	<25	40	<25	40	<25	40	28	40	31	40	35	40	36	40	36	40	36	40	36	40	36	40
R236	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R237	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R238	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R239	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R240	NO	<25	40	<25	40	<25	40	27	40	31	40	34	40	36	40	36	40	36	40	36	41	36	43
R241	NO	<25	40	<25	40	<25	40	27	40	31	40	34	40	36	40	36	40	36	40	36	41	36	43
R242	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R243	YES	27	45	27	45	28	45	31	45	34	45	38	45	39	45	39	45	39	45	39	45	39	45

Residence ID	Associated	3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s		13m/s	
		Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion
R244	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R245	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	32	40	33	40	33	40	33	40	33	40
R246	NO	<25	40	<25	40	<25	40	28	40	31	40	35	40	36	40	36	40	36	40	36	40	36	40
R247	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R248	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R249	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R250	NO	<25	40	<25	40	<25	40	<25	40	27	40	31	40	32	40	32	40	32	40	32	40	32	40
R251	NO	<25	40	<25	40	<25	40	<25	40	29	40	32	40	33	40	33	40	34	40	34	40	34	43
R252	NO	<25	40	<25	40	<25	40	26	40	30	40	34	40	35	40	35	40	35	40	35	40	35	40
R253	NO	<25	40	<25	40	<25	40	<25	40	26	40	30	40	31	40	31	40	31	40	31	40	31	40
R255	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	35	40	35	40	35	40	35	40	35	40
R256	NO	<25	40	<25	40	<25	40	26	40	30	40	34	40	35	40	35	40	35	40	35	40	35	40
R257	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
R260	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	35	40	35	40	35	40	35	40	35	43
R261	NO	<25	40	<25	40	<25	40	25	40	29	40	32	40	34	40	34	40	34	40	34	40	34	40
R266	NO	<25	40	<25	40	<25	40	27	40	30	40	34	40	35	40	35	40	35	40	35	40	35	40
R268	NO	<25	40	<25	40	<25	40	<25	40	26	40	29	40	30	40	31	40	31	40	31	40	31	40
R269	NO	<25	40	<25	40	<25	40	<25	40	26	40	29	40	30	40	31	40	31	40	31	40	31	40
R270	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	31	40	32	40	32	40	32	40	32	40
R275	NO	<25	40	<25	40	<25	40	26	40	30	40	33	40	35	40	35	40	35	40	35	41	35	43
R276	NO	<25	40	<25	40	<25	40	<25	40	28	40	31	40	33	40	33	40	33	40	33	40	33	40
R277	NO	27	40	27	40	27	40	31	40	34	40	38	40	39	40	39	40	39	40	39	41	39	43
R279	NO	<25	40	<25	40	<25	40	<25	40	26	40	29	40	31	40	31	40	31	43	31	45	31	44
R286	NO	<25	35	<25	35	<25	35	<25	35	27	35	31	35	32	35	32	35	32	36	32	38	32	38
R287	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
R288	YES	26	45	26	45	27	45	30	45	34	45	38	45	39	45	39	45	39	45	39	45	39	45
R289	NO	<25	35	<25	35	<25	35	<25	35	27	35	31	35	32	36	32	36	32	36	32	36	32	38
R290	NO	<25	40	<25	40	<25	40	26	40	29	40	33	40	34	40	34	40	34	40	34	40	34	40
R317	NO	<25	40	<25	40	<25	40	<25	40	27	40	30	40	32	40	32	40	32	40	32	40	32	40
VL10	NO	<25	35	<25	35	<25	35	<25	35	27	35	31	35	32	35	32	35	32	36	32	38	32	38

The above results indicate that compliance will be achieved at all residences with the exception of A77. The criteria will be marginally exceeded at A77 for wind speeds of 8m/s, 9m/s, and 10m/s, as shown in **RED** in Table 14. It is noted that there are two associated residences, R139 and R254, for which the wind farm developer will have lease agreements in place that require these dwellings to be unoccupied for the construction and operational phases of the Project. These residences have been omitted from the above table.

The indicative turbine used for this assessment can be operated in nine different modes, one standard mode and eight sound optimised (**SO**) modes. Operating a turbine in a SO mode reduces the noise level produced by the turbine. The overall sound power levels for the different SO modes can be seen in Table 15.

Table 15: Sound Optimised Mode Sound Power Levels

Sound Optimised Mode	Sound Power Level [dB(A)] per Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
SO1	93.9	94	94.9	97.9	101.3	104.2	105	105	105	105	105
SO2	93.9	94	94.9	97.9	101.3	103.7	104	104	104	104	104
SO3	93.9	94	94.9	97.9	101.3	103	103	103	103	103	103
SO4	93.9	94	94.9	97.9	101.2	102	102	102	102	102	102
SO5	93.9	94	94.9	97.9	100.7	101	101	101	101	101	101
SO6	93.9	94	94.9	97.8	100	100	100	100	100	100	100
SO7	93.9	94	94.9	97.7	99	99	99	99	99	99	99
SO8	93.9	94	94.9	97.5	98	98	98	98	98	98	98

To ensure compliance with the relevant noise criteria at residence A77, it is recommended that select turbines be operated in a SO mode for the specific wind speeds where the criteria are exceeded. Table 16 shows the operational modes recommended to achieve compliance at A77 for wind speeds of 8m/s, 9m/s, and 10m/s.

Table 16: Recommended Turbine Operational Modes

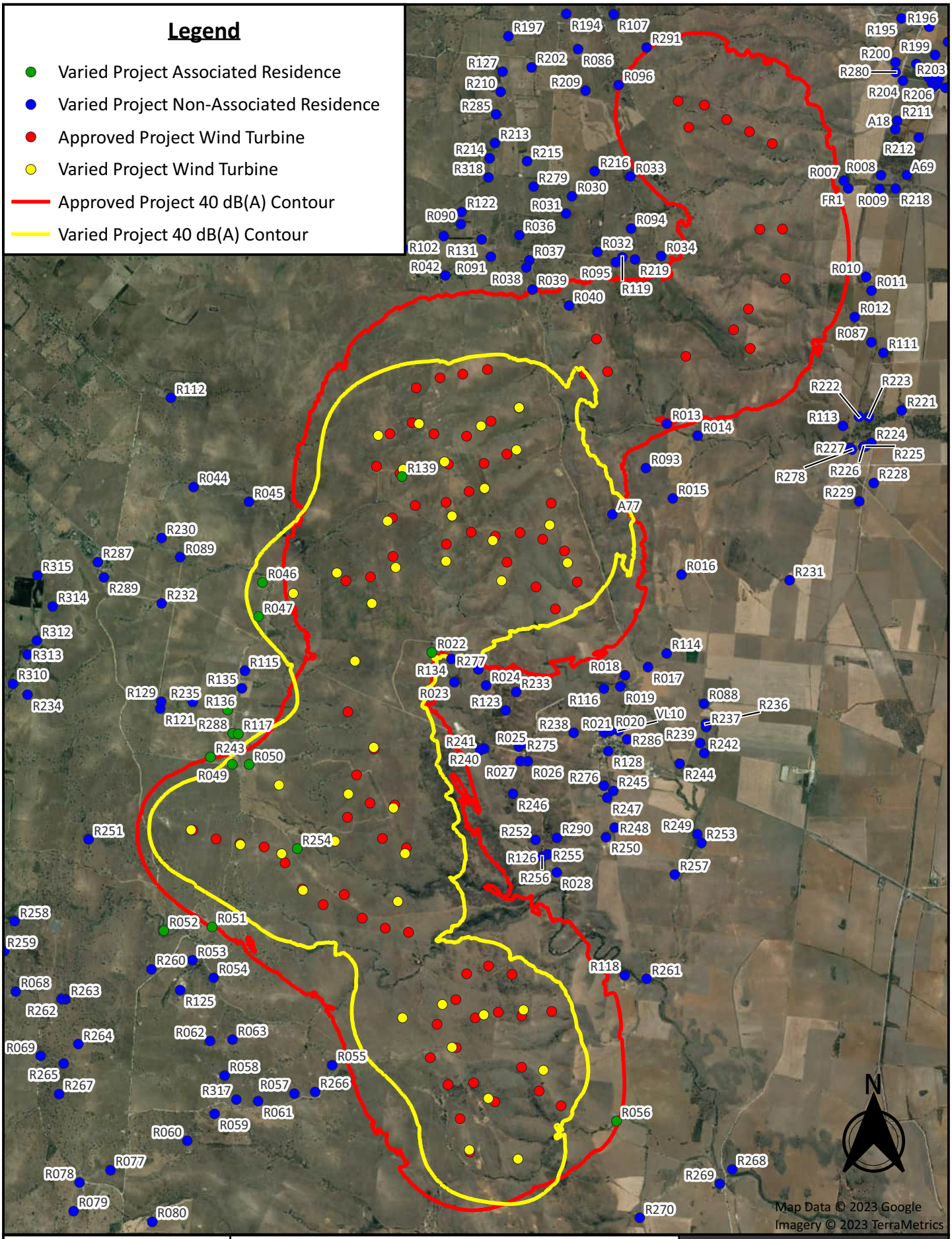
Turbine	SO Mode per Hub Height (130m) Wind Speed		
	8m/s	9m/s	10m/s
B51	SO1	SO4	SO1
B60	SO1	SO4	SO1

7 APPROVED VS VARIED PROJECT

The highest predicted noise levels for the Varied Project have been compared to those of the Approved Project and can be seen in Table 17. Where the difference is positive, this represents an increase in noise levels for the Varied Project. Instances where the noise level has increased have been highlighted in **RED**. It is noted that only residences where predictions were made for the Approved Project have been included in this table. A comparison of the 40 dB(A) noise contours for the Approved and Varied Projects has been included in Figure 3.

Table 17: Approved Project vs Varied Project Comparison (Highest Predicted Noise Levels)

Residence	Approved Result	Varied Result	Difference	Residence	Approved Result	Varied Result	Difference	Residence	Approved Result	Varied Result	Difference
FR01	39	22	-17	R040	43	36	-7	R106	28	19	-9
R001	32	11	-21	R042	38	33	-5	R107	33	24	-9
R002	31	11	-20	R043	34	32	-2	R108	25	28	**3**
R003	33	15	-18	R044	31	33	**2**	R110	24	28	**4**
R004	31	16	-15	R045	36	37	**1**	R111	33	25	-8
R005	31	17	-14	R046	37	43	**6**	R112	28	31	**3**
R006	29	17	-12	R047	37	41	**4**	R113	33	26	-7
R007	39	22	-17	R049	41	41	0	R114	34	33	-1
R008	35	22	-13	R050	41	43	**2**	R115	36	38	**2**
R009	35	22	-13	R051	40	38	-2	R116	35	33	-2
R010	38	24	-14	R052	36	35	-1	R117	38	39	**1**
R011	37	24	-13	R053	36	35	-1	R118	38	35	-3
R012	38	24	-14	R054	36	35	-1	R119	38	31	-7
R013	40	34	-6	R055	39	37	-2	R121	33	35	**2**
R014	39	32	-7	R056	40	36	-4	R122	33	31	-2
R015	36	34	-2	R057	34	34	0	R123	37	37	0
R016	36	34	-2	R058	31	32	**1**	R124	29	20	-9
R017	35	34	-1	R059	29	31	**2**	R125	33	33	0
R018	36	34	-2	R061	32	33	**1**	R126	37	35	-2
R019	35	33	-2	R062	32	33	**1**	R127	28	25	-3
R020	32	32	0	R063	33	34	**1**	R128	32	33	**1**
R021	32	32	0	R086	33	25	-8	R129	33	36	**3**
R022	41	41	0	R087	35	25	-10	R131	35	32	-3
R023	38	38	0	R088	30	31	**1**	R134	40	40	0
R024	39	39	0	R089	29	33	**4**	R135	36	38	**2**
R025	35	35	0	R090	34	31	-3	R136	36	38	**2**
R026	35	35	0	R091	37	32	-5	VL01	33	12	-21
R027	35	35	0	R093	39	34	-5	VL02	34	13	-21
R028	37	35	-2	R094	37	28	-9	VL03	34	13	-21
R030	35	31	-4	R095	39	32	-7	VL04	35	13	-22
R031	34	32	-2	R096	40	24	-16	VL05	35	14	-21
R032	37	33	-4	R097	29	18	-11	VL06	34	15	-19
R033	39	28	-11	R098	30	17	-13	VL07	35	15	-20
R034	39	31	-8	R099	31	17	-14	VL08	34	16	-18
R036	35	32	-3	R100	36	16	-20	VL09	35	16	-19
R037	37	32	-5	R102	34	32	-2	VL10	32	32	0
R038	38	33	-5	R104	31	16	-15				
R039	40	34	-6	R105	29	17	-12				



0 1 2 km

PALMER WIND FARM
Noise Contour Comparison
Figure 3
Approved Project (Area B & C) vs Varied Project

Project Number: S4171

sonus.

From Table 17 it can be seen that 76 residences assessed as part of the Approved Project will experience a reduction in the highest predicted noise levels with the Varied Project, with 22 residences, 17 of which are non-associated, experiencing an increase in the highest predicted noise level with the Varied Project compared to the Approved Project. Regardless of the increase in noise, it is noted that the applicable noise criteria will still be achieved at all sensitive receivers. For reference, an increase in noise level of 1 dB(A) would not be noticeable, an increase of 3 dB(A) would be subjectively described as “just noticeable”, and an increase of 5 dB(A) would be “clearly noticeable”. As such, only 7 residences, 5 of which are non-associated, are expected to experience a change in noise level that could be described as noticeable.

8 CONCLUSION

A noise impact assessment has been completed for the varied Palmer Wind Farm Project, located approximately 50km east of the Adelaide CBD. The noise impact assessment has been updated to consider the changes from the Approved Project.

Contemporary background noise measurements were taken and showed that there were no significant changes in criteria associated with the additional background noise monitoring. Applicable criteria were therefore determined based on a combination of the contemporary and original background noise monitoring data, with the latter updated to the new hub height.

Predictions of the level of noise generated by the new layout indicate that the wind farm will comply with the relevant noise criteria at all nearby sensitive receivers. The predicted noise levels have also been compared to those for the Approved Project, indicating that the noise levels have generally decreased, with 76 residences experiencing a decrease in noise level and a small number of residences experiencing a noticeable increase in noise level (5 non-associated residences and 2 associated residences). Despite the increase in noise level, the noise criteria will still be achieved at all residences.

APPENDIX A: NEARBY SENSITIVE RECEIVERS

Table 18: Nearby Sensitive Receivers

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
A18	336469	6151915	NO	Rural	NO	40	<25
A69	336657	6151165	NO	Rural	NO	40	<25
A77	331814	6145583	NO	Rural	NO	40	42
FR1	335694	6150943	NO	Rural	NO	40	<25
R001	338654	6161550	NO	Rural	NO	40	<25
R002	338811	6161205	NO	Rural Living	YES	35	<25
R003	338320	6158503	NO	Rural Living	YES	35	<25
R004	338364	6157115	NO	Rural	NO	40	<25
R005	337746	6156234	NO	Rural Living	YES	35	<25
R006	338054	6155947	NO	Rural Living	YES	35	<25
R007	335621	6151072	NO	Rural	NO	40	<25
R008	336232	6151162	NO	Rural	NO	40	<25
R009	336211	6150936	NO	Rural	NO	40	<25
R010	335987	6149489	NO	Rural	NO	40	<25
R011	336076	6149263	NO	Rural	NO	40	<25
R012	335800	6148831	NO	Rural	NO	40	<25
R013	332709	6147074	NO	Rural	NO	40	34
R014	333217	6146878	NO	Rural	NO	40	32
R015	332807	6145845	NO	Rural	NO	40	34
R016	332951	6144593	NO	Rural	NO	40	34
R017	332399	6143071	NO	Rural	NO	40	34
R018	332021	6142935	NO	Rural	NO	40	34
R019	331944	6142751	NO	Rural	NO	40	33
R020	331779	6142022	NO	Rural	NO	40	32
R021	331681	6141997	NO	Rural	NO	40	32
R022	328843	6143312	YES	Rural	NO	45	41
R023	329212	6142822	NO	Rural	NO	40	38
R024	329736	6142771	NO	Rural	NO	40	39
R025	330275	6141763	NO	Rural	NO	40	35
R026	330422	6141522	NO	Rural	NO	40	35
R027	330300	6141524	NO	Rural	NO	40	35
R028	330898	6139694	NO	Rural	NO	40	35
R030	331148	6150815	NO	Rural	NO	40	31
R031	331051	6150531	NO	Rural	NO	40	32
R032	331566	6149899	NO	Rural	NO	40	33
R033	332110	6151142	NO	Rural	NO	40	28
R034	332616	6149832	NO	Rural	NO	40	31
R036	330282	6150175	NO	Rural	NO	40	32
R037	330446	6149761	NO	Rural	NO	40	32

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R038	330397	6149643	NO	Rural	NO	40	33
R039	330500	6149283	NO	Rural	NO	40	34
R040	331100	6149018	NO	Rural	NO	40	36
R042	329065	6149513	NO	Rural	NO	40	33
R043	328370	6149965	NO	Rural	NO	40	32
R044	324923	6146033	NO	Rural	NO	40	33
R045	325833	6145790	NO	Rural	NO	40	37
R046	326057	6144462	YES	Rural	NO	45	43
R047	325992	6143904	YES	Rural	NO	45	41
R049	325559	6141472	YES	Rural	NO	45	41
R050	325835	6141470	YES	Rural	NO	45	43
R051	325227	6138796	YES	Rural	NO	45	38
R052	324434	6138735	YES	Rural	NO	45	35
R053	324903	6138250	NO	Rural	NO	40	35
R054	325252	6137961	NO	Rural	NO	40	35
R055	327202	6136523	NO	Rural	NO	40	37
R056	331881	6135603	YES	Rural	NO	45	36
R057	326580	6136056	NO	Rural	NO	40	34
R058	325433	6136353	NO	Rural	NO	40	32
R059	325267	6135722	NO	Rural	NO	40	31
R060	324819	6135280	NO	Rural	NO	40	30
R061	325984	6135932	NO	Rural	NO	40	33
R062	325195	6136921	NO	Rural	NO	40	33
R063	325563	6136944	NO	Rural	NO	40	34
R064	320205	6138564	NO	Rural	NO	40	26
R065	321003	6138371	NO	Rural	NO	40	27
R066	321240	6138066	NO	Rural	NO	40	27
R067	321390	6138112	NO	Rural	NO	40	27
R068	321996	6137734	NO	Rural	NO	40	29
R069	322406	6136677	NO	Rural	NO	40	28
R070	319208	6136351	NO	Rural	NO	40	<25
R071	318203	6135360	NO	Rural	NO	40	<25
R072	320048	6135737	NO	Rural	NO	40	26
R073	319623	6135176	NO	Rural	NO	40	<25
R074	318903	6134003	NO	Rural	NO	40	<25
R075	318404	6132973	NO	Rural	NO	40	<25
R076	318606	6132870	NO	Rural	NO	40	<25
R077	323555	6134795	NO	Rural	NO	40	29
R078	323046	6134593	NO	Rural	NO	40	27
R079	322949	6134121	NO	Rural	NO	40	26
R080	324244	6133946	NO	Rural	NO	40	27
R081	323788	6132911	NO	Rural	NO	40	<25

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R082	323349	6132164	NO	Rural	NO	40	<25
R083	323702	6131999	NO	Rural	NO	40	<25
R084	323574	6131726	NO	Rural	NO	40	<25
R086	331247	6153235	NO	Rural	NO	40	25
R087	336074	6148414	NO	Rural	NO	40	<25
R088	333320	6142469	NO	Rural	NO	40	31
R089	324701	6144879	NO	Rural	NO	40	33
R090	329320	6150356	NO	Rural	NO	40	31
R091	329814	6149821	NO	Rural	NO	40	32
R093	332363	6146343	NO	Rural	NO	40	34
R094	332121	6150283	NO	Rural	NO	40	28
R095	331871	6149732	NO	Rural	NO	40	32
R096	331916	6152646	NO	Rural	NO	40	<25
R097	337544	6155599	NO	Rural Living	YES	35	<25
R098	337771	6155826	NO	Rural Living	YES	35	<25
R099	337626	6156005	NO	Rural Living	YES	35	<25
R100	337396	6156972	NO	Rural Living	YES	35	<25
R102	329039	6150160	NO	Rural	NO	40	32
R103	332644	6160275	NO	Rural	NO	40	<25
R104	332968	6159901	NO	Rural	NO	40	<25
R105	333080	6157733	NO	Rural	NO	40	<25
R106	333858	6155432	NO	Rural	NO	40	<25
R107	331833	6153810	NO	Rural	NO	40	<25
R108	325567	6150649	NO	Rural	NO	40	28
R110	324311	6149918	NO	Rural	NO	40	28
R111	336272	6148239	NO	Rural	NO	40	25
R112	324550	6147499	NO	Rural	NO	40	31
R113	335608	6147038	NO	Rural	NO	40	26
R114	332707	6143294	NO	Rural	NO	40	33
R115	325766	6143010	NO	Rural	NO	40	38
R116	331673	6142717	NO	Rural	NO	40	33
R117	325657	6141972	YES	Rural	NO	45	39
R118	332017	6138001	NO	Rural	NO	40	35
R119	331977	6149812	NO	Rural	NO	40	31
R120	337780	6154485	NO	Rural	NO	40	<25
R121	324374	6142390	NO	Rural	NO	40	35
R122	329332	6150556	NO	Rural	NO	40	31
R123	330057	6142357	NO	Rural	NO	40	37
R124	337016	6152769	NO	Rural Living	YES	35	<25
R125	324701	6137756	NO	Rural	NO	40	33
R126	330653	6139949	NO	Rural	NO	40	35
R127	330007	6152865	NO	Rural	NO	40	<25

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R128[1]	331745	6141689	NO	Township	NO	40	33
R129	324390	6142502	NO	Rural	NO	40	36
R130	340417	6149805	NO	Rural	NO	40	<25
R131	329662	6150104	NO	Rural	NO	40	32
R132	332434	6157779	NO	Rural	NO	40	<25
R133	337397	6152709	NO	Rural Settlement	YES	35	<25
R134	329165	6143203	NO	Rural	NO	40	40
R135	325716	6142721	NO	Rural	NO	40	38
R136	325483	6142365	YES	Rural	NO	45	38
R140	339936	6165703	NO	Rural	NO	40	<25
R141	339479	6165476	NO	Rural	NO	40	<25
R142	332950	6164874	NO	Rural	NO	40	<25
R143	333052	6164849	NO	Rural	NO	40	<25
R144	339717	6163973	NO	Rural	NO	40	<25
R145	339625	6163973	NO	Rural	NO	40	<25
R146	332855	6163078	NO	Rural	NO	40	<25
R147	339937	6162742	NO	Rural	NO	40	<25
R148	340410	6162491	NO	Rural	NO	40	<25
R149	340307	6162097	NO	Rural	NO	40	<25
R150	340514	6161856	NO	Rural Living	YES	35	<25
R151	340421	6161792	NO	Rural Living	YES	35	<25
R152	340281	6161751	NO	Rural Living	YES	35	<25
R153	340649	6161517	NO	Rural Living	YES	35	<25
R154	340923	6161507	NO	Rural Living	YES	35	<25
R155	340064	6161447	NO	Rural Living	YES	35	<25
R156	339123	6161274	NO	Rural Living	YES	35	<25
R157	339685	6161249	NO	Rural Living	YES	35	<25
R158	340626	6161168	NO	Rural Living	YES	35	<25
R159	339056	6160935	NO	Rural Living	YES	35	<25
R160	339654	6160830	NO	Rural Living	YES	35	<25
R161	338909	6160683	NO	Rural Living	YES	35	<25
R162	340226	6160679	NO	Rural	NO	40	<25
R163	338896	6160475	NO	Rural Living	YES	35	<25
R164	338453	6160166	NO	Rural Living	YES	35	<25
R165	339344	6160060	NO	Rural	NO	40	<25
R166	338525	6159896	NO	Rural Living	YES	35	<25
R167	339225	6159392	NO	Rural	NO	40	<25
R168	338700	6159260	NO	Rural Living	YES	35	<25
R169	332400	6159209	NO	Rural	NO	40	<25
R170	333083	6158736	NO	Rural	NO	40	<25
R171	332350	6158670	NO	Rural	NO	40	<25
R172	332024	6158393	NO	Rural	NO	40	<25

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R173	332314	6158133	NO	Rural	NO	40	<25
R174	332397	6157914	NO	Rural	NO	40	<25
R175	332621	6157711	NO	Rural	NO	40	<25
R176	333048	6157634	NO	Rural	NO	40	<25
R177	333251	6156841	NO	Rural	NO	40	<25
R178	337245	6156573	NO	Rural Living	YES	35	<25
R179	338467	6156358	NO	Rural	NO	40	<25
R180	338093	6156010	NO	Rural Living	YES	35	<25
R181	333915	6155653	NO	Rural	NO	40	<25
R182	337940	6155485	NO	Rural Living	YES	35	<25
R183	334054	6155460	NO	Rural	NO	40	<25
R184	337625	6155271	NO	Rural Living	YES	35	<25
R185	338023	6155199	NO	Rural	NO	40	<25
R186	331887	6155090	NO	Rural	NO	40	<25
R187	337695	6155015	NO	Rural Living	YES	35	<25
R188	331576	6154755	NO	Rural	NO	40	<25
R189	331154	6154537	NO	Rural	NO	40	<25
R190	331768	6154271	NO	Rural	NO	40	<25
R191	337029	6154186	NO	Rural Living	YES	35	<25
R192	337286	6154101	NO	Rural Living	YES	35	<25
R193	336409	6154098	NO	Rural	NO	40	<25
R194	331055	6153816	NO	Rural	NO	40	<25
R195	336568	6153740	NO	Rural	NO	40	<25
R196	337026	6153604	NO	Rural Living	YES	35	<25
R197	330101	6153447	NO	Rural	NO	40	<25
R198	337336	6153354	NO	Rural Living	YES	35	<25
R199	337122	6153140	NO	Rural Living	YES	35	<25
R200	336471	6153016	NO	Rural	NO	40	<25
R201	336814	6152993	NO	Rural Living	YES	35	<25
R202	330484	6152934	NO	Rural	NO	40	<25
R203	337181	6152752	NO	Rural Settlement	YES	35	<25
R204	336594	6152715	NO	Rural	NO	40	<25
R205	337069	6152685	NO	Rural Settlement	YES	35	<25
R206	337167	6152665	NO	Rural Settlement	YES	35	<25
R207	337098	6152618	NO	Rural Settlement	YES	35	<25
R208	337293	6152600	NO	Rural Settlement	YES	35	<25
R209	331371	6152553	NO	Rural	NO	40	26
R210	329974	6152533	NO	Rural	NO	40	<25
R211	336498	6152055	NO	Rural	NO	40	<25
R212	336853	6151780	NO	Rural	NO	40	<25
R213	329881	6151689	NO	Rural	NO	40	29
R214	329794	6151439	NO	Rural	NO	40	28

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R215	330409	6151393	NO	Rural	NO	40	28
R216	331521	6151225	NO	Rural	NO	40	29
R217	327430	6151211	NO	Rural	NO	40	28
R218	336473	6150940	NO	Rural	NO	40	<25
R219	332185	6149776	NO	Rural	NO	40	31
R220	337560	6148657	NO	Rural	NO	40	<25
R221	336572	6147292	NO	Rural	NO	40	25
R222	335871	6147189	NO	Rural Settlement	YES	35	25
R223	336033	6147188	NO	Rural Settlement	YES	35	26
R224	336072	6146759	NO	Rural	NO	40	26
R225	335978	6146703	NO	Rural	NO	40	27
R226	335945	6146694	NO	Rural	NO	40	26
R227	335723	6146679	NO	Rural	NO	40	27
R228	336114	6146099	NO	Rural	NO	40	26
R229	335875	6145797	NO	Rural	NO	40	26
R230	324395	6145193	NO	Rural	NO	40	32
R231	334727	6144499	NO	Rural	NO	40	29
R232	324397	6144118	NO	Rural	NO	40	34
R233	330230	6142661	NO	Rural	NO	40	37
R234	322190	6142616	NO	Rural	NO	40	30
R235	324908	6142496	NO	Rural	NO	40	36
R236	333352	6142136	NO	Rural	NO	40	31
R237	333356	6142084	NO	Rural	NO	40	31
R238	331176	6141990	NO	Rural	NO	40	33
R239	333258	6141822	NO	Rural	NO	40	31
R240	329703	6141732	NO	Rural	NO	40	36
R241	329641	6141706	NO	Rural	NO	40	36
R242	333324	6141656	NO	Rural	NO	40	31
R243	325200	6141592	YES	Rural	NO	45	39
R244	332920	6141483	NO	Rural	NO	40	31
R245	331827	6141032	NO	Rural	NO	40	33
R246	330177	6140987	NO	Rural	NO	40	36
R247	331728	6140923	NO	Rural	NO	40	32
R248	331851	6140430	NO	Rural	NO	40	32
R249	333210	6140322	NO	Rural	NO	40	31
R250	331708	6140273	NO	Rural	NO	40	32
R251	323195	6140237	NO	Rural	NO	40	34
R252	330547	6140230	NO	Rural	NO	40	35
R253	333277	6140177	NO	Rural	NO	40	31
R255	330747	6139991	NO	Rural	NO	40	35
R256	330656	6139949	NO	Rural	NO	40	35
R257	332839	6139658	NO	Rural	NO	40	32

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R258	321978	6138890	NO	Rural	NO	40	29
R259	321808	6138400	NO	Rural	NO	40	28
R260	324229	6138099	NO	Rural	NO	40	35
R261	332375	6137943	NO	Rural	NO	40	34
R262	322750	6137610	NO	Rural	NO	40	29
R263	322815	6137606	NO	Rural	NO	40	29
R264	323025	6136871	NO	Rural	NO	40	30
R265	322785	6136549	NO	Rural	NO	40	28
R266	326921	6136083	NO	Rural	NO	40	35
R267	322708	6136048	NO	Rural	NO	40	27
R268	333784	6134808	NO	Rural	NO	40	31
R269	333580	6134572	NO	Rural	NO	40	31
R270	332263	6134013	NO	Rural	NO	40	32
R271	323403	6133353	NO	Rural	NO	40	26
R272	324600	6132061	NO	Rural	NO	40	25
R273	338847	6160720	NO	Rural Living	YES	35	<25
R274	321570	6138704	NO	Rural	NO	40	28
R275	330327	6141805	NO	Rural	NO	40	35
R276	331675	6141120	NO	Rural	NO	40	33
R277	329608	6143033	NO	Rural	NO	40	39
R278	335754	6146646	NO	Rural	NO	40	27
R279	330516	6150974	NO	Rural	NO	40	31
R280	336473	6152858	NO	Rural	NO	40	<25
R281	337777	6154535	NO	Rural	NO	40	<25
R282	338678	6160452	NO	Rural Living	YES	35	<25
R283	339084	6160558	NO	Rural Living	YES	35	<25
R284	331697	6154016	NO	Rural	NO	40	<25
R285	329900	6152161	NO	Rural	NO	40	27
R286[2]	332056	6141884	NO	Rural Neighbourhood	YES	35	32
R287[3]	323346	6144797	NO	Township	NO	40	32
R288	325566	6141980	YES	Rural	NO	45	39
R289[4]	323447	6144546	NO	Rural Neighbourhood	YES	35	32
R290	330898	6140262	NO	Rural	NO	40	34
R291	332376	6153262	NO	Rural	NO	40	<25
R292	336777	6155192	NO	Rural	NO	40	<25
R293	319488	6138407	NO	Rural	NO	40	<25
R294	319164	6135557	NO	Rural	NO	40	<25
R295	319769	6135334	NO	Rural	NO	40	<25
R296	320394	6139316	NO	Rural	NO	40	25
R297	320038	6140224	NO	Rural	NO	40	26
R298	319103	6140353	NO	Rural	NO	40	25
R299	318233	6139321	NO	Rural	NO	40	<25

Residence ID	Coordinates (UTM WGS 84 54H)		Associated (YES/NO)	Land Use Zone	Promotes Rural Living (YES/NO)	Baseline Noise Criterion, dB(A)	Predicted Noise Level, dB(A)
	Easting	Northing					
R300	318804	6139306	NO	Rural	NO	40	<25
R301	321253	6140786	NO	Rural	NO	40	29
R302	321211	6142056	NO	Rural	NO	40	29
R303	319061	6141598	NO	Rural	NO	40	25
R304	319419	6141668	NO	Rural	NO	40	<25
R305	318297	6140628	NO	Rural	NO	40	<25
R306	319319	6142682	NO	Rural	NO	40	26
R307	321205	6142388	NO	Rural	NO	40	28
R308	321541	6142713	NO	Rural	NO	40	28
R309	321423	6142570	NO	Rural	NO	40	28
R310	321950	6142795	NO	Rural	NO	40	29
R311	321641	6142993	NO	Rural	NO	40	28
R312	322342	6143507	NO	Rural	NO	40	28
R313	322188	6143278	NO	Rural	NO	40	28
R314	322603	6144069	NO	Rural	NO	40	28
R315	322352	6144579	NO	Rural	NO	40	28
R316	319832	6141716	NO	Rural	NO	40	25
R317	325626	6135957	NO	Rural	NO	40	32
R318	329774	6151125	NO	Rural	NO	40	30
VL1	338624	6160690	NO	Rural	NO	40	<25
VL2	338390	6160058	NO	Rural	NO	40	<25
VL3	338334	6159661	NO	Rural	NO	40	<25
VL4	338153	6159244	NO	Rural	NO	40	<25
VL5	338083	6158671	NO	Rural Living	YES	35	<25
VL6	338061	6158231	NO	Rural Living	YES	35	<25
VL7	337736	6157749	NO	Rural Living	YES	35	<25
VL8	337801	6157266	NO	Rural Living	YES	35	<25
VL9	337257	6156678	NO	Rural Living	YES	35	<25
VL10	331915	6142023	NO	Rural Neighbourhood	YES	35	32

1. This residence was selected as a representative location for other residences within the Township Zone at Palmer.
2. This residence was selected as a representative location for other residences within the Rural Neighbourhood Zone at Palmer.
3. This residence was selected as a representative location for other residences within the Township Zone at Tungkillo.
4. This residence was selected as a representative location for other residences within the Rural Neighbourhood Zone at Tungkillo.

APPENDIX B: NOISE MONITORING PHOTOS

Figure 4: Monitoring Equipment at A77









Figure 5: Monitoring Equipment at R022







Figure 6: Monitoring Equipment at R042







Figure 7: Monitoring Equipment at R051









APPENDIX C: BACKGROUND NOISE CORRELATION GRAPHS

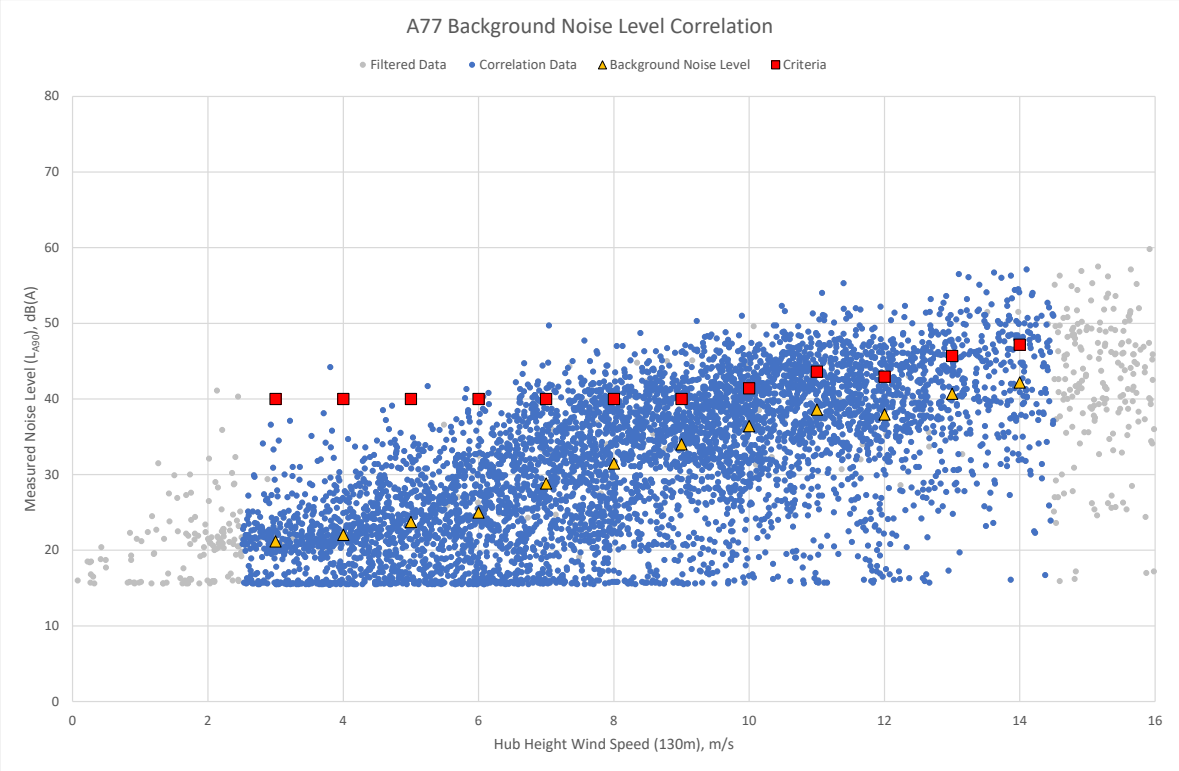


Figure 8: A77 Background Noise Level Correlation

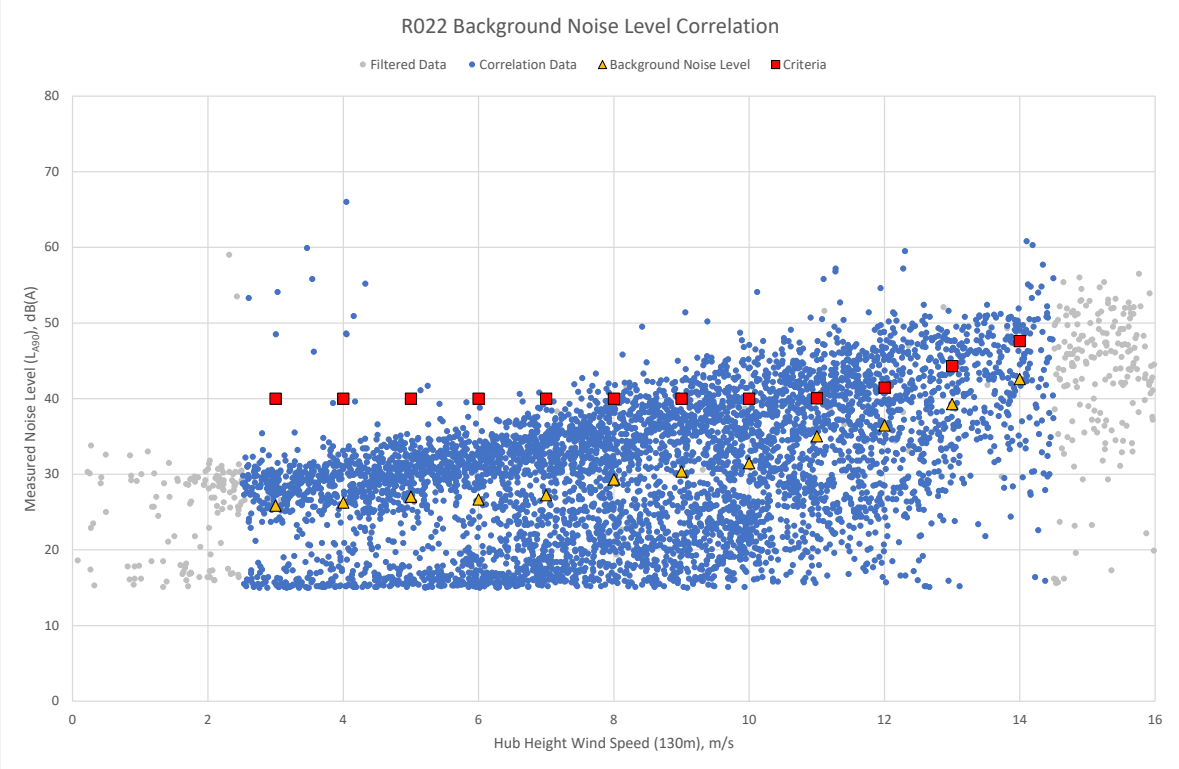


Figure 9: R022 Background Noise Level Correlation

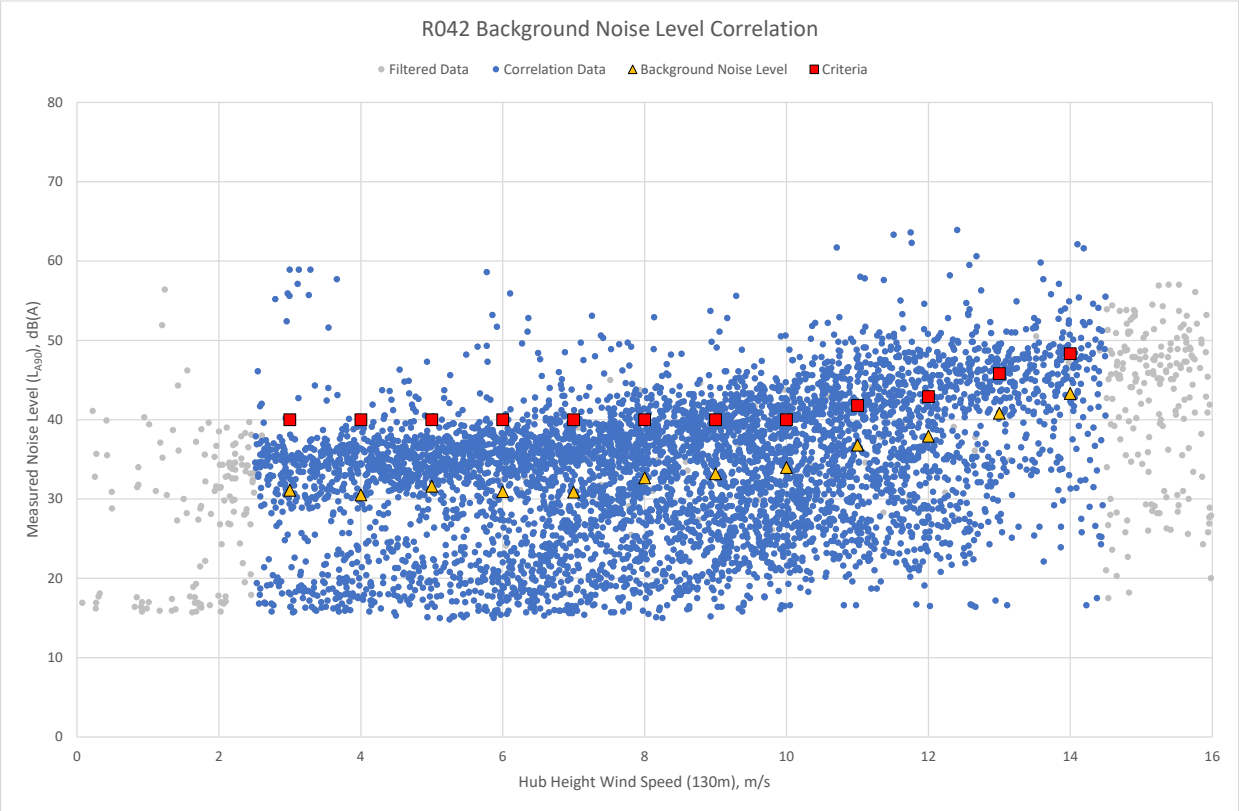


Figure 10: R042 Background Noise Level Correlation

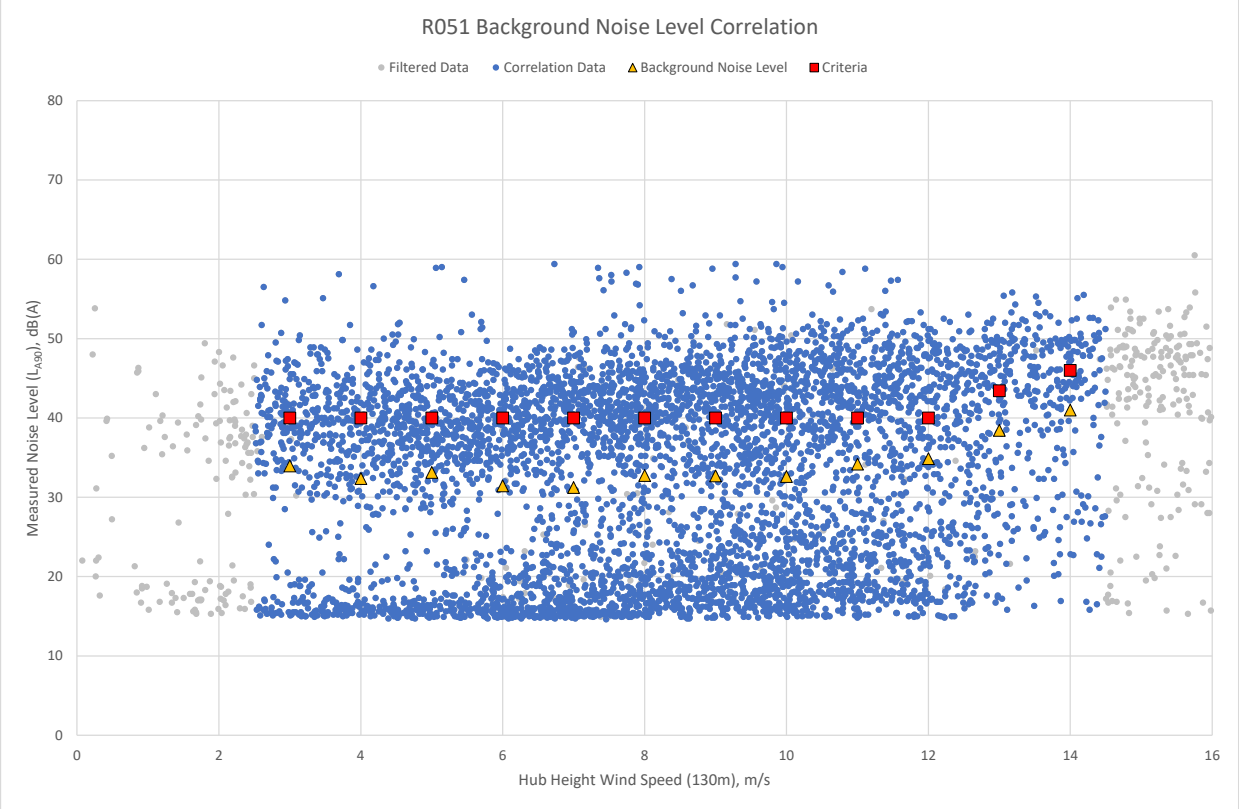


Figure 11: R051 Background Noise Level Correlation

APPENDIX D: BACKGROUND NOISE RE-CORRELATION GRAPHS

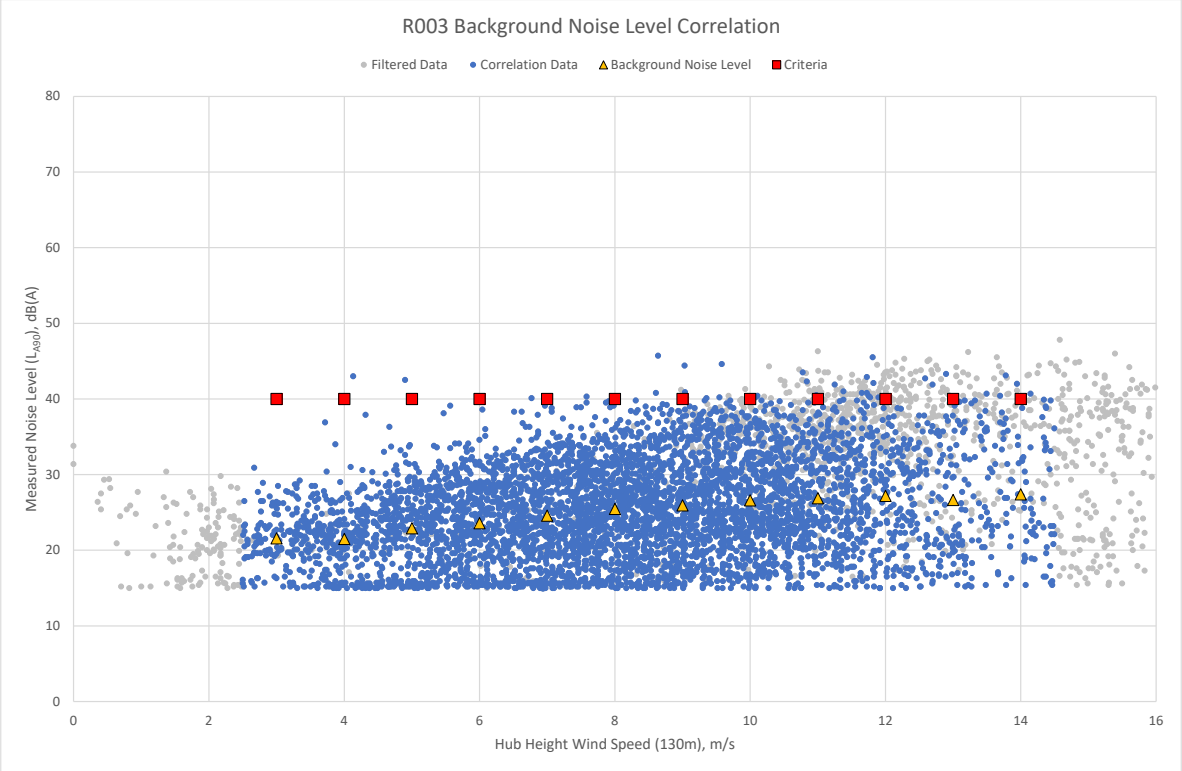


Figure 12: R003 Background Noise Level Correlation

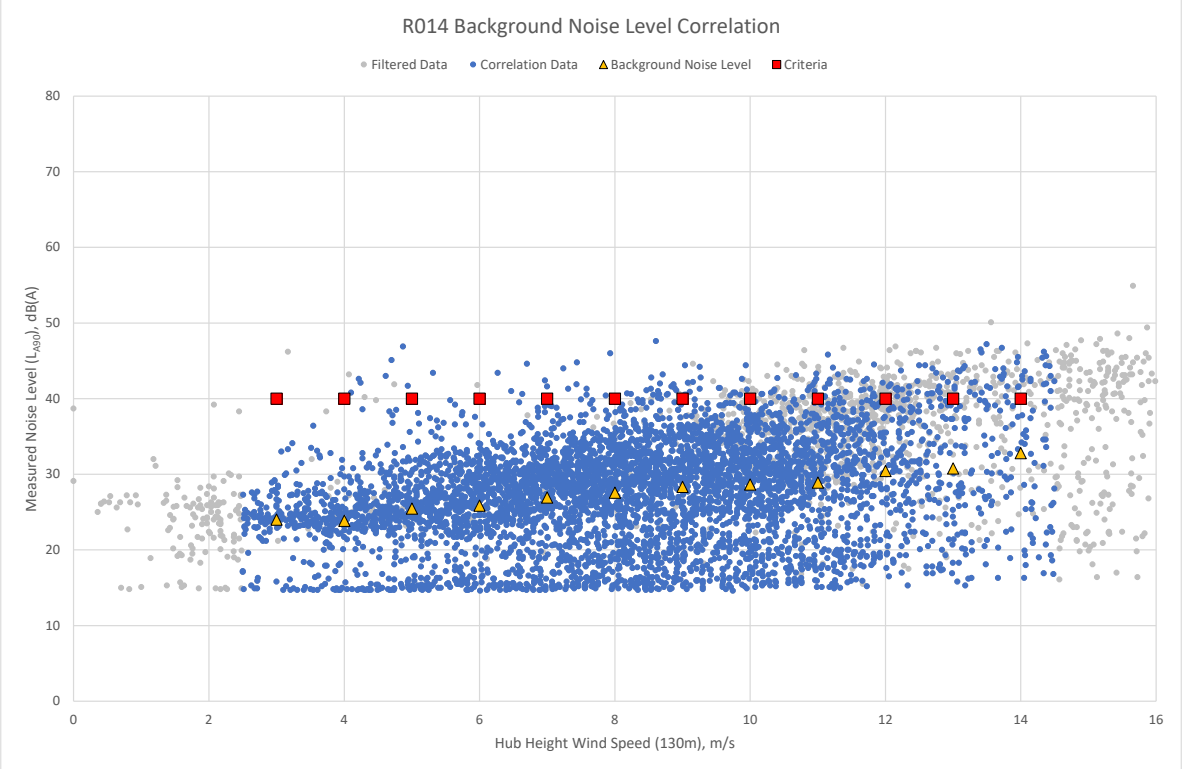


Figure 13: R014 Background Noise Level Correlation

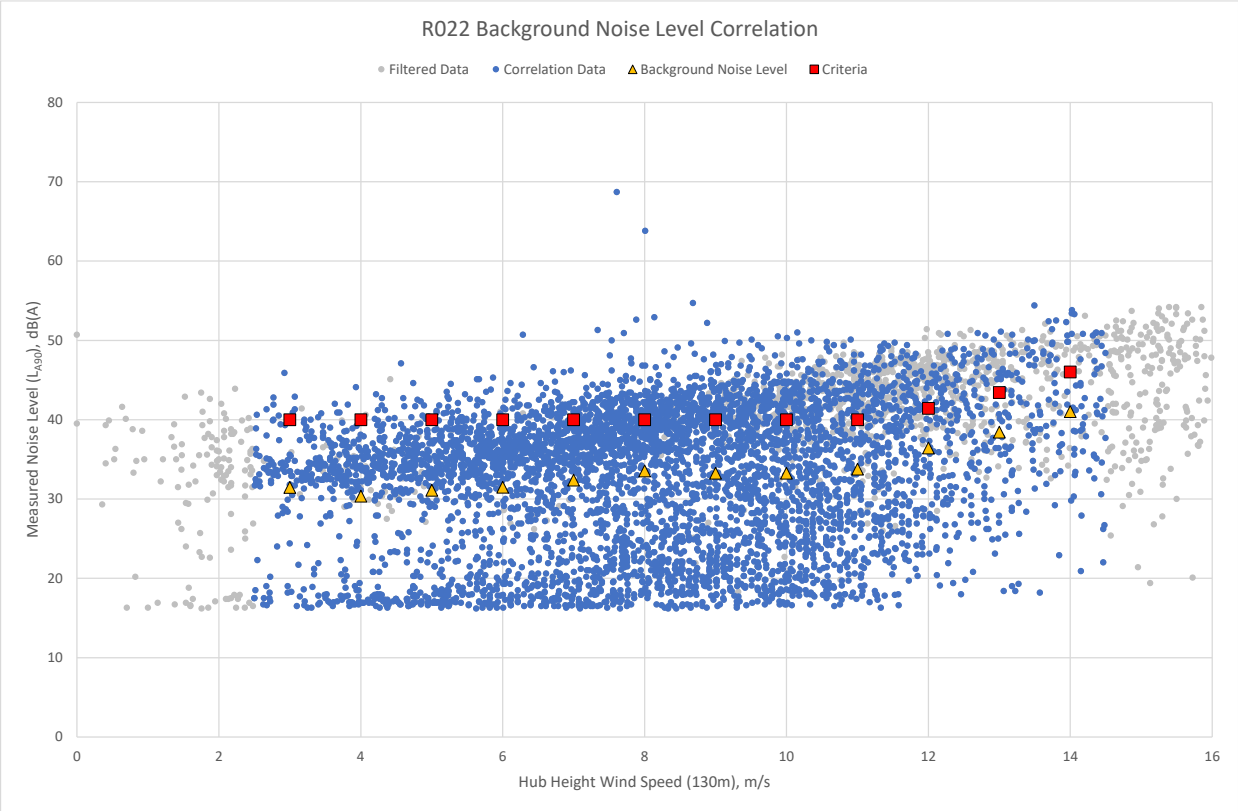


Figure 14: R022 Background Noise Level Correlation

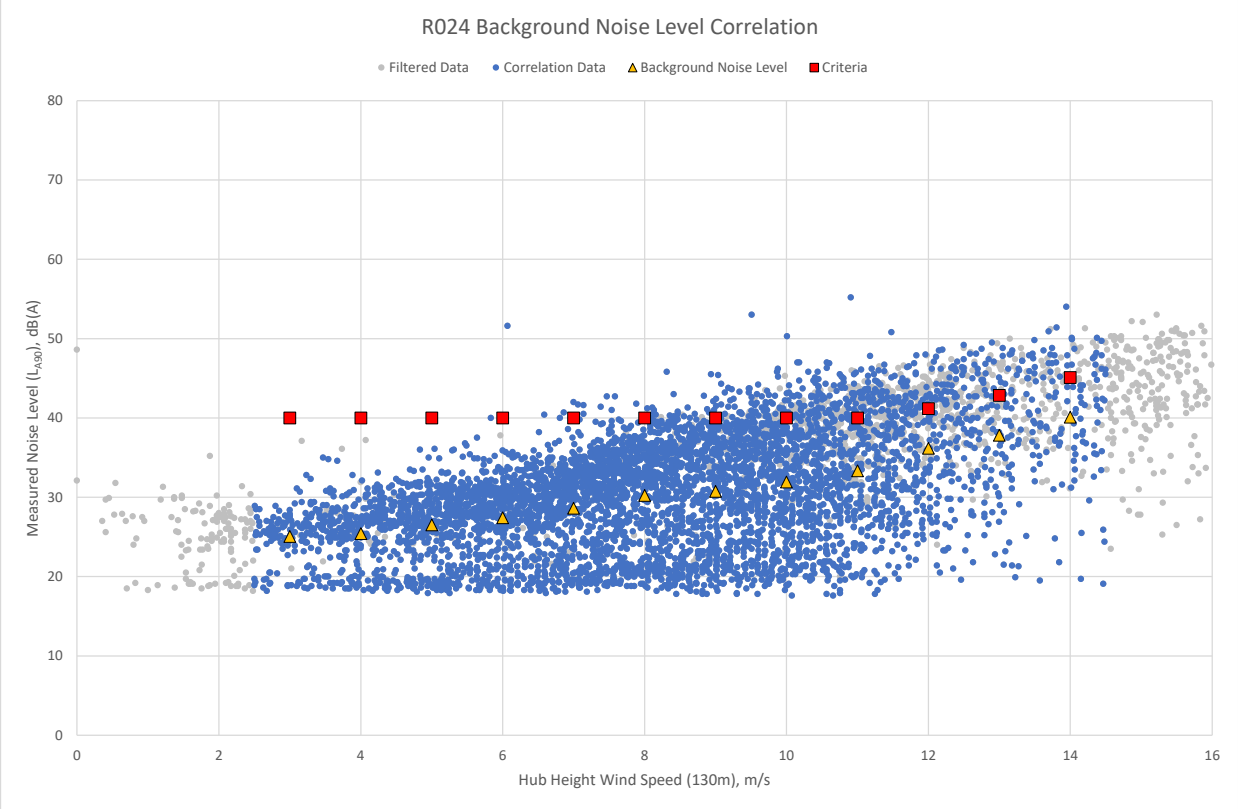


Figure 15: R024 Background Noise Level Correlation

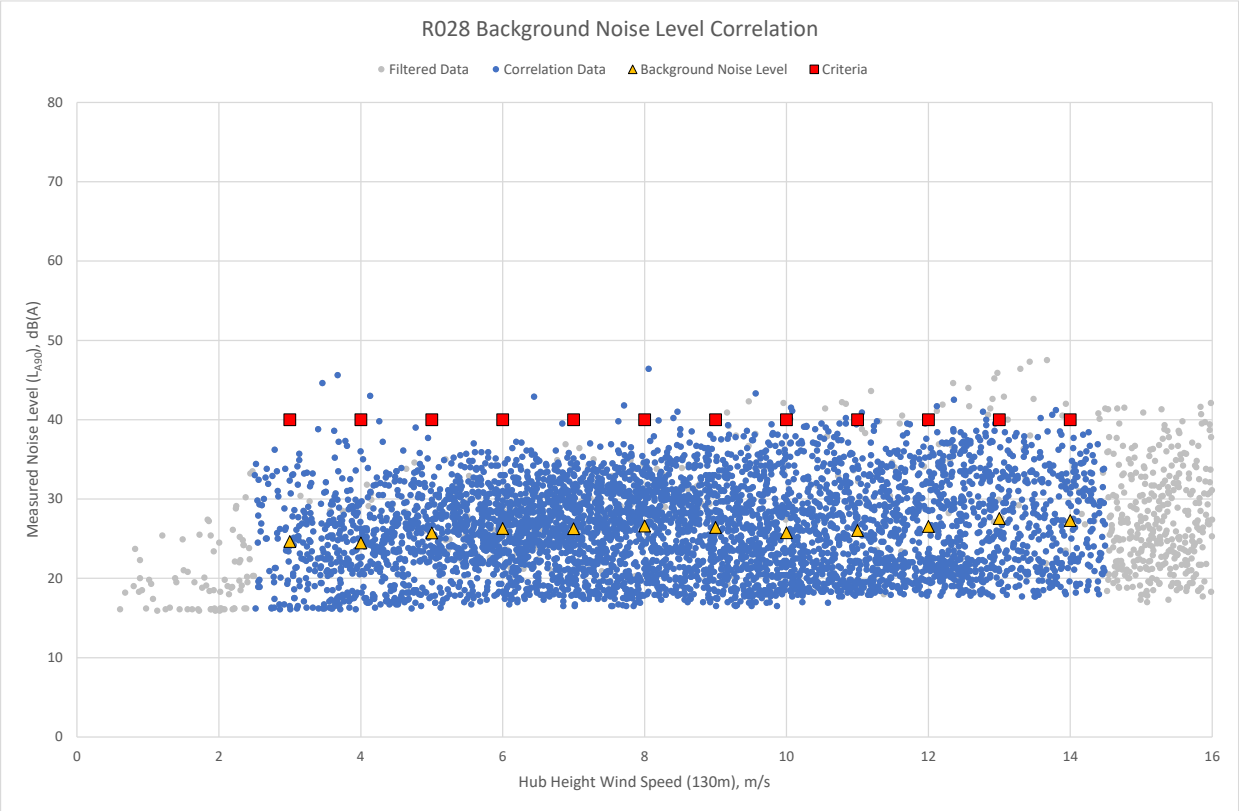


Figure 16: R028 Background Noise Level Correlation

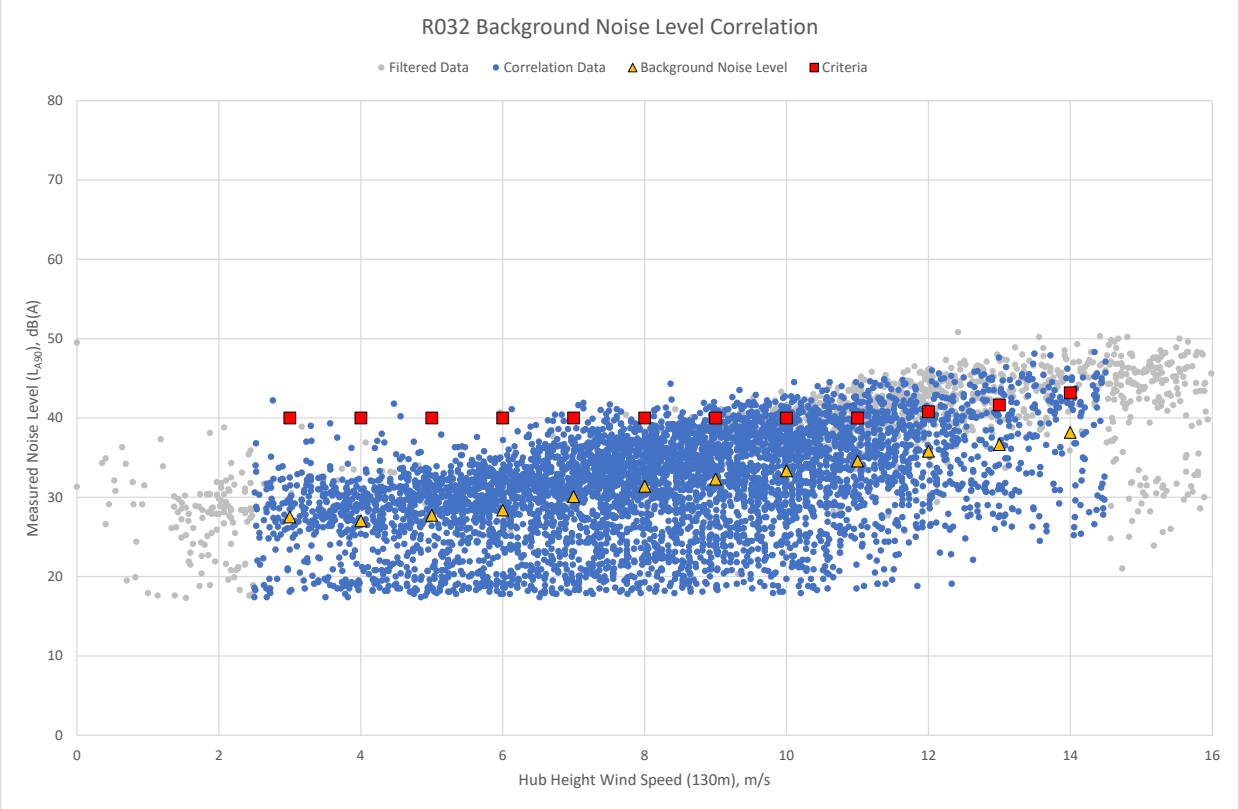


Figure 17: R032 Background Noise Level Correlation

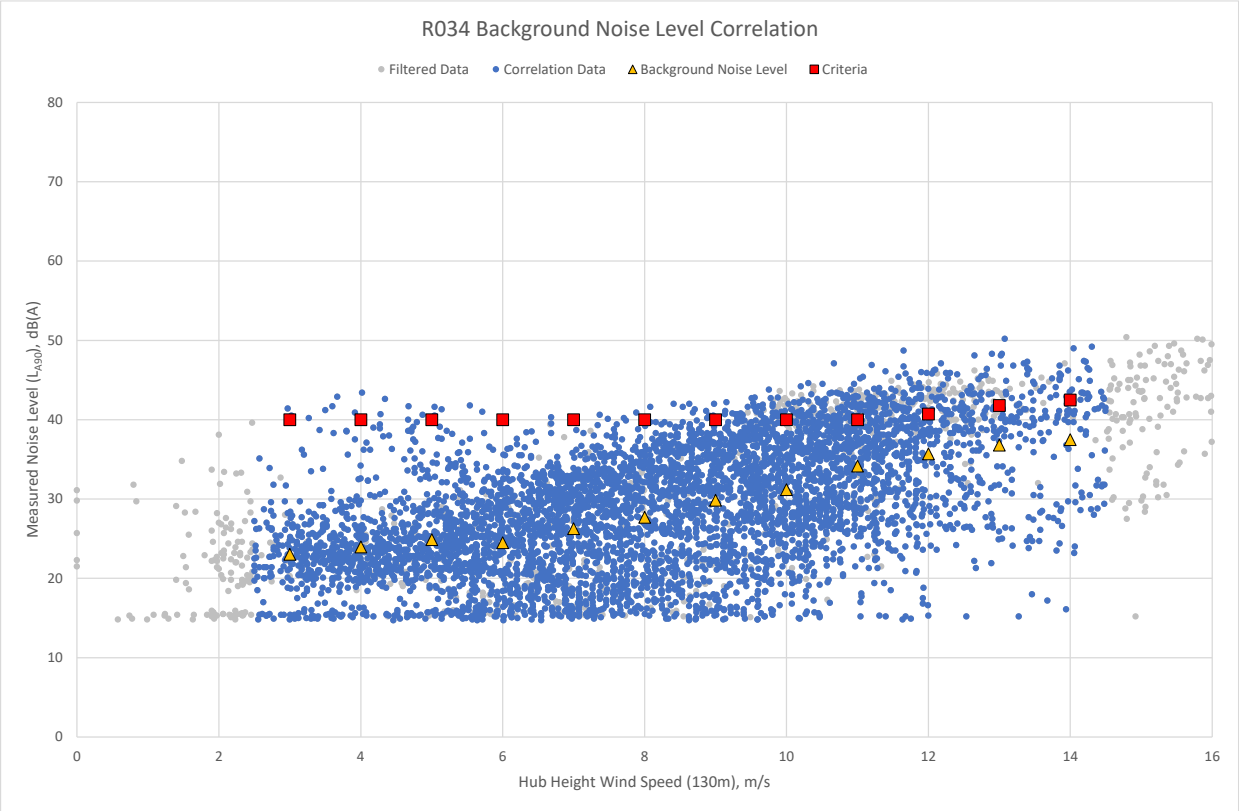


Figure 18: R034 Background Noise Level Correlation

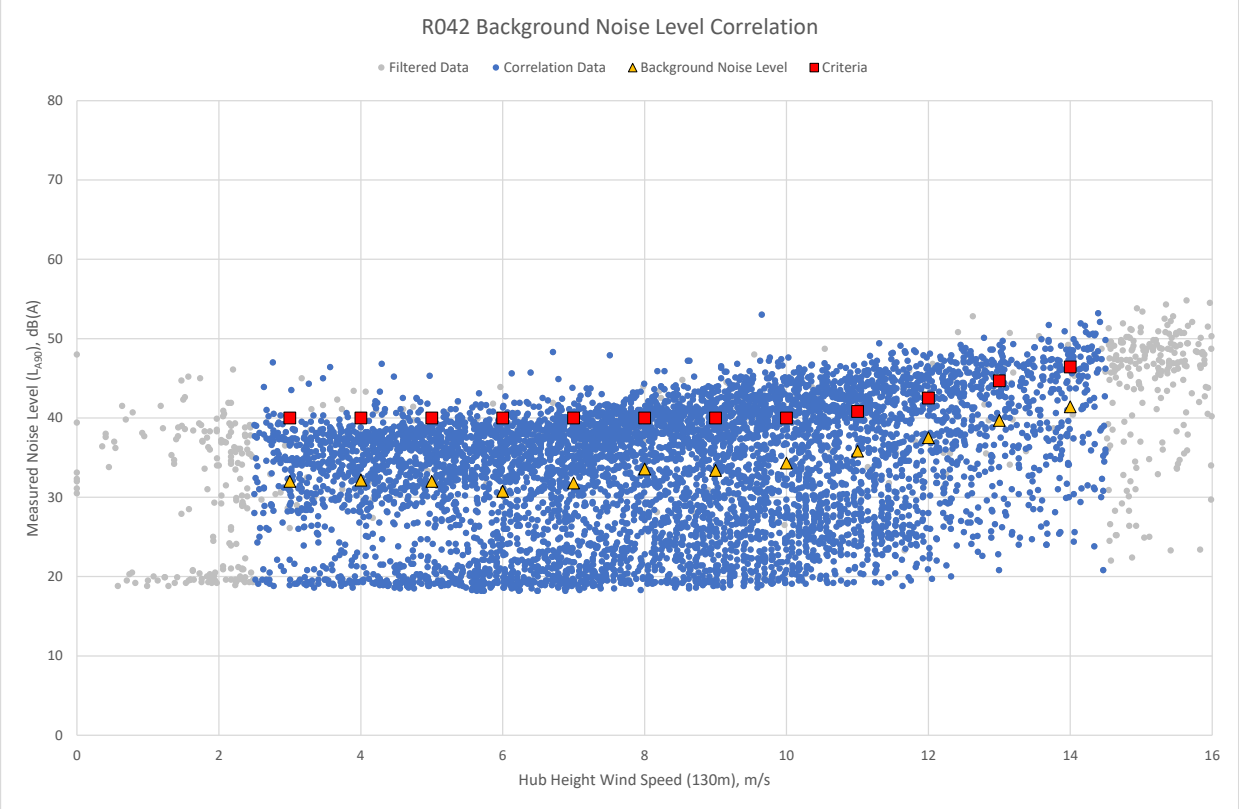


Figure 19: R042 Background Noise Level Correlation

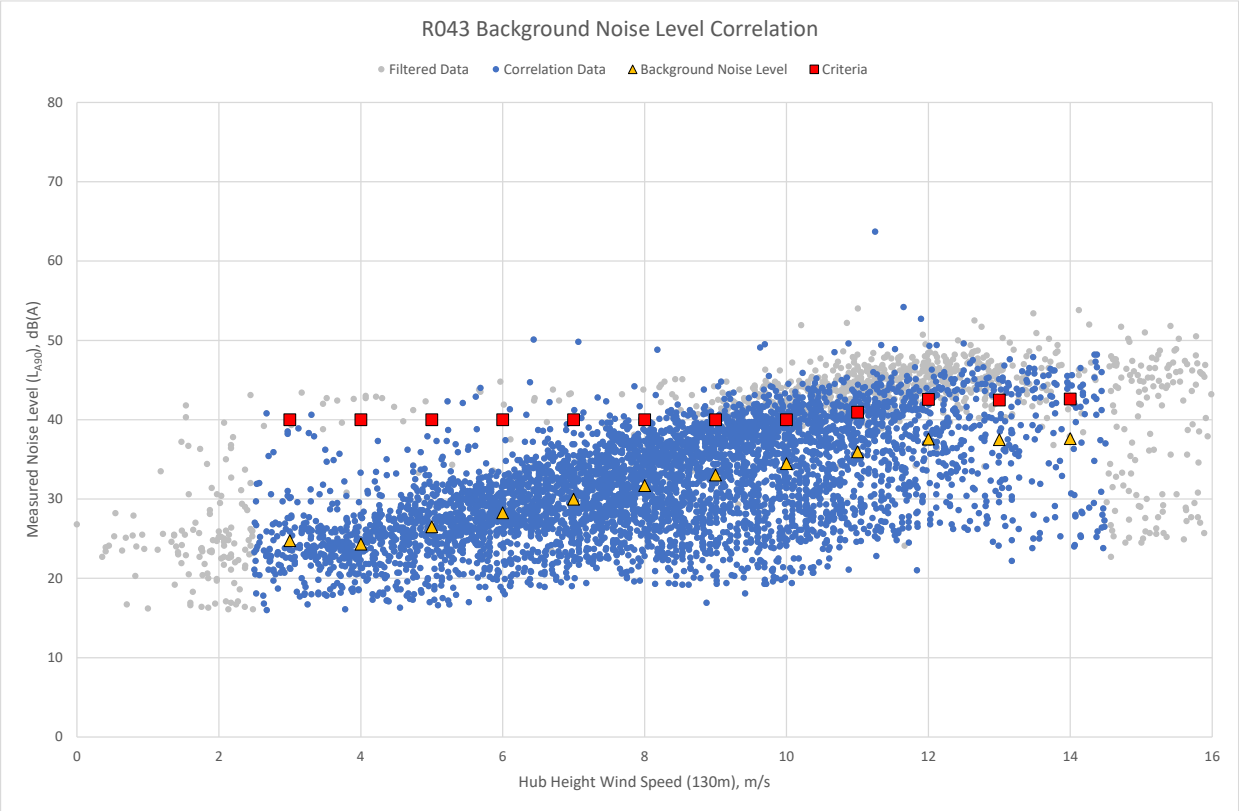


Figure 20: R043 Background Noise Level Correlation

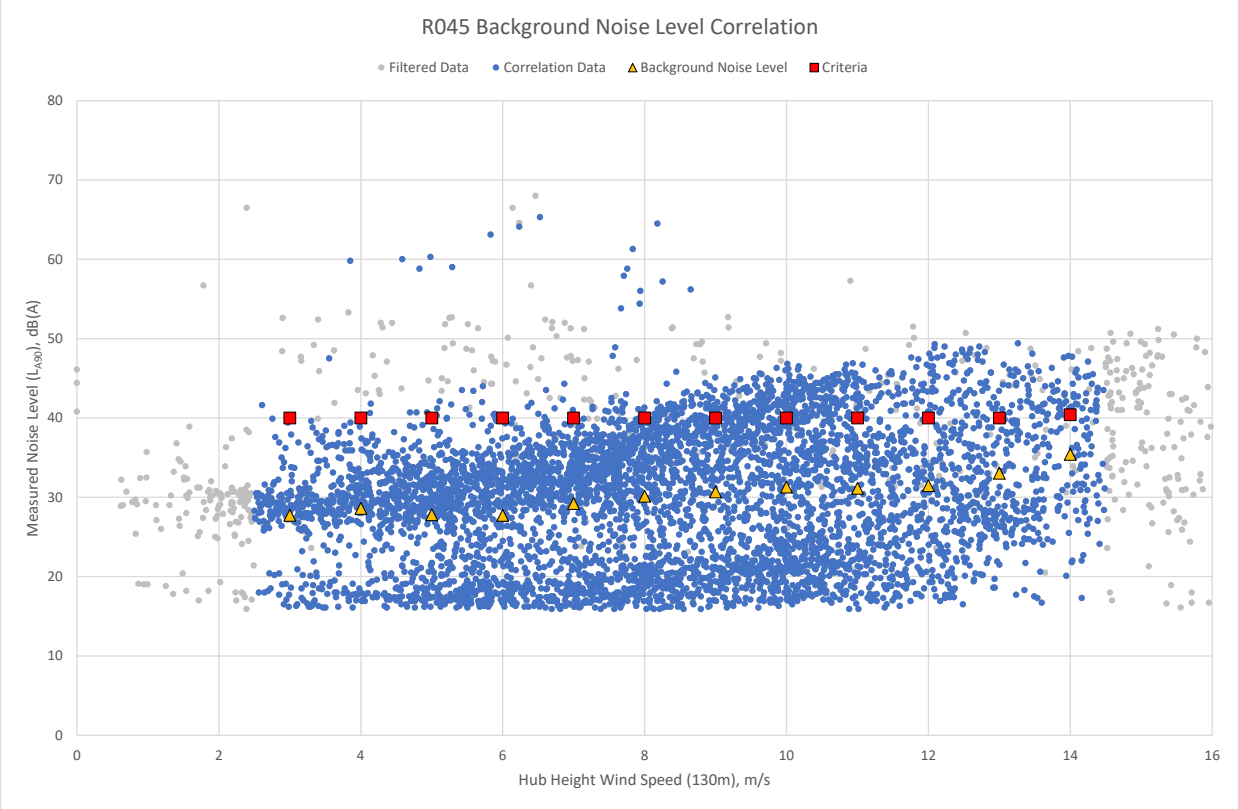


Figure 21: R045 Background Noise Level Correlation

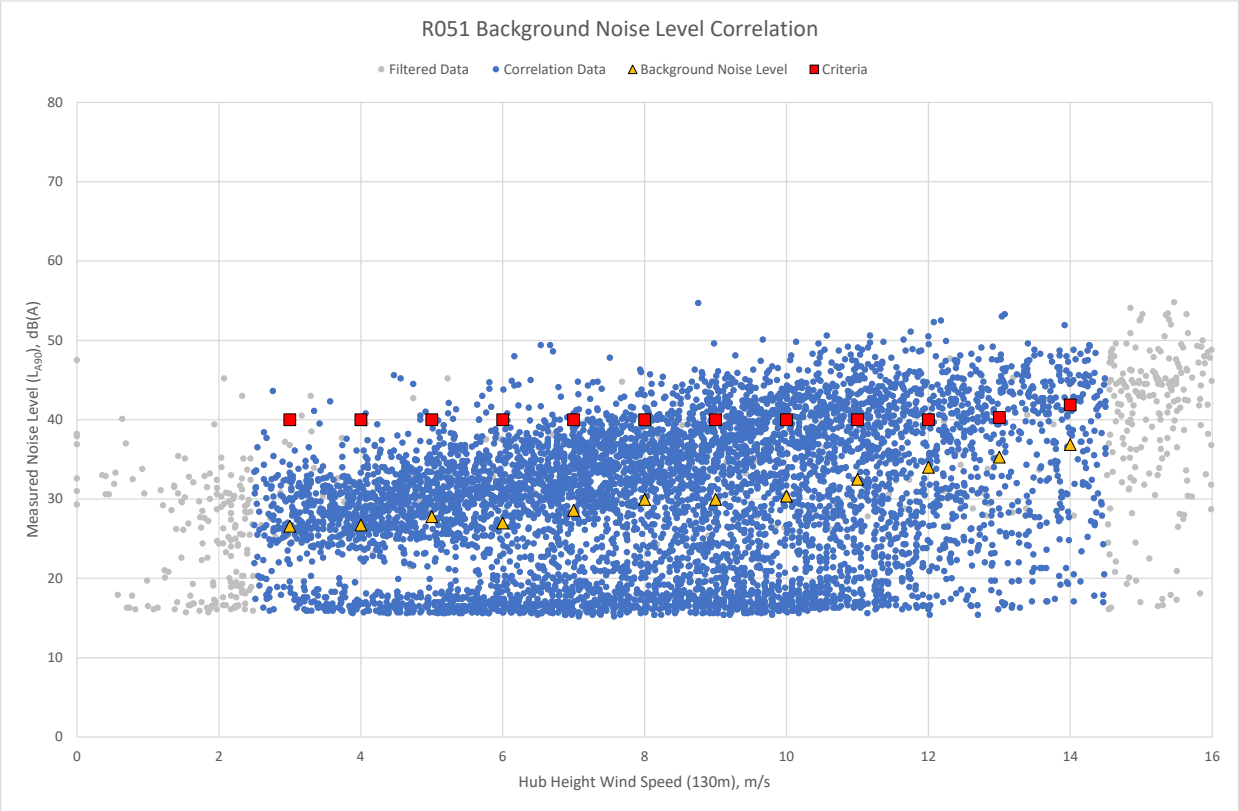


Figure 22: R051 Background Noise Level Correlation

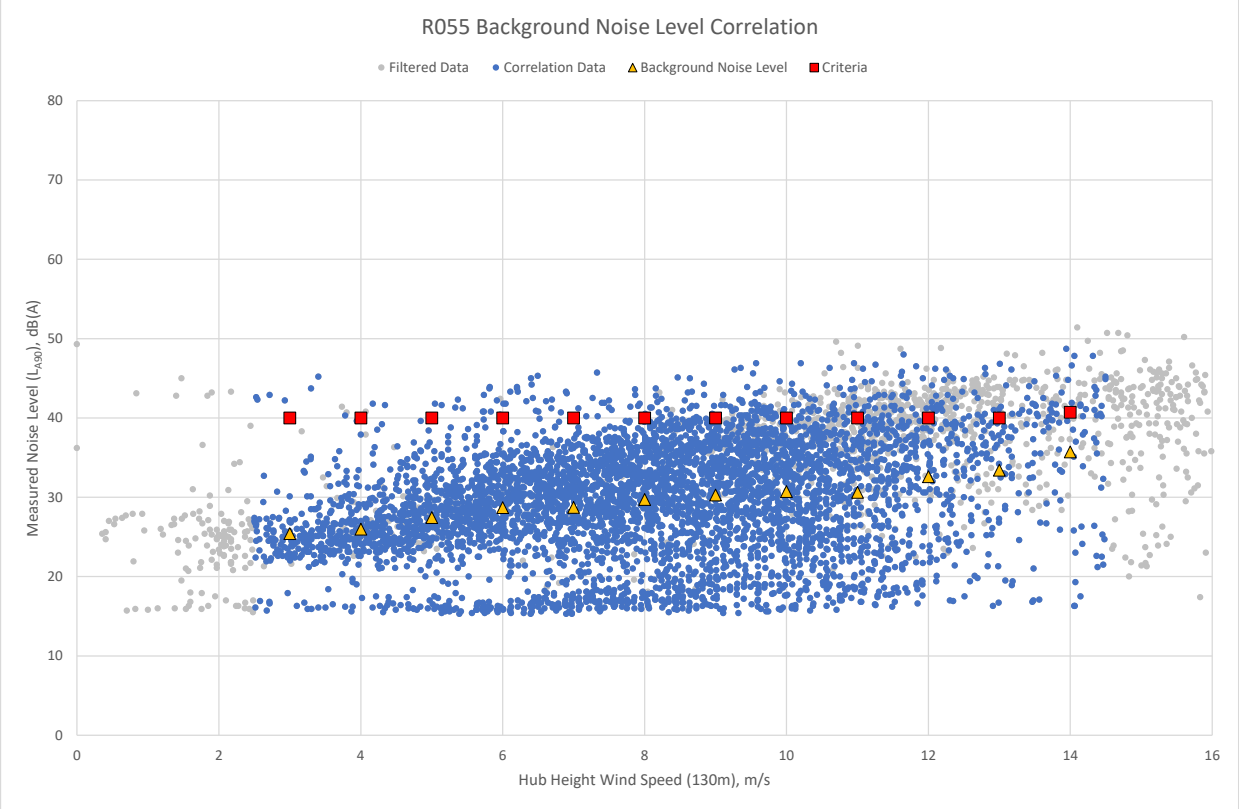


Figure 23: R055 Background Noise Level Correlation

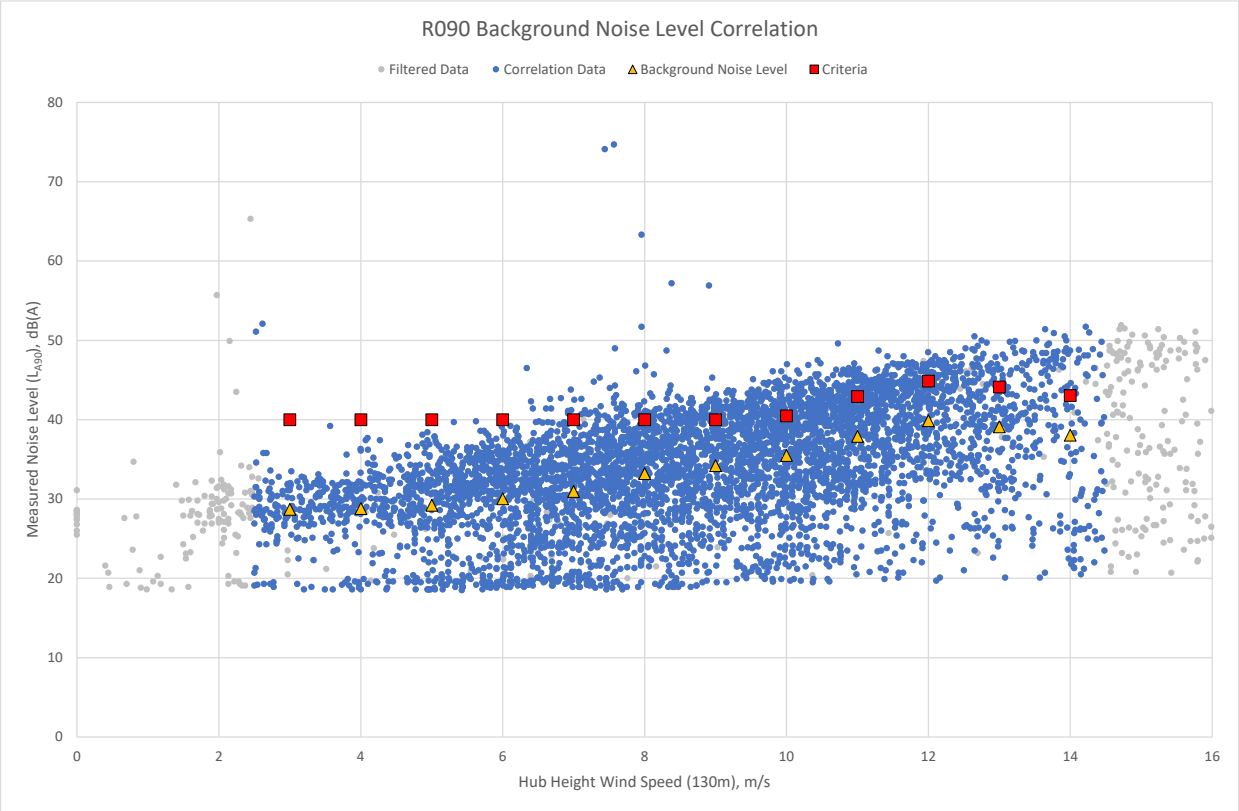


Figure 24: R090 Background Noise Level Correlation

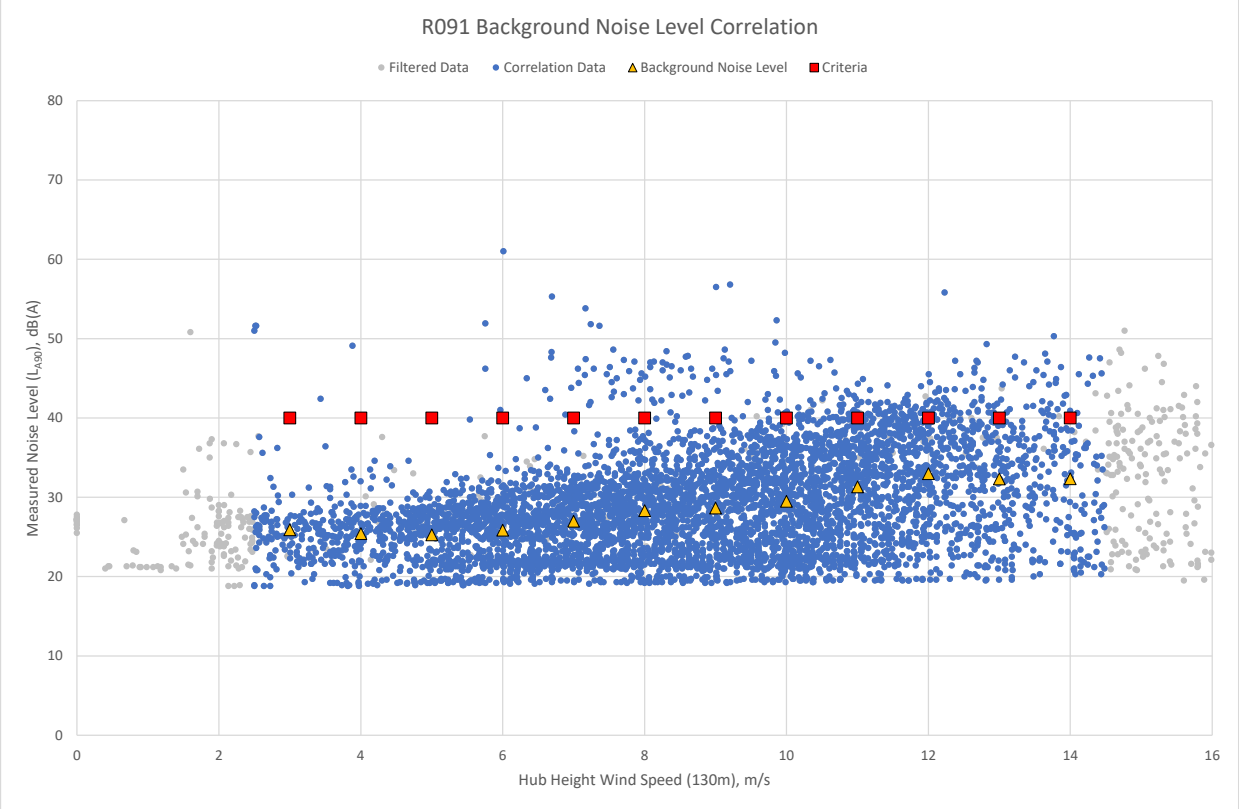


Figure 25: R091 Background Noise Level Correlation

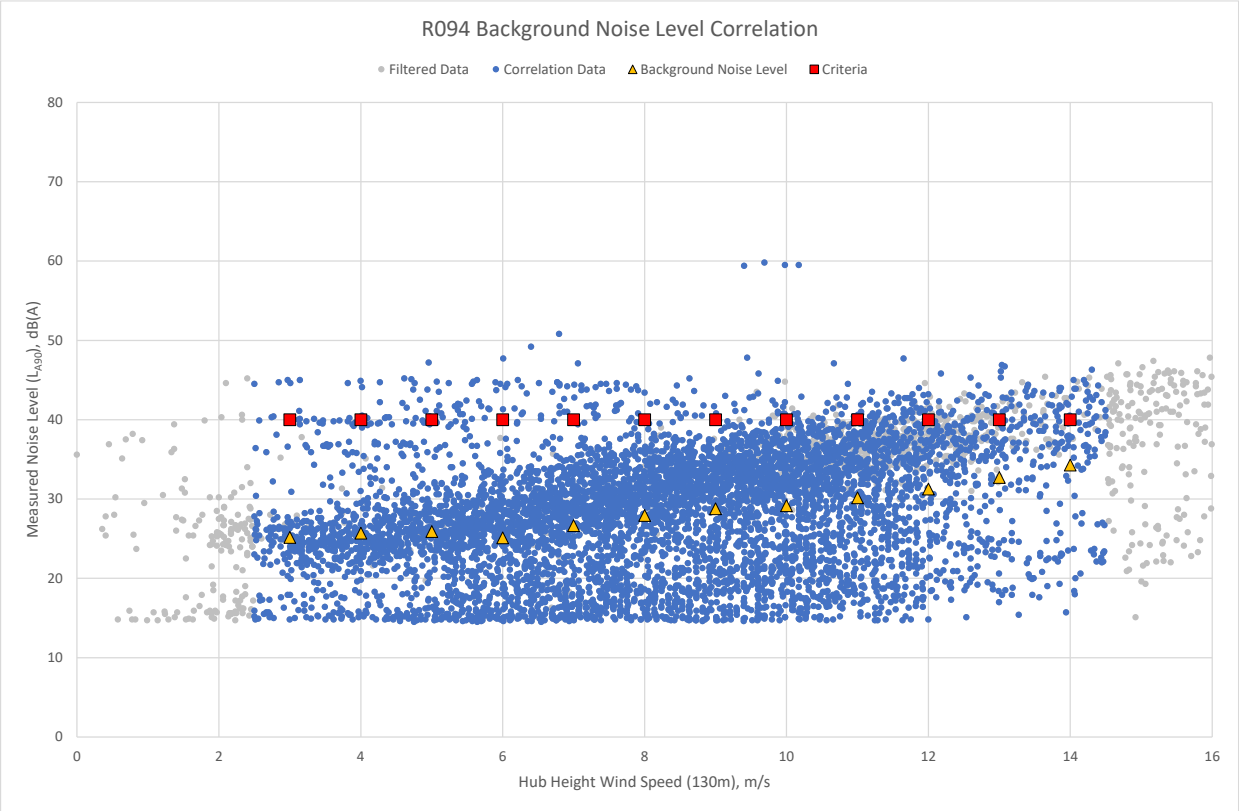


Figure 26: R094 Background Noise Level Correlation

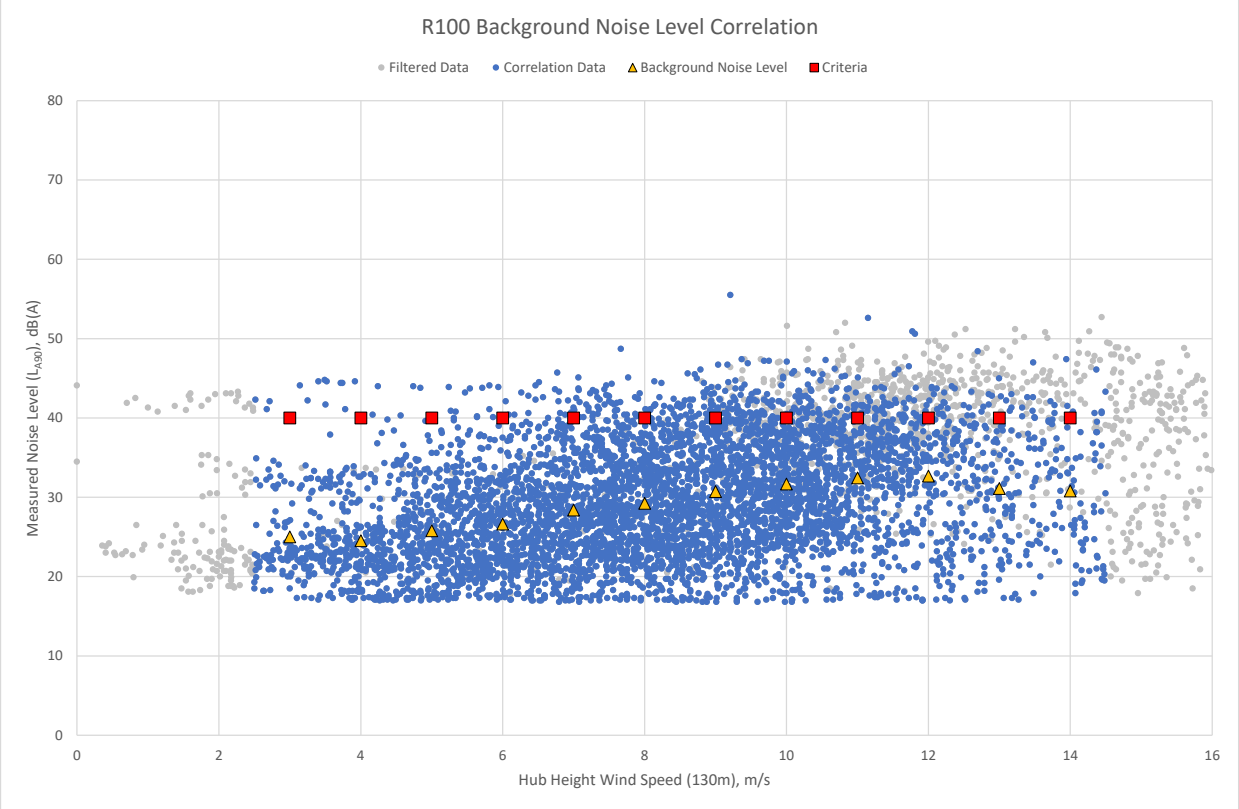


Figure 27: R100 Background Noise Level Correlation

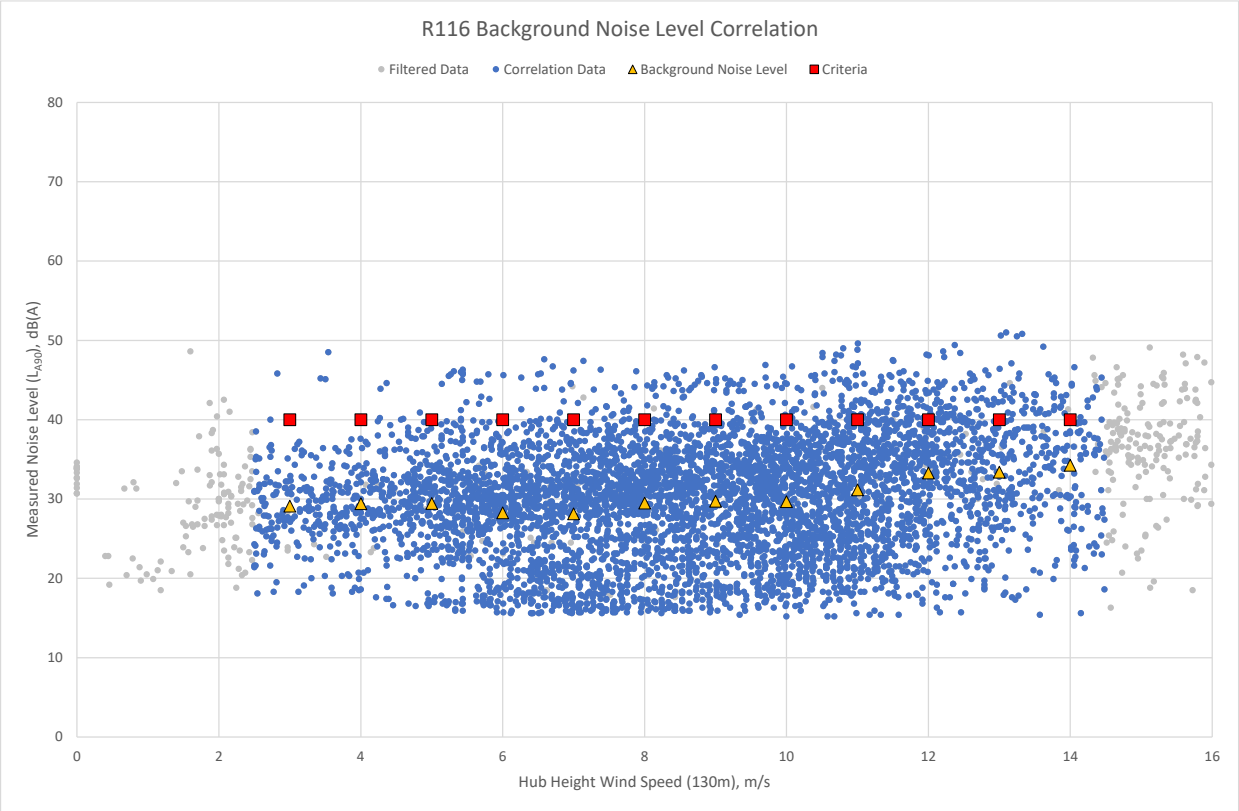


Figure 28: R116 Background Noise Level Correlation

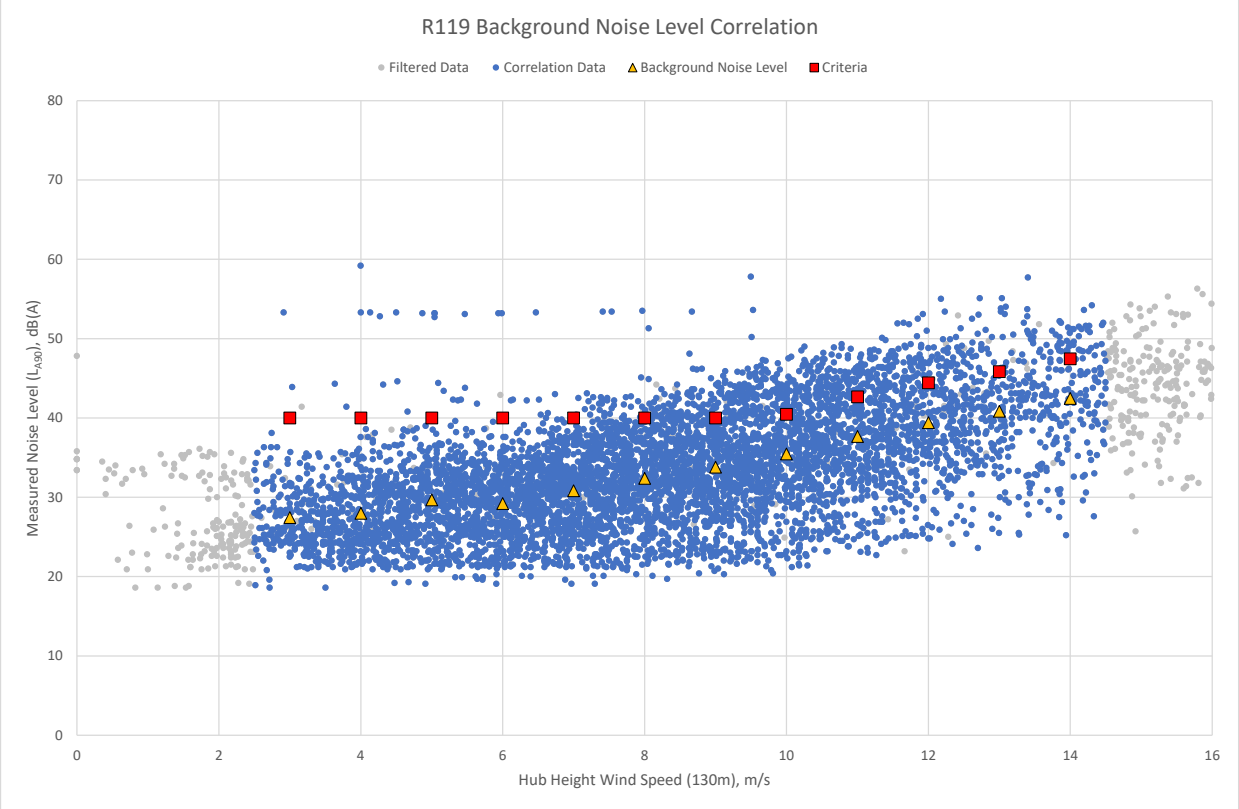


Figure 29: R119 Background Noise Level Correlation

APPENDIX E: NOISE LEVEL CRITERIA

Table 19: Operational Noise Criteria, dB(A)

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
A18	40	40	40	40	40	40	40	40	40	41	42
A69	40	40	40	40	40	40	40	40	40	41	42
A77	40	40	40	40	40	40	40	41	44	43	46
FR1	40	40	40	40	40	40	40	40	40	41	42
R001	40	40	40	40	40	40	40	40	40	40	40
R002	35	35	35	35	35	35	35	35	35	35	35
R003	35	35	35	35	35	35	35	35	35	35	35
R004	40	40	40	40	40	40	40	40	40	40	40
R005	35	35	35	35	35	35	36	37	37	38	36
R006	35	35	35	35	35	35	36	37	37	38	36
R007	40	40	40	40	40	40	40	40	40	41	42
R008	40	40	40	40	40	40	40	40	40	41	42
R009	40	40	40	40	40	40	40	40	40	41	42
R010	40	40	40	40	40	40	40	40	40	41	42
R011	40	40	40	40	40	40	40	40	40	41	42
R012	40	40	40	40	40	40	40	40	40	40	40
R013	40	40	40	40	40	40	40	40	40	40	40
R014	40	40	40	40	40	40	40	40	40	40	40
R015	40	40	40	40	40	40	40	41	44	43	46
R016	40	40	40	40	40	40	40	41	44	43	46
R017	40	40	40	40	40	40	40	40	40	40	40
R018	40	40	40	40	40	40	40	40	40	40	40
R019	40	40	40	40	40	40	40	40	40	40	40
R020	40	40	40	40	40	40	40	40	40	40	40
R021	40	40	40	40	40	40	40	40	40	40	40
R022	45	45	45	45	45	45	45	45	45	45	45
R023	40	40	40	40	40	40	40	40	40	41	43
R024	40	40	40	40	40	40	40	40	40	41	43
R025	40	40	40	40	40	40	40	40	40	41	43
R026	40	40	40	40	40	40	40	40	40	41	43
R027	40	40	40	40	40	40	40	40	40	41	43
R028	40	40	40	40	40	40	40	40	40	40	40
R030	40	40	40	40	40	40	40	40	40	41	42
R031	40	40	40	40	40	40	40	40	40	41	42
R032	40	40	40	40	40	40	40	40	40	41	42
R033	40	40	40	40	40	40	40	40	40	40	40
R034	40	40	40	40	40	40	40	40	40	41	42
R036	40	40	40	40	40	40	40	40	40	40	40
R037	40	40	40	40	40	40	40	40	40	40	40

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R038	40	40	40	40	40	40	40	40	40	40	40
R039	40	40	40	40	40	40	40	40	40	40	40
R040	40	40	40	40	40	40	40	40	40	41	42
R042	40	40	40	40	40	40	40	40	42	43	46
R043	40	40	40	40	40	40	40	40	41	43	42
R044	40	40	40	40	40	40	40	40	40	40	40
R045	40	40	40	40	40	40	40	40	40	40	40
R046	45	45	45	45	45	45	45	45	45	45	45
R047	45	45	45	45	45	45	45	45	45	45	45
R049	45	45	45	45	45	45	45	45	45	45	45
R050	45	45	45	45	45	45	45	45	45	45	45
R051	45	45	45	45	45	45	45	45	45	45	45
R052	45	45	45	45	45	45	45	45	45	45	45
R053	40	40	40	40	40	40	40	40	40	40	43
R054	40	40	40	40	40	40	40	40	40	40	43
R055	40	40	40	40	40	40	40	40	40	40	40
R056	45	45	45	45	45	45	45	45	45	45	45
R057	40	40	40	40	40	40	40	40	40	40	40
R058	40	40	40	40	40	40	40	40	40	40	40
R059	40	40	40	40	40	40	40	40	40	40	40
R060	40	40	40	40	40	40	40	40	40	40	40
R061	40	40	40	40	40	40	40	40	40	40	40
R062	40	40	40	40	40	40	40	40	40	40	43
R063	40	40	40	40	40	40	40	40	40	40	40
R064	40	40	40	40	40	40	40	40	40	40	43
R065	40	40	40	40	40	40	40	40	40	40	43
R066	40	40	40	40	40	40	40	40	40	40	43
R067	40	40	40	40	40	40	40	40	40	40	43
R068	40	40	40	40	40	40	40	40	40	40	43
R069	40	40	40	40	40	40	40	40	40	40	43
R070	40	40	40	40	40	40	40	40	40	40	43
R071	40	40	40	40	40	40	40	40	40	40	43
R072	40	40	40	40	40	40	40	40	40	40	43
R073	40	40	40	40	40	40	40	40	40	40	43
R074	40	40	40	40	40	40	40	40	40	40	43
R075	40	40	40	40	40	40	40	40	40	40	43
R076	40	40	40	40	40	40	40	40	40	40	43
R077	40	40	40	40	40	40	40	40	40	40	40
R078	40	40	40	40	40	40	40	40	40	40	40
R079	40	40	40	40	40	40	40	40	40	40	40
R080	40	40	40	40	40	40	40	40	40	40	40
R081	40	40	40	40	40	40	40	40	40	40	40

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R082	40	40	40	40	40	40	40	40	40	40	40
R083	40	40	40	40	40	40	40	40	40	40	40
R084	40	40	40	40	40	40	40	40	40	40	40
R086	40	40	40	40	40	40	40	40	40	40	40
R087	40	40	40	40	40	40	40	40	40	40	40
R088	40	40	40	40	40	40	40	40	40	40	40
R089	40	40	40	40	40	40	40	40	40	40	40
R090	40	40	40	40	40	40	40	40	43	45	44
R091	40	40	40	40	40	40	40	40	40	40	40
R093	40	40	40	40	40	40	40	41	44	43	46
R094	40	40	40	40	40	40	40	40	40	40	40
R095	40	40	40	40	40	40	40	40	43	44	46
R096	40	40	40	40	40	40	40	40	40	40	40
R097	35	35	35	35	35	35	36	37	37	38	36
R098	35	35	35	35	35	35	36	37	37	38	36
R099	35	35	35	35	35	35	36	37	37	38	36
R100	35	35	35	35	35	35	36	37	37	38	36
R102	40	40	40	40	40	40	40	40	43	45	44
R103	40	40	40	40	40	40	40	40	40	40	40
R104	40	40	40	40	40	40	40	40	40	40	40
R105	40	40	40	40	40	40	40	40	40	40	40
R106	40	40	40	40	40	40	40	40	40	40	40
R107	40	40	40	40	40	40	40	40	40	40	40
R108	40	40	40	40	40	40	40	40	41	43	42
R110	40	40	40	40	40	40	40	40	41	43	42
R111	40	40	40	40	40	40	40	40	40	40	40
R112	40	40	40	40	40	40	40	40	40	40	40
R113	40	40	40	40	40	40	40	40	40	40	40
R114	40	40	40	40	40	40	40	40	40	40	40
R115	40	40	40	40	40	40	40	40	40	40	40
R116	40	40	40	40	40	40	40	40	40	40	40
R117	45	45	45	45	45	45	45	45	45	45	45
R118	40	40	40	40	40	40	40	40	40	40	40
R119	40	40	40	40	40	40	40	40	43	44	46
R120	40	40	40	40	40	40	40	40	40	40	40
R121	40	40	40	40	40	40	40	40	40	40	43
R122	40	40	40	40	40	40	40	40	43	45	44
R123	40	40	40	40	40	40	40	40	40	41	43
R124	35	35	35	35	35	35	36	37	37	38	36
R125	40	40	40	40	40	40	40	40	40	40	43
R126	40	40	40	40	40	40	40	40	40	40	40
R127	40	40	40	40	40	40	40	40	43	45	44

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R128	40	40	40	40	40	40	40	40	40	40	40
R129	40	40	40	40	40	40	40	40	40	40	40
R130	40	40	40	40	40	40	40	40	40	40	40
R131	40	40	40	40	40	40	40	40	40	40	40
R132	40	40	40	40	40	40	40	40	40	40	40
R133	35	35	35	35	35	35	36	37	37	38	36
R134	40	40	40	40	40	40	40	40	40	41	44
R135	40	40	40	40	40	40	40	40	40	40	40
R136	45	45	45	45	45	45	45	45	45	45	45
R140	40	40	40	40	40	40	40	40	40	40	40
R141	40	40	40	40	40	40	40	40	40	40	40
R142	40	40	40	40	40	40	40	40	40	40	40
R143	40	40	40	40	40	40	40	40	40	40	40
R144	40	40	40	40	40	40	40	40	40	40	40
R145	40	40	40	40	40	40	40	40	40	40	40
R146	40	40	40	40	40	40	40	40	40	40	40
R147	40	40	40	40	40	40	40	40	40	40	40
R148	40	40	40	40	40	40	40	40	40	40	40
R149	40	40	40	40	40	40	40	40	40	40	40
R150	35	35	35	35	35	35	35	35	35	35	35
R151	35	35	35	35	35	35	35	35	35	35	35
R152	35	35	35	35	35	35	35	35	35	35	35
R153	35	35	35	35	35	35	35	35	35	35	35
R154	35	35	35	35	35	35	35	35	35	35	35
R155	35	35	35	35	35	35	35	35	35	35	35
R156	35	35	35	35	35	35	35	35	35	35	35
R157	35	35	35	35	35	35	35	35	35	35	35
R158	35	35	35	35	35	35	35	35	35	35	35
R159	35	35	35	35	35	35	35	35	35	35	35
R160	35	35	35	35	35	35	35	35	35	35	35
R161	35	35	35	35	35	35	35	35	35	35	35
R162	40	40	40	40	40	40	40	40	40	40	40
R163	35	35	35	35	35	35	35	35	35	35	35
R164	35	35	35	35	35	35	35	35	35	35	35
R165	40	40	40	40	40	40	40	40	40	40	40
R166	35	35	35	35	35	35	35	35	35	35	35
R167	40	40	40	40	40	40	40	40	40	40	40
R168	35	35	35	35	35	35	35	35	35	35	35
R169	40	40	40	40	40	40	40	40	40	40	40
R170	40	40	40	40	40	40	40	40	40	40	40
R171	40	40	40	40	40	40	40	40	40	40	40
R172	40	40	40	40	40	40	40	40	40	40	40

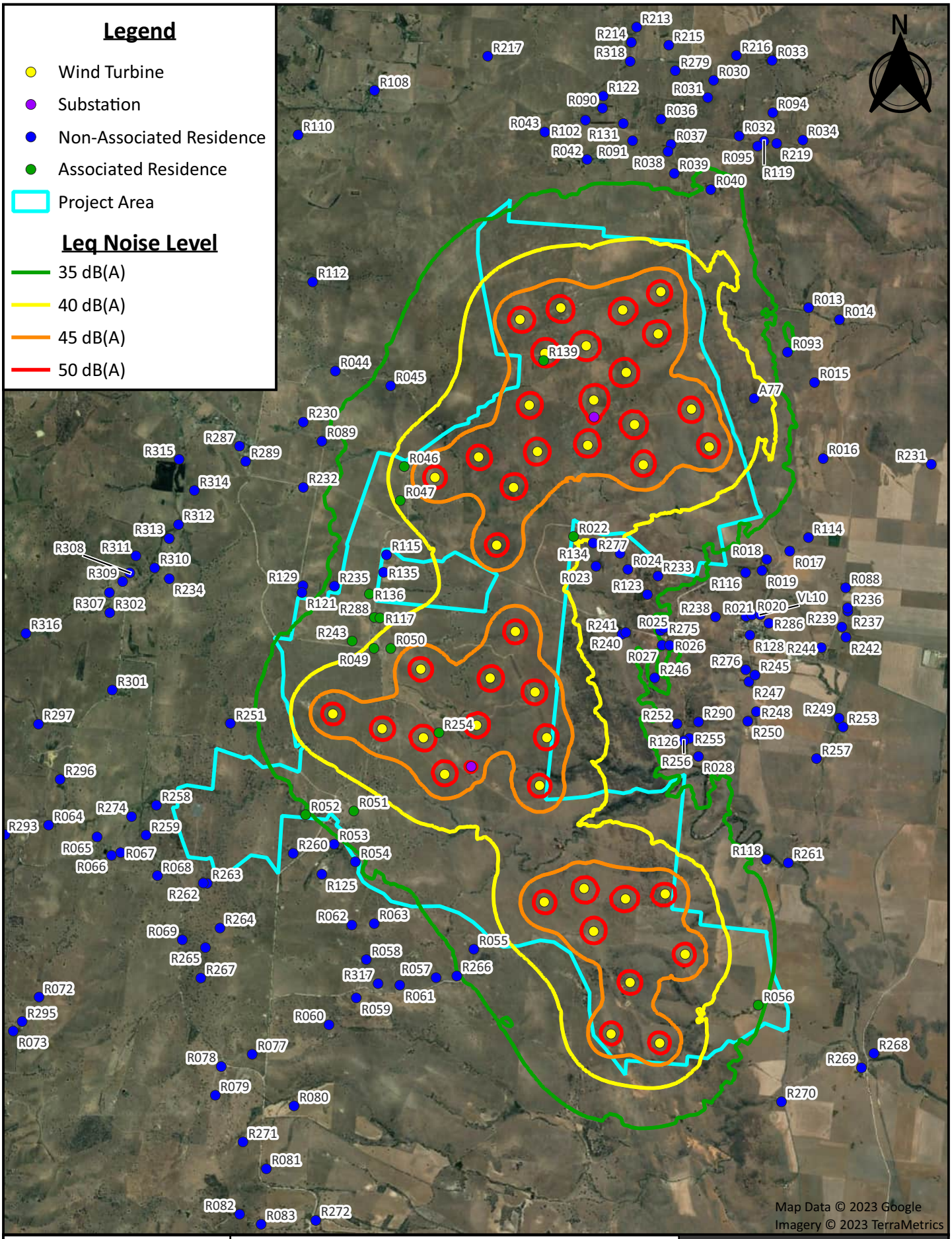
Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R173	40	40	40	40	40	40	40	40	40	40	40
R174	40	40	40	40	40	40	40	40	40	40	40
R175	40	40	40	40	40	40	40	40	40	40	40
R176	40	40	40	40	40	40	40	40	40	40	40
R177	40	40	40	40	40	40	40	40	40	40	40
R178	35	35	35	35	35	35	36	37	37	38	36
R179	40	40	40	40	40	40	40	40	40	40	40
R180	35	35	35	35	35	35	36	37	37	38	36
R181	40	40	40	40	40	40	40	40	40	40	40
R182	35	35	35	35	35	35	36	37	37	38	36
R183	40	40	40	40	40	40	40	40	40	40	40
R184	35	35	35	35	35	35	36	37	37	38	36
R185	40	40	40	40	40	40	40	40	40	40	40
R186	40	40	40	40	40	40	40	40	40	40	40
R187	35	35	35	35	35	35	36	37	37	38	36
R188	40	40	40	40	40	40	40	40	40	40	40
R189	40	40	40	40	40	40	40	40	40	40	40
R190	40	40	40	40	40	40	40	40	40	40	40
R191	35	35	35	35	35	35	36	37	37	38	36
R192	35	35	35	35	35	35	36	37	37	38	36
R193	40	40	40	40	40	40	40	40	40	40	40
R194	40	40	40	40	40	40	40	40	40	40	40
R195	40	40	40	40	40	40	40	40	40	40	40
R196	35	35	35	35	35	35	36	37	37	38	36
R197	40	40	40	40	40	40	40	40	43	45	44
R198	35	35	35	35	35	35	36	37	37	38	36
R199	35	35	35	35	35	35	36	37	37	38	36
R200	40	40	40	40	40	40	40	40	40	40	40
R201	35	35	35	35	35	35	36	37	37	38	36
R202	40	40	40	40	40	40	40	40	43	45	44
R203	35	35	35	35	35	35	36	37	37	38	36
R204	40	40	40	40	40	40	40	40	40	40	40
R205	35	35	35	35	35	35	36	37	37	38	36
R206	35	35	35	35	35	35	36	37	37	38	36
R207	35	35	35	35	35	35	36	37	37	38	36
R208	35	35	35	35	35	35	36	37	37	38	36
R209	40	40	40	40	40	40	40	40	40	40	40
R210	40	40	40	40	40	40	40	40	43	45	44
R211	40	40	40	40	40	40	40	40	40	41	42
R212	40	40	40	40	40	40	40	40	40	41	42
R213	40	40	40	40	40	40	40	40	43	45	44
R214	40	40	40	40	40	40	40	40	43	45	44

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R215	40	40	40	40	40	40	40	40	43	45	44
R216	40	40	40	40	40	40	40	40	40	40	40
R217	40	40	40	40	40	40	40	40	41	43	42
R218	40	40	40	40	40	40	40	40	40	41	42
R219	40	40	40	40	40	40	40	40	43	44	46
R220	40	40	40	40	40	40	40	40	40	40	40
R221	40	40	40	40	40	40	40	40	40	40	40
R222	35	35	35	35	35	35	35	35	35	35	36
R223	35	35	35	35	35	35	35	35	35	35	36
R224	40	40	40	40	40	40	40	40	40	40	40
R225	40	40	40	40	40	40	40	40	40	40	40
R226	40	40	40	40	40	40	40	40	40	40	40
R227	40	40	40	40	40	40	40	40	40	40	40
R228	40	40	40	40	40	40	40	40	40	40	40
R229	40	40	40	40	40	40	40	40	40	40	40
R230	40	40	40	40	40	40	40	40	40	40	40
R231	40	40	40	40	40	40	40	40	40	40	40
R232	40	40	40	40	40	40	40	40	40	40	40
R233	40	40	40	40	40	40	40	40	40	41	43
R234	40	40	40	40	40	40	40	40	40	40	40
R235	40	40	40	40	40	40	40	40	40	40	40
R236	40	40	40	40	40	40	40	40	40	40	40
R237	40	40	40	40	40	40	40	40	40	40	40
R238	40	40	40	40	40	40	40	40	40	40	40
R239	40	40	40	40	40	40	40	40	40	40	40
R240	40	40	40	40	40	40	40	40	40	41	43
R241	40	40	40	40	40	40	40	40	40	41	43
R242	40	40	40	40	40	40	40	40	40	40	40
R243	45	45	45	45	45	45	45	45	45	45	45
R244	40	40	40	40	40	40	40	40	40	40	40
R245	40	40	40	40	40	40	40	40	40	40	40
R246	40	40	40	40	40	40	40	40	40	40	40
R247	40	40	40	40	40	40	40	40	40	40	40
R248	40	40	40	40	40	40	40	40	40	40	40
R249	40	40	40	40	40	40	40	40	40	40	40
R250	40	40	40	40	40	40	40	40	40	40	40
R251	40	40	40	40	40	40	40	40	40	40	43
R252	40	40	40	40	40	40	40	40	40	40	40
R253	40	40	40	40	40	40	40	40	40	40	40
R255	40	40	40	40	40	40	40	40	40	40	40
R256	40	40	40	40	40	40	40	40	40	40	40
R257	40	40	40	40	40	40	40	40	40	40	40

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R258	40	40	40	40	40	40	40	40	40	40	43
R259	40	40	40	40	40	40	40	40	40	40	43
R260	40	40	40	40	40	40	40	40	40	40	43
R261	40	40	40	40	40	40	40	40	40	40	40
R262	40	40	40	40	40	40	40	40	40	40	43
R263	40	40	40	40	40	40	40	40	40	40	43
R264	40	40	40	40	40	40	40	40	40	40	43
R265	40	40	40	40	40	40	40	40	40	40	43
R266	40	40	40	40	40	40	40	40	40	40	40
R267	40	40	40	40	40	40	40	40	40	40	43
R268	40	40	40	40	40	40	40	40	40	40	40
R269	40	40	40	40	40	40	40	40	40	40	40
R270	40	40	40	40	40	40	40	40	40	40	40
R271	40	40	40	40	40	40	40	40	40	40	40
R272	40	40	40	40	40	40	40	40	40	40	40
R273	35	35	35	35	35	35	35	35	35	35	35
R274	40	40	40	40	40	40	40	40	40	40	43
R275	40	40	40	40	40	40	40	40	40	41	43
R276	40	40	40	40	40	40	40	40	40	40	40
R277	40	40	40	40	40	40	40	40	40	41	43
R278	40	40	40	40	40	40	40	40	40	40	40
R279	40	40	40	40	40	40	40	40	43	45	44
R280	40	40	40	40	40	40	40	40	40	40	40
R281	40	40	40	40	40	40	40	40	40	40	40
R282	35	35	35	35	35	35	35	35	35	35	35
R283	35	35	35	35	35	35	35	35	35	35	35
R284	40	40	40	40	40	40	40	40	40	40	40
R285	40	40	40	40	40	40	40	40	43	45	44
R286	35	35	35	35	35	35	35	35	36	38	38
R287	40	40	40	40	40	40	40	40	40	40	40
R288	45	45	45	45	45	45	45	45	45	45	45
R289	35	35	35	35	35	35	36	36	36	36	38
R290	40	40	40	40	40	40	40	40	40	40	40
R291	40	40	40	40	40	40	40	40	40	40	40
R292	40	40	40	40	40	40	40	40	40	40	40
R293	40	40	40	40	40	40	40	40	40	40	43
R294	40	40	40	40	40	40	40	40	40	40	43
R295	40	40	40	40	40	40	40	40	40	40	43
R296	40	40	40	40	40	40	40	40	40	40	43
R297	40	40	40	40	40	40	40	40	40	40	43
R298	40	40	40	40	40	40	40	40	40	40	43
R299	40	40	40	40	40	40	40	40	40	40	43

Residence ID	Hub Height (130m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R300	40	40	40	40	40	40	40	40	40	40	43
R301	40	40	40	40	40	40	40	40	40	40	43
R302	40	40	40	40	40	40	40	40	40	40	43
R303	40	40	40	40	40	40	40	40	40	40	43
R304	40	40	40	40	40	40	40	40	40	40	43
R305	40	40	40	40	40	40	40	40	40	40	43
R306	40	40	40	40	40	40	40	40	40	40	43
R307	40	40	40	40	40	40	40	40	40	40	43
R308	40	40	40	40	40	40	40	40	40	40	40
R309	40	40	40	40	40	40	40	40	40	40	43
R310	40	40	40	40	40	40	40	40	40	40	40
R311	40	40	40	40	40	40	40	40	40	40	40
R312	40	40	40	40	40	40	40	40	40	40	40
R313	40	40	40	40	40	40	40	40	40	40	40
R314	40	40	40	40	40	40	40	40	40	40	40
R315	40	40	40	40	40	40	40	40	40	40	40
R316	40	40	40	40	40	40	40	40	40	40	43
R317	40	40	40	40	40	40	40	40	40	40	40
R318	40	40	40	40	40	40	40	40	43	45	44
VL1	40	40	40	40	40	40	40	40	40	40	40
VL2	40	40	40	40	40	40	40	40	40	40	40
VL3	40	40	40	40	40	40	40	40	40	40	40
VL4	40	40	40	40	40	40	40	40	40	40	40
VL5	35	35	35	35	35	35	35	35	35	35	35
VL6	35	35	35	35	35	35	35	35	35	35	35
VL7	35	35	35	35	35	35	36	37	37	38	36
VL8	35	35	35	35	35	35	36	37	37	38	36
VL9	35	35	35	35	35	35	36	37	37	38	36
VL10	35	35	35	35	35	35	35	35	36	38	38

APPENDIX F: NOISE LEVEL CONTOURS

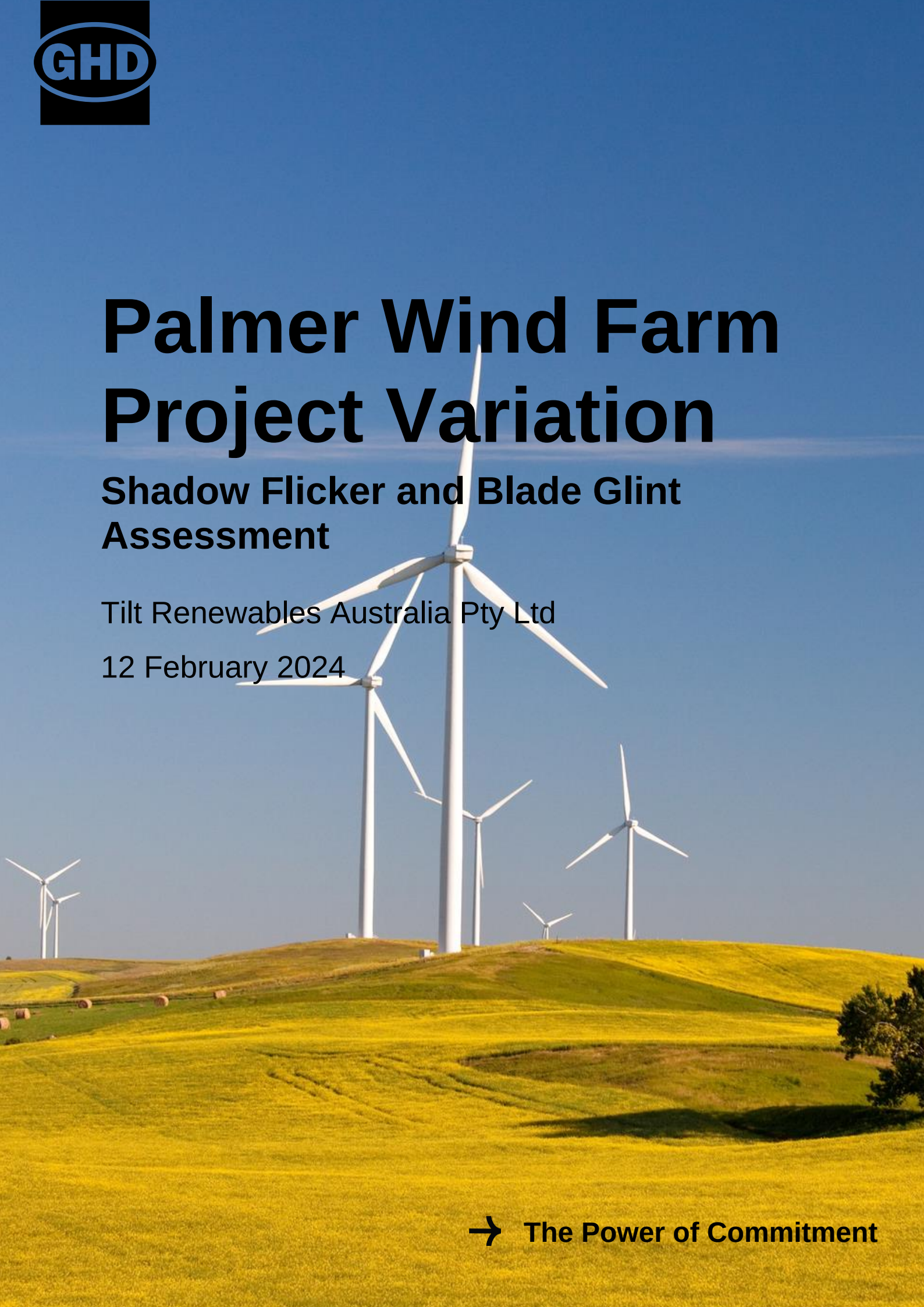

Legend
Wind Turbine
Substation
Non-Associated Residence
Associated Residence
Project Area
Leq Noise Level
35 dB(A)
40 dB(A)
45 dB(A)
50 dB(A)
N
R213
R214
R215
R216
R033
R217
R318
R279
R030
R108
R122
R031
R090
R094
R036
R110
R043
R102
R131
R032
R034
R037
R042
R091
R095
R219
R038
R039
R119
R040
R112
R013
R014
R139
R093
R044
R045
R015
A77
R230
R089
R287
R289
R315
R046
R016
R231
R314
R232
R047
R312
R313
R022
R277
R114
R308
R311
R115
R134
R018
R310
R024
R017
R309
R135
R233
R023
R088
R129
R235
R123
R116
R019
R234
R136
R236
R307
R302
R121
R288
R238
R021
R020
VL10
R239
R316
R117
R241
R025
R275
R286
R237
R243
R050
R240
R026
R128
R244
R242
R049
R027
R276
R246
R245
R301
R247
R297
R251
R254
R252
R290
R248
R249
R253
R250
R126
R255
R257
R256
R028
R296
R258
R052
R051
R274
R064
R293
R259
R053
R065
R067
R260
R054
R118
R261
R066
R068
R263
R125
R262
R062
R063
R264
R069
R055
R265
R058
R266
R267
R317
R057
R072
R061
R056
R295
R059
R060
R268
R073
R077
R269
R078
R079
R080
R270
R271
R081
R082
R083
R272
Map Data © 2023 Google
Imagery © 2023 TerraMetrics
0
1
2 km
PALMER WIND FARM
Noise Contour Plot
Vestas V172-7.2MW - 13m/s
Project Number: S4171
sonus.

Palmer Wind Farm Project Variation

Shadow Flicker and Blade Glint Assessment

Tilt Renewables Australia Pty Ltd

12 February 2024



The Power of Commitment

Project name		Palmer Wind Farm – Technical Assessments					
Document title		Palmer Wind Farm Project Variation | Shadow Flicker and Blade Glint Assessment					
Project number		12610992					
File name		12610992_RPT_Palmer Wind Farm Shadow Flicker Assessment_Rev1.docx					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
			Name	**Signature**	**Name**	**Signature**	**Date**
S4	0	L Markovic	J King		J Burdeniuk		25/01/24
S4	1	L Markovic	J King	*J King	J Burdeniuk		12/02/24

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Executive Summary

GHD Pty Ltd (GHD) was engaged by Tilt Renewables Australia Pty Ltd as trustee for Palmer Wind Farm Project Trust (Tilt Renewables) to prepare a shadow flicker and blade glint assessment for the proposed variation to the approved Palmer Wind Farm, which is to be located near Palmer, South Australia. The assessment comprised of undertaking a desktop shadow flicker study which involved modelling the proposed wind turbine generator configuration and the surrounding buildings (sensitive receptors), whilst identifying relevant impacts and mitigation measures for potential impacts on sensitive receptors located near the proposed wind farm.

Shadow flicker calculations for the proposed 2024 wind farm layout at Palmer Wind Farm were undertaken in accordance with the Draft National Wind Farm Development Guidelines for Australia (2010) (Draft Guidelines). This assessment has been undertaken for 40 specific turbines and 309 Receptor locations provided by Tilt Renewables. In the event that further changes are implemented to turbine siting, upon finalisation of the turbine locations prior to construction, Tilt Renewables should undertake an updated shadow flicker assessment to verify that there has been no increase in shadow flicker.

Receptors A77, R046, R047, and R049 were found to have theoretical worst case shadow flicker ranging from 40.41 to 136.18 hours per year (exceeding the 30 hours per year threshold in the Draft Guidelines) and expected shadow flicker ranging from 26.25 and 84.25 hours per year (exceeding the 10 hours per year threshold in the Draft Guidelines). Tilt Renewables has agreements in place with the owners of these dwellings and is seeking express consent from the owners in respect of the anticipated shadow flicker impacts. GHD has been advised by Tilt Renewables that if consent is not obtained prior to operation of the wind farm, curtailment measures will be put in place as necessary to reduce shadow flicker impacts at the relevant dwellings to the guideline levels.

It should be noted that the windPRO model is conservative for the worst case scenario and the results from the shadow flicker assessment are not completely representative of the actual shadow flicker created once the wind farm is operational.

In respect of blade glint, all wind turbine technical specifications and procurement documents should require that wind turbine blades are coated with a non-reflective finish to avoid the possible effects of blade glint to the surrounding areas.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.3 and the assumptions and qualifications contained throughout the Report.

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Appendix B Coordinates of proposed wind turbines (Approved Project)
Appendix C Coordinates of shadow flicker receptors

1. Introduction

GHD Pty Ltd (GHD) was engaged by Tilt Renewables Australia Pty Ltd as trustee for Palmer Wind Farm Project Trust (Tilt Renewables) to prepare a shadow flicker and blade glint assessment for the proposed variation to the approved Palmer Wind Farm, which is to be located near Palmer, South Australia. The assessment comprised of undertaking a desktop shadow flicker study which involved modelling the proposed wind turbine generator configuration and the surrounding buildings (sensitive receptors), whilst identifying relevant impacts and mitigation measures for potential impacts on buildings located near the proposed wind farm. The Approved Project is proposed to be varied to reduce the number of wind turbine generators (WTG) from 103 to 40 and to increase the turbine height and blade length.

1.1 Purpose of this report

The purpose of this report is to assess the potential impacts of shadow flicker and blade glint caused by the revised WTG layout at Palmer Wind Farm, and to assist with the assessment of Tilt Renewables' application to vary the existing Development Plan Consent for the Project. A comparative analysis was also undertaken for the potential impacts associated with the Varied Project against the Approved Project.

1.2 Project overview

The proposed wind farm development is located approximately 50 km East of Adelaide. The proposed wind farm (as varied) will have 40 wind turbines.



Figure 1 Palmer Wind Farm location showing varied turbine layout

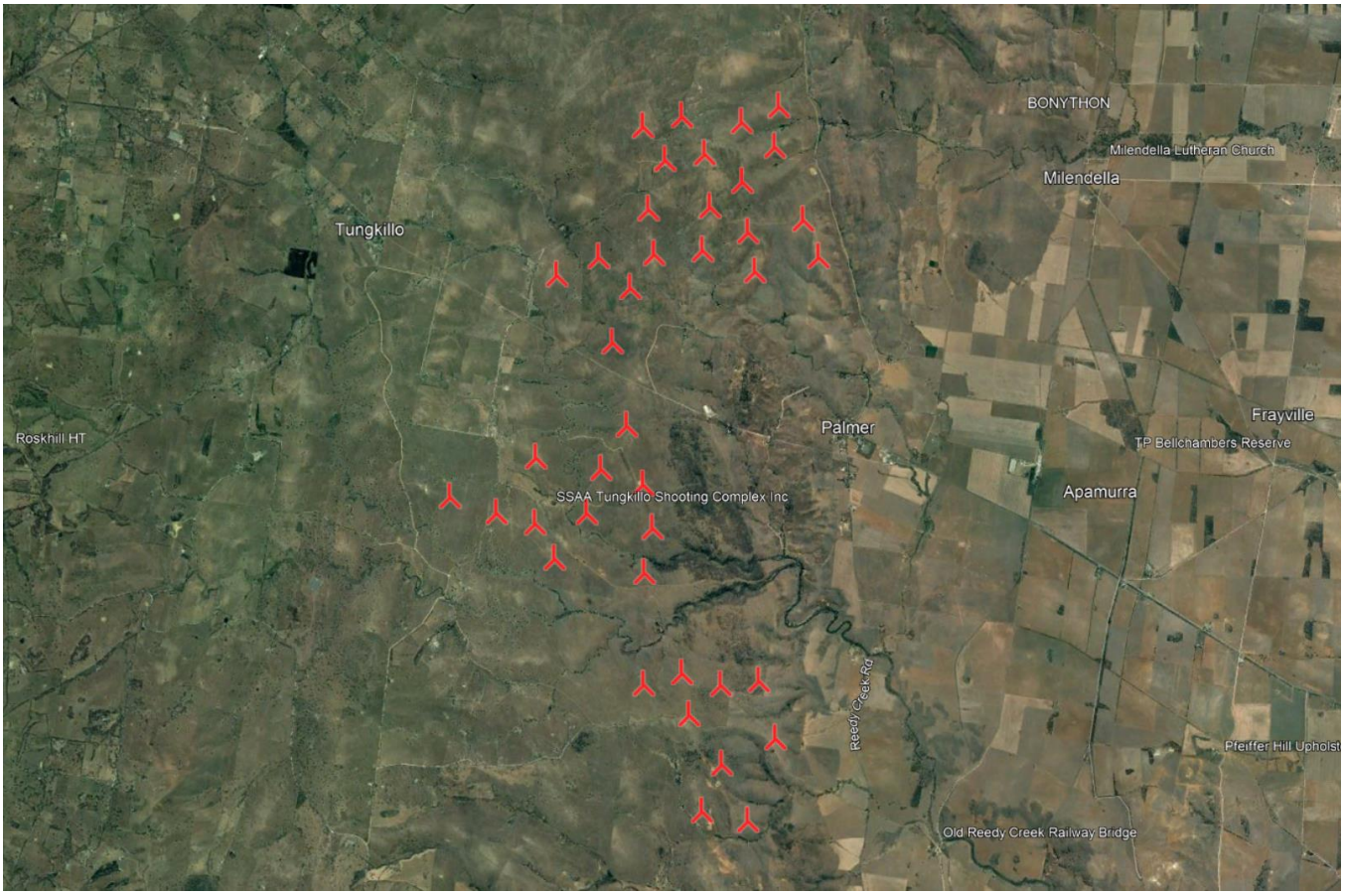


Figure 2 Overview of wind farm arrangement (40 WTG varied layout)

1.3 Scope and limitations

This report has been prepared by GHD for Tilt Renewables Australia Pty Ltd and may only be used and relied on by Tilt Renewables Australia Pty Ltd for the purpose agreed between GHD and Tilt Renewables Australia Pty Ltd as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Tilt Renewables Australia Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

GHD has prepared this report on the basis of information provided by Tilt Renewables Australia Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Methodology

The following methodology was used to complete the shadow flicker and blade glint assessment.

1. Request for Information, including:
    a. Turbine layout (turbine designations and coordinates)
    b. Turbine model technical parameters (i.e. hub height, rotor diameter, etc.)
    c. Proposed infrastructure/buildings (sensitive receptors) designation and coordinates
2. Input of base information into EMD windPRO 3.6 wind farm modelling software package
3. Selection of shadow flicker calculation parameters
4. Shadow flicker simulation
5. Recommendations on blade glint
6. Reporting

2.1 Information provided

The permitted turbine locations, contours, and receptor locations were obtained from Tilt Renewables on 24 May 2023[1,2,3], whilst information for the proposed turbine model, including hub height, rotor diameter, and maximum blade chord was obtained over email from Tilt Renewables on 30 May 2023. The updated WTG layout and further information for the Varied Project area was received in an email from Tilt Renewables on 23 October 2023[4] and 30 October 2023[5].

2.2 Reference documents and assessment requirements

GHD has conducted the shadow flicker assessment in accordance with the *Draft National Wind Farm Development Guidelines for Australia (2010)* (Draft Guidelines), which state that maximum value of shadow flicker duration experienced within 50 m of the centre of a dwelling must not exceed 30 hours per year.

Exception is given if the operator of the wind energy facility has entered into an agreement with a landowner under which the landowner acknowledges and accepts that shadow flicker may exceed 30 hours per annum at the landowner's residence.

Table 1 Assessment requirements as per Draft Guidelines

Parameter	Limit/Description
Shadow flicker limit	30 h/year at each Receptor (worst case) 10 h/year at each Receptor (expected case)
Zone of influence of shadows	Distance limit of 265 x maximum blade chord in metres (1,145 m)
Impact of cloud cover	Not to be included in the windPRO simulation and has not been considered

[1] PMWF Varied Project Data Supply 20230524.zip
[2] PMWF_Varied Project Data supply 1m_Contours_20230524.zip
[3] PMWF_Varied Project Data Supply Elevation DTM_20230524.zip
[4] PMWF_Varied Project_20231023
[5] 231024 PMWF Turbine Coordinates.xlsx

2.3 Inputs

The following inputs were used for the shadow flicker assessment.

– Turbine characteristics[6] (refer to Section 2.3.1)
– Varied Project turbine layout[7]
– Receptor locations (based on site layout[8])
– Information is based on the GDA2020 MGA Zone 54 datum coordinate system

It should be noted that publicly sourced height contour information from windPRO was used for this study as the contours provided by Tilt Renewables did not provide height data for all Receptor locations provided.

2.3.1 Turbine characteristics

Tilt Renewables has requested the following turbine variant and hub height to be modelled for this assessment, as shown in Table 2.

Table 2 Turbine specifications

Part	Dimension
Turbine type	Vestas V172-7.2
Maximum blade chord width	4.32 m
Hub height	130 m
Rotor diameter	180 m

2.4 Assumptions

The shadow flicker model was calculated for a distance of 1,145 m from the turbines and was conducted at 1-minute intervals with a grid resolution of 10 m. The turbine orientation within the shadow flicker model is such that the turbine and rotor plane is facing the azimuth at 180° relative to all Receptors. The following key assumptions in Table 3 were used for the model.

Table 3 Draft Guideline parameters

Parameter	Limit / Description
Shadow flicker limit	30 h/year at each Receptor (worst case) 10 h/year at each Receptor (expected case)
Receptor height	2 m
Receptor model	Greenhouse mode (i.e. the Receptors do not face any specific direction and instead face all directions. This model is conservative and is deemed appropriate as the specific properties of the Receptors – e.g. location, positioning of windows, etc. – are unknown)
Turbine orientation and rotation	Worst case scenario (the turbines are always rotating and perpendicular to the direction of incident sunlight)
Maximum distance of influence	1,145 m (265 x maximum blade chord)
Minimum sun angle	3 degrees
Impact of cloud cover	Not considered
Turbine model	Vestas V172-7.2 (using the specifications outlined in Table 2)

[6] Email from Tilt Renewables dated 30 May 2023
[7] 231024 PMWF Turbine Coordinates.xlsx
[8] Dwellings.shp

Parameter	Limit / Description
Residence window size	2 x 2 m
Slope of window	90° vertical (normal window)
Grid resolution	10 m
Time step for calculation	1 minute
Day step for calculation	1 day

It is noted that the worst-case shadow flicker model is conservative and does not consider the following:

– Cloud cover
– Impact of wind direction on the orientation of the WTG during periods of potential shadow flicker, and whether this might reduce the shadow flicker experienced at the Receptors (as opposed to the assumption that turbines will always be perpendicular to the sun)
– Any potential changes to the wind farm's operating regime to minimise operation of wind turbines contributing to shadow flicker
– Turbine down-time due to wind speeds below the cut-in wind speed
– Turbine down-time during maintenance
– Existing screening in the vicinity of affected properties (i.e. vegetation)
– Any vegetation blocking the visibility of wind turbines

3. Calculations and Results

3.1 Modelled shadow flicker

The shadow flicker assessment completed in windPRO was modelled using both a worst case and expected case scenario. The worst case scenario obtained a shadow flicker model that was highly conservative as it assumes that the sun is always shining for the entire day (sunrise to sunset) with zero cloud cover, whilst the expected case uses historical cloud cover statistics.

3.1.1 Worst case shadow flicker

As a first pass check, 'worst case' amounts of shadow flicker were calculated. These are considered highly conservative due to the following assumption in addition to the above:

– The sun is shining the entire day, from sunrise to sunset, with zero cloud cover

3.1.2 Expected case shadow flicker

The 'expected case' modelling differs from the worst-case model as the results are scaled according to the statistical likelihood of cloud cover for different times of day, and month of year. Other than an adjustment for cloud cover, the expected case still includes the conservative assumptions described in Section 2.3, as recommended by the Guideline. Cloud cover statistics are based on:

– Historical cloud cover statistics taken from Nuriootpa Climate Station (approximately 46 km from the site).

3.1.3 Results

The results for the shadow flicker assessment indicate that Receptors A77, R046, R047, and R049 exceed the maximum recommended limit of 30 hours per year for the worst case scenario. Furthermore, there is an exceedance of the recommended 10 hours per year limit for expected case shadow flicker, which varies from 26.25 hours/year to 84.25 hours/year for the aforementioned Receptors.

Tilt Renewables has agreements in place with the owners of these dwellings and is seeking express consent from the owners in respect of the anticipated shadow flicker impacts. GHD has been advised by Tilt Renewables that if consent is not obtained prior to operation of the wind farm, curtailment measures will be put in place as necessary to reduce shadow flicker impacts at the relevant dwellings to the guideline levels.

Due to the significant number of Receptor locations assessed, only those relevant to the Varied Project and with calculated shadow flicker greater than zero are depicted in Table 4.

Table 4 windPRO shadow flicker results (Varied Project layout – 40 WTG)

Receptor	Easting (m)*	Southing (m)*	Z (m)	Worst Case Shadow Flicker (days/year)	Worst Case Max. Shadow Hours per Day (hours/day)	Worst Case Shadow Flicker (hours/year)	Expected Case Shadow Flicker (hours/year)
A77	331813	6145581	354.0	72	0.45	40.41	26.25
R046	326056	6144460	325.3	105	1.28	127.13	84.25
R047	325991	6143902	323.7	137	1.12	136.18	68.29
R049	325558	6141470	310.2	75	0.56	57.02	37.42
R139[+]	328350	6146204	430.0	303	5.52	1205.45	665.01
R254[+]	326627	6140083	305.3	235	2.18	392.44	250.37

* *GDA2020 MGA Zone 54*

[+] *Agreements with owners are in place for these buildings to be abandoned for the life of the wind farm.*

By way of comparison, the shadow flicker results for Receptors that would have been affected by the Approved Project layout (i.e. 103 WTG) has been provided in Table 5. A side-by-side comparison of the results for the Varied Project against the Approved Project is provided in Table 6.

Table 5 windPRO shadow flicker results (Approved Project layout – 103 WTG)

Receptor	Easting (m)*	Southing (m)*	Z (m)	Worst Case Shadow Flicker (days/year)	Worst Case Max. Shadow Hours per Day (hours/day)	Worst Case Shadow Flicker (hours/year)	Expected Case Shadow Flicker (hours/year)
A77	331813	6145581	354.0	66	0.46	37.11	21.26
R056	331880	6135601	112.0	69	0.48	41.42	23.54
R139+	328350	6146204	430.0	365	8.27	2035.55	1212.52
R254+	326627	6140083	305.3	240	1.21	214.58	123.00
R096	331915	6152644	376.8	118	0.48	67.08	44.36

* *GDA2020 MGA Zone 54*

+ *Agreements with owners are in place for these buildings to be abandoned for the life of the wind farm.*

Shadow flicker varies between the Approved and Varied Project layout due to the differences in WTG layout (i.e. layout has been reduced from 103 WTG to 40 WTG and turbine coordinates are different). While shadow flicker exceedance has diminished within the Varied project layout for Receptors R056, R096, R139, and R254, there has been an increase in shadow flicker exceedance for Receptors A77, R046, R047, R049, and the expected case for Receptor R254, as depicted in Table 6. However, as previously noted, R254 will be abandoned for the life of the wind farm and the remaining dwellings will have agreements in place to accept shadow flicker impacts, or curtailment measures will be implemented to ensure shadow flicker impacts are reduced to the acceptable guideline levels.

Table 6 Varied Project (40 WTG) and Approved Project (103 WTG) windPRO shadow flicker result comparison

Receptor	Easting (m)*	Southing (m)*	Z (m)	Worst Case Shadow Flicker (hours/year)		Expected Case Shadow Flicker (hours/year)	
				Varied Project	Approved Project	Varied Project	Approved Project
A77	331813	6145581	354.0	40.41	37.11	26.25	21.26
R046	326056	6144460	325.3	127.13	0	84.25	0
R047	325991	6143902	323.7	136.18	0	68.29	0
R049	325558	6141470	310.2	57.02	0	37.42	0
R056	331880	6135601	112.0	0	41.42	0	23.54
R096	331915	6152644	376.8	0	67.08	0	44.36
R139+	328350	6146204	430.0	1205.45	2035.55	665.01	1212.52
R254+	326627	6140083	305.3	392.44	214.58	250.37	123.00

* *GDA2020 MGA Zone 54*

+ *Agreements with owners are in place for these buildings to be abandoned for the life of the wind farm.*

3.1.4 Shadow flicker map

The shadow flicker maps for the Varied Project and Approved Project, provided in Figure 3 to Figure 4, and Figure 5 to Figure 6 respectively, highlight the areas inside which worst case shadow flicker is 30 hour/year or greater (red and yellow). Due to the large area of the windfarm, the map has been divided into two sections.

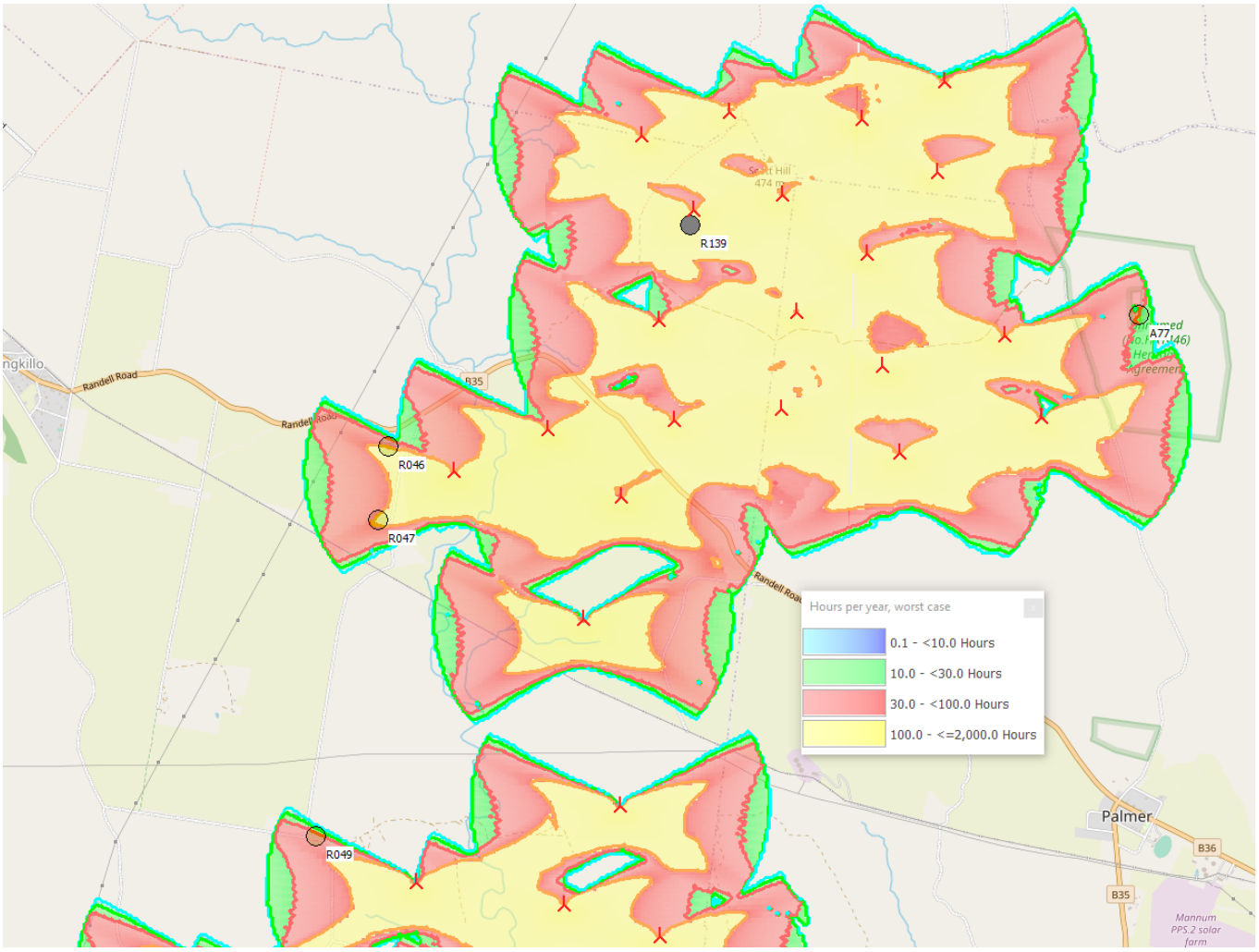


Figure 3 Shadow flicker map with affected Receptors (worst case results, 40 WTG Varied Project) – Northern area[9]

[9] Greyed out circles represent dwellings with agreements to be abandoned.

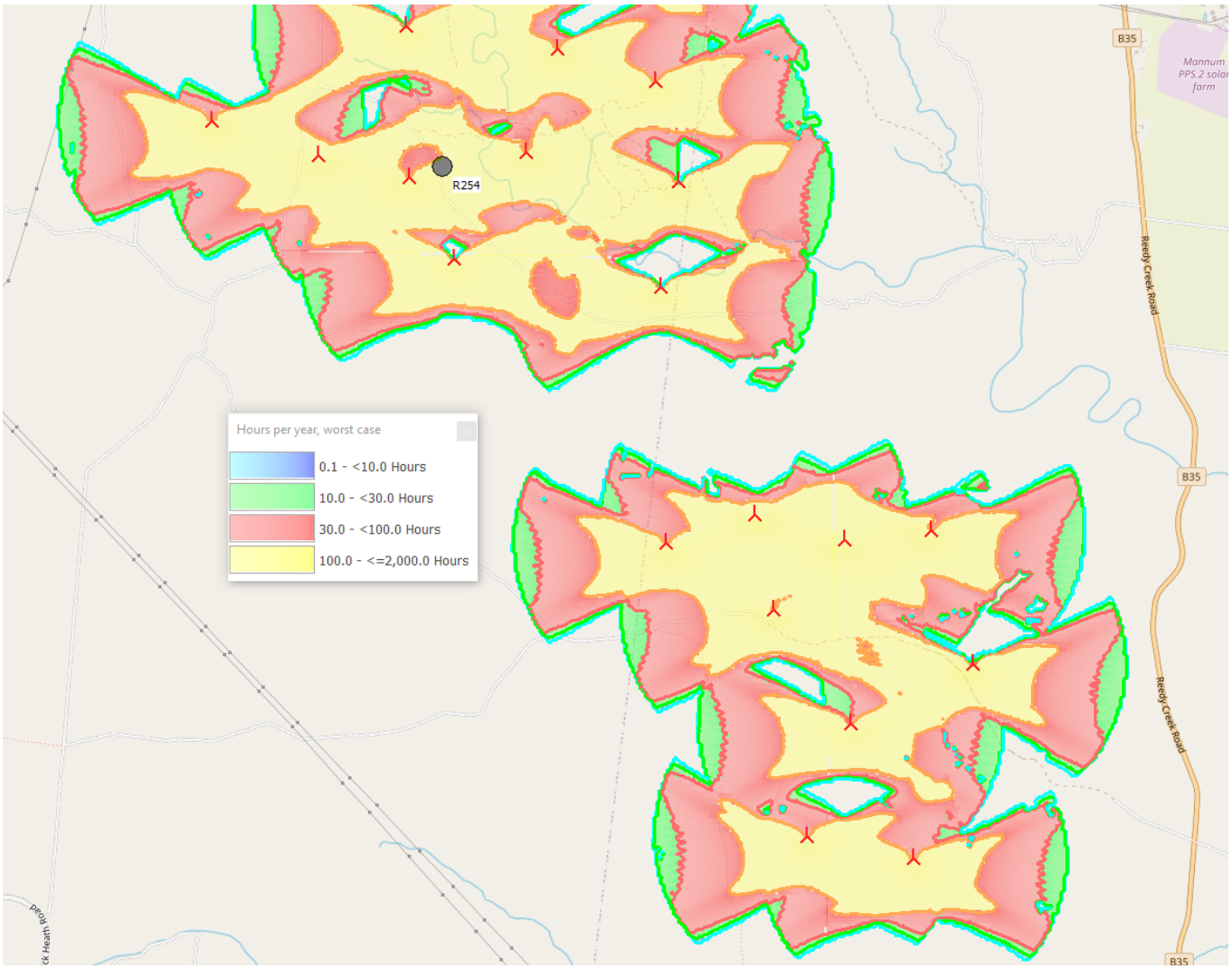


Figure 4 ***Shadow flicker map with affected Receptors (worst case results, 40 WTG Varied Project) – Southern area***[10]

[10] Greyed out circles represent dwellings with agreements to be abandoned.

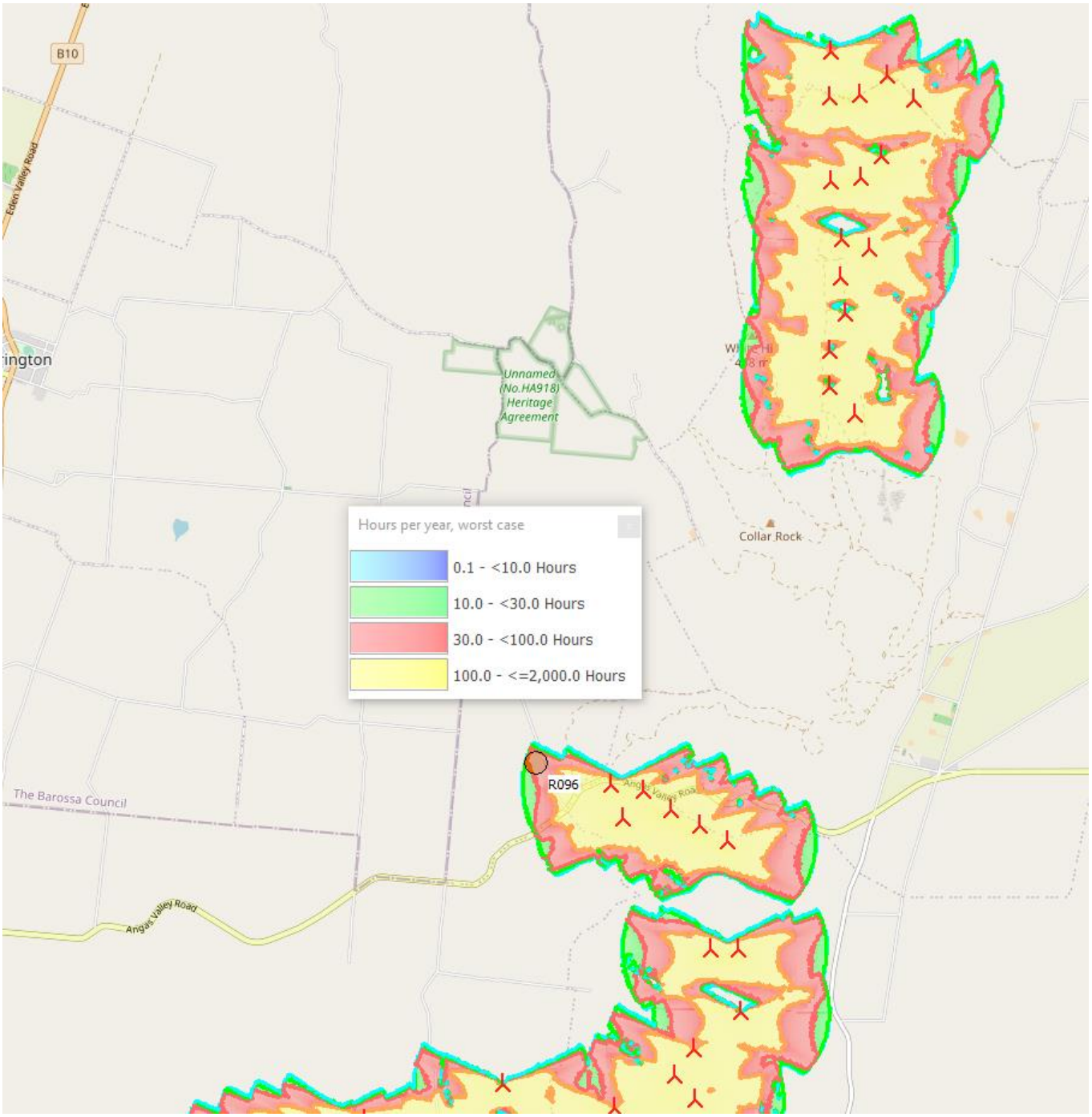


Figure 5 ***Shadow flicker map with affected Receptors (worst case results, 103 WTG Approved Project) – Northern area***

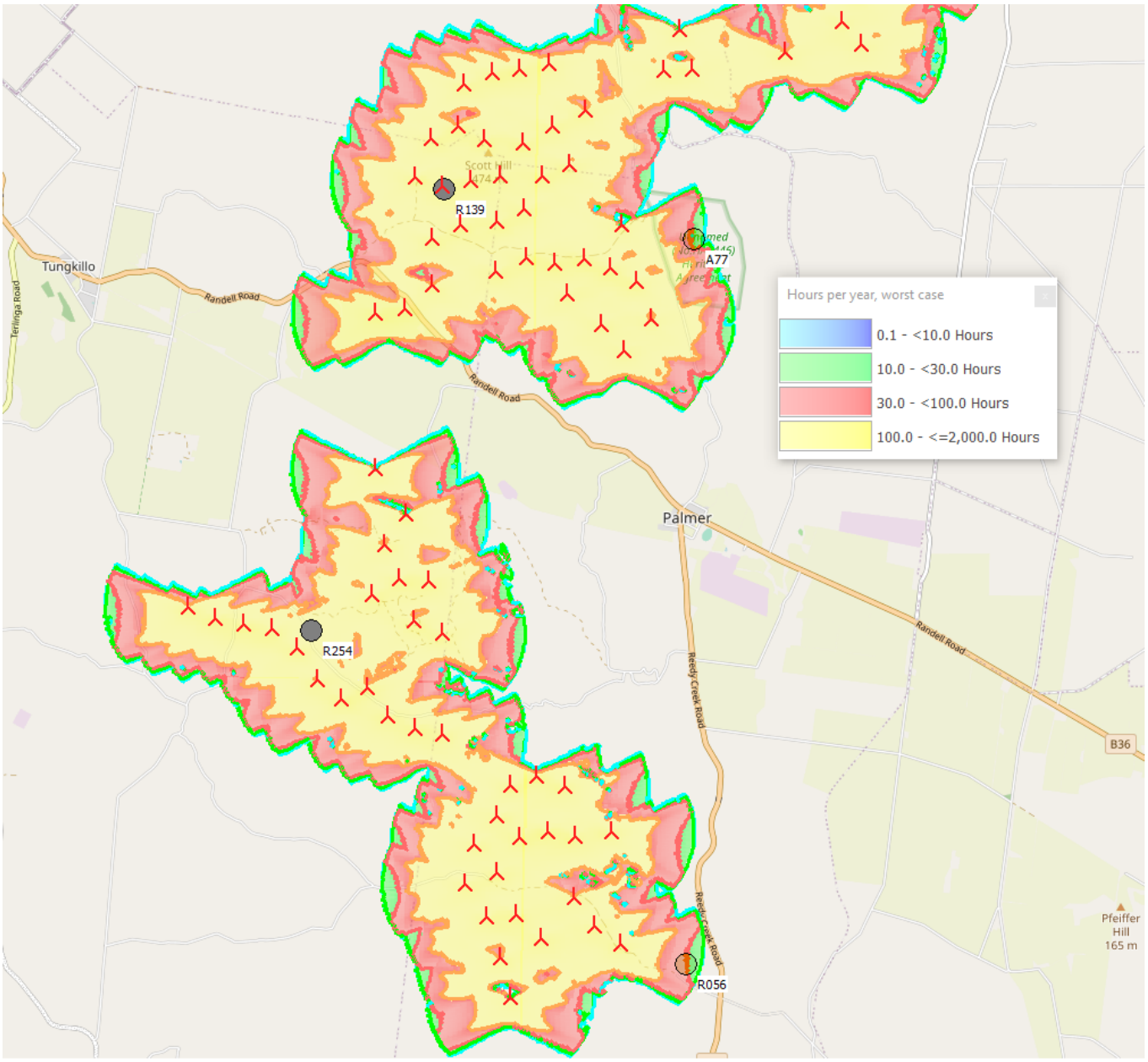


Figure 6 *Shadow flicker map with affected Receptors (worst case results, 103 WTG Approved Project) – Southern area*[11]

3.2 Blade glint

As per the Draft Guidelines, wind turbine blades must be finished using a low-reflective treatment such that reflective glinting from the blade surface or strobing reflections caused by blade rotation is mitigated. As many wind turbine blade manufacturers are currently applying the aforementioned treatment to their blades, the risk of blade glint is considered low and no further assessment was undertaken in this report. However, blade specifications should ensure that a low reflective coating is applied to the blades.

[11] Greyed out circles represent dwellings with agreements to be abandoned.

3.3 Driver safety

The Draft Guidelines indicate that there is a negligible risk associated with the distraction of vehicle drivers who experience shadow flicker. This is likely because shadow flicker operates differently on a moving vehicle than the effect of shadow on a stationary object e.g. a receptor. At the time the Draft Guidelines were published, there were no records of motor vehicle accidents caused by this phenomenon. Further information on driver safety can be located within the driver safety assessment, which is included in Section 8 of the Traffic Impact Assessment.

4. Conclusions and Recommendations

4.1 Conclusions

Shadow-flicker calculations at the Palmer Wind Farm, undertaken in accordance with the Draft Guidelines, are greater than the specified worst case limit of 30 hours per year for four Receptors within the modelled shadow flicker area.

When the calculation is based on expected-case sunshine statistics from Nuriootpa Climate Station (approximately 46 km from the site), exceedances of 26.25, 84.25, 68.29, and 37.42 hours/year occur at Receptors A77, R046, R047, and R049 respectively. This exceeds the 10 hours/year limit for the shadow flicker expected case as outlined in the Draft Guidelines. Tilt Renewables has agreements in place with the owners of these dwellings and is seeking express consent from the owners in respect of the anticipated shadow flicker impacts. GHD has been advised by Tilt Renewables that if consent is not obtained prior to operation of the wind farm, curtailment measures will be put in place as necessary to reduce shadow flicker impacts at the relevant dwellings to the guideline levels.

Shadow flicker varies between the Approved and Varied Project layout due to the differences in WTG layout (i.e. layout has been reduced from 103 WTG to 40 WTG and turbine coordinates are different). The reduction in turbines resulted in shadow flicker exceedance being diminished within the Varied Project layout.

In accordance with the Draft Guidelines, blade glint is not expected to be an issue provided that wind turbines use non-reflective coatings on the blades of the wind turbines.

It should be noted that the windPRO model is conservative for the worst case scenario and the results from the shadow flicker assessment are not completely representative of the actual shadow flicker created once the wind farm is operational.

4.2 Recommendations

This assessment has been undertaken for 40 specific turbine locations and 309 Receptor locations as provided by Tilt Renewables. Development approvals typically allow for some degree of flexibility in turbine siting. Prior to finalisation and micro siting of the turbine locations and construction, Tilt Renewables should undertake an updated shadow flicker assessment to verify that no increase in expected shadow flicker occurs.

It should be ensured that all wind turbine technical specifications and procurement documents require all wind turbine blades are coated with a non-reflective finish to avoid the possible effects of blade glint to the surrounding areas.

Appendices

Appendix A

Coordinates of proposed wind turbines (Varied Project)

Table A.1 Coordinates of proposed wind turbines (Varied Project)

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
B58	328114	6145472	410.0
B42	328632	6147073	455.6
B45	327961	6146882	413.4
B46	330236	6146644	375.8
B47	329051	6146448	464.9
B40	330278	6147338	384.3
B41	329652	6147038	393.4
B10	328371	6146323	432.2
B62	329846	6145151	430.2
B22	329990	6144490	395.9
B13	329076	6144812	407.0
B56	329175	6145555	438.0
B51	331075	6144785	360.4
B52	329710	6146010	425.3
B60	330782	6145407	388.6
B55	326563	6144283	343.4
C01	327578	6143169	353.9
B29	327856	6144118	382.5
B25	328249	6144708	419.0
B18	327281	6144620	361.7
C27	330351	6137432	270.3
C30	329173	6136816	313.4
C26	329697	6137351	300.3
C24	329016	6137522	300.0
C21	330260	6134979	249.0
C38	329459	6135129	287.0
C32	330679	6136439	247.5
C34	329772	6135976	285.3
C17	328283	6139216	280.0
C29	328361	6137301	301.0
C05	328210	6140753	342.5
C08	328402	6140003	317.3
C09	324882	6140394	352.4
C13	326723	6139400	326.0
C15	325693	6140150	330.4
C14	326372	6140001	334.0
C04	327470	6140983	329.1
C03	327886	6141749	341.0
C06	327248	6140207	307.7
C10	326329	6141130	319.0

*UTM (south)-WSG84 Zone: 54

Appendix B

Coordinates of proposed wind turbines (Approved Project)

Table B.1 Coordinates of proposed wind turbines (Approved Project)

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
WTG01	336354	6161693	287.8
WTG02	335995	6161428	330.0
WTG03	336699	6161376	310.0
WTG04	335606	6161392	347.1
WTG05	335638	6160293	340.0
WTG06	336294	6160637	329.3
WTG07	336033	6160346	330.0
WTG08	335793	6159546	350.0
WTG09	335609	6161990	348.3
WTG10	336155	6159431	340.0
WTG11	335786	6159040	344.5
WTG12	335848	6158573	369.6
WTG13	336011	6157266	329.1
WTG14	335659	6158084	350.0
WTG15	335672	6157618	327.1
WTG16	332895	6152380	387.9
WTG17	333326	6152313	378.0
WTG18	330875	6144025	356.5
WTG19	333691	6152073	371.6
WTG20	334443	6151678	301.8
WTG21	333069	6151949	378.1
WTG22	334068	6151876	346.5
WTG23	334658	6149460	277.8
WTG24	328319	6146255	428.7
WTG25	334239	6150270	321.5
WTG26	329081	6145090	423.6
WTG27	334611	6150275	273.0
WTG28	330555	6144387	357.0
WTG29	327428	6144488	367.0
WTG30	334050	6148960	331.0
WTG31	331232	6144468	346.5
WTG32	330077	6144795	407.8
WTG33	333808	6148617	341.8
WTG34	328203	6144889	409.0
WTG35	334081	6148311	301.2
WTG36	331551	6148465	395.7
WTG37	327833	6144553	387.7
WTG38	333022	6148180	314.0
WTG39	329755	6147963	394.6
WTG40	329351	6147887	409.3
WTG41	331344	6147896	383.5

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
WTG42	328585	6147662	448.2
WTG43	328978	6147826	431.7
WTG44	331733	6147930	376.2
WTG45	330275	6147331	384.5
WTG46	329816	6147114	387.9
WTG47	328516	6147088	452.5
WTG48	329413	6146867	416.7
WTG49	328876	6146905	461.9
WTG50	328153	6146907	429.2
WTG51	330075	6146572	386.9
WTG52	329114	6146407	461.7
WTG53	329701	6146419	412.1
WTG54	328701	6146329	442.5
WTG55	327931	6146371	411.3
WTG56	331025	6144980	370.4
WTG57	329452	6145958	445.5
WTG58	330806	6145764	377.6
WTG59	328568	6145726	418.9
WTG60	329075	6145777	441.7
WTG61	328192	6145525	410.7
WTG62	330294	6145281	388.9
WTG63	330666	6145173	387.7
WTG64	329489	6145287	412.4
WTG65	329885	6145221	427.9
WTG66	327461	6142333	346.4
WTG67	329530	6136231	288.3
WTG68	327891	6141720	341.0
WTG69	327605	6141295	331.2
WTG70	328230	6140800	340.7
WTG71	327453	6140599	322.0
WTG72	328029	6140249	319.6
WTG73	328423	6140095	321.7
WTG74	324914	6140388	352.0
WTG75	326082	6140111	325.9
WTG76	325292	6140242	336.5
WTG77	327401	6139327	306.2
WTG78	326710	6139419	326.0
WTG79	326426	6139849	331.0
WTG80	325686	6140167	329.8
WTG81	327697	6138941	296.5
WTG82	328075	6138775	289.6
WTG83	327055	6139162	305.7

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
WTG84	328458	6138706	284.6
WTG85	329774	6138153	288.1
WTG86	330967	6135852	215.1
WTG87	329414	6138024	295.8
WTG88	330162	6138014	277.7
WTG89	329237	6137599	305.3
WTG90	330814	6137405	215.0
WTG91	329555	6137299	304.5
WTG92	330320	6137332	273.8
WTG93	329935	6137393	291.1
WTG94	328927	6137194	302.8
WTG95	329243	6136809	310.8
WTG96	328816	6136645	307.7
WTG97	330608	6136097	238.4
WTG98	329109	6136201	291.0
WTG99	329877	6135919	280.2
WTG100	329307	6135640	292.2
WTG101	329468	6135090	285.0
WTG102	330319	6136487	252.6
WTG103	327823	6140833	334.4

*UTM (south)-WSG84 Zone: 54

Appendix C

Coordinates of shadow flicker receptors

Table C.1 Coordinates of shadow flicker receptors

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
A18	336468	6151914	165.0
A69	336656	6151163	159.9
A77	331813	6145581	354.0
R001	338653	6161548	122.5
R002	338810	6161203	119.0
R003	338319	6158501	178.9
R004	338363	6157113	160.0
R005	337745	6156232	160.2
R006	338053	6155946	142.5
R007	335620	6151070	179.1
R008	336231	6151160	166.1
R009	336210	6150934	167.0
R010	335986	6149487	179.6
R011	336075	6149261	176.2
R012	335799	6148829	175.0
R013	332708	6147072	233.6
R014	333216	6146876	222.2
R015	332806	6145843	263.9
R016	332950	6144591	257.5
R017	332398	6143069	200.3
R018	332020	6142933	198.3
R019	331943	6142749	189.7
R020	331778	6142020	200.6
R021	331680	6141995	205.2
R022	328842	6143310	345.7
R023	329211	6142820	297.1
R024	329735	6142769	335.0
R025	330274	6141761	241.5
R026	330421	6141520	225.0
R027	330299	6141522	227.0
R028	330897	6139692	147.0
R030	331147	6150813	408.5
R031	331050	6150529	404.2
R032	331565	6149897	409.5
R033	332109	6151140	383.0
R034	332615	6149830	381.9
R036	330281	6150173	371.5
R037	330445	6149759	335.4
R038	330396	6149641	330.6
R039	330499	6149281	323.5
R040	331099	6149016	354.0

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R042	329064	6149511	380.7
R043	328369	6149963	458.5
R044	324922	6146031	369.2
R045	325832	6145788	348.0
R046	326056	6144460	325.3
R047	325991	6143902	323.7
R049	325558	6141470	310.2
R050	325834	6141468	311.0
R051	325226	6138794	310.5
R052	324433	6138733	287.0
R053	324902	6138248	304.2
R054	325251	6137959	316.3
R055	327201	6136521	323.5
R056	331880	6135601	112.0
R057	326579	6136054	321.0
R058	325432	6136351	320.9
R059	325266	6135720	329.0
R060	324818	6135278	322.4
R061	325983	6135930	322.6
R062	325194	6136919	336.0
R063	325562	6136942	327.0
R064	320204	6138562	383.3
R065	321002	6138369	376.6
R066	321239	6138064	367.8
R067	321389	6138110	364.0
R068	321995	6137732	396.5
R069	322405	6136675	360.0
R070	319207	6136349	412.1
R071	318202	6135358	415.6
R072	320047	6135735	480.0
R073	319622	6135174	440.9
R074	318902	6134001	375.0
R075	318403	6132971	370.0
R076	318605	6132868	364.5
R077	323554	6134793	404.1
R078	323045	6134591	400.0
R079	322948	6134119	390.0
R080	324243	6133944	338.4
R081	323787	6132909	340.6
R082	323348	6132162	369.4
R083	323701	6131997	324.2
R084	323573	6131724	327.2

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R086	331247	6153233	381.2
R087	336073	6148412	163.7
R088	333319	6142467	169.0
R089	324700	6144877	350.9
R090	329319	6150354	420.5
R091	329813	6149819	360.4
R093	332362	6146342	284.4
R094	332120	6150281	369.9
R095	331870	6149730	400.6
R096	331915	6152644	376.8
R097	337543	6155597	146.8
R098	337770	6155824	144.4
R099	337625	6156003	154.3
R100	337395	6156970	186.3
R102	329038	6150158	437.1
R103	332643	6160273	340.0
R104	332967	6159899	326.7
R105	333079	6157731	262.2
R106	333857	6155430	225.4
R107	331832	6153808	373.0
R108	325566	6150647	400.0
R110	324310	6149916	407.0
R111	336271	6148237	160.5
R112	324549	6147497	396.5
R113	335607	6147036	154.5
R114	332706	6143292	210.5
R115	325765	6143008	340.0
R116	331672	6142715	209.9
R117	325656	6141970	319.9
R118	332016	6137999	103.6
R119	331976	6149810	390.5
R120	337779	6154484	125.6
R121	324373	6142389	375.7
R122	329331	6150554	432.5
R123	330057	6142355	322.0
R124	337015	6152768	151.2
R125	324700	6137754	312.8
R126	330653	6139947	135.3
R127	330006	6152863	384.4
R128	331744	6141687	191.0
R129	324390	6142500	381.3
R130	340416	6149804	126.0

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R131	329661	6150103	368.6
R132	332433	6157777	273.5
R133	337396	6152708	150.6
R134	329164	6143202	341.9
R135	325716	6142720	342.2
R136	325482	6142364	344.5
R139	328350	6146204	430.0
R140	339935	6165701	162.8
R141	339478	6165475	177.3
R142	332950	6164873	320.0
R143	333051	6164848	320.0
R144	339716	6163972	149.6
R145	339625	6163971	150.0
R146	332855	6163077	260.0
R147	339937	6162741	110.7
R148	340409	6162490	100.0
R149	340306	6162096	100.0
R150	340513	6161855	101.5
R151	340421	6161791	106.6
R152	340280	6161750	106.4
R153	340649	6161516	116.8
R154	340922	6161505	115.7
R155	340064	6161446	114.2
R156	339122	6161272	111.1
R157	339684	6161247	115.4
R158	340625	6161166	120.0
R159	339055	6160934	120.6
R160	339653	6160828	125.1
R161	338908	6160681	139.5
R162	340225	6160677	122.4
R163	338896	6160474	141.0
R164	338453	6160165	140.5
R165	339344	6160059	141.4
R166	338524	6159895	149.2
R167	339225	6159390	150.7
R168	338699	6159258	165.3
R169	332399	6159207	294.6
R170	333082	6158734	293.0
R171	332349	6158668	280.0
R172	332024	6158391	280.0
R173	332314	6158132	273.2
R174	332397	6157912	273.9

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R175	332621	6157709	264.2
R176	333048	6157632	260.0
R177	333251	6156840	254.4
R178	337245	6156571	186.1
R179	338467	6156356	146.6
R180	338093	6156009	142.3
R181	333914	6155652	221.3
R182	337939	6155484	130.1
R183	334054	6155459	220.0
R184	337625	6155270	134.6
R185	338022	6155198	125.2
R186	331887	6155088	380.0
R187	337695	6155013	130.0
R188	331575	6154754	359.5
R189	331153	6154536	344.4
R190	331767	6154269	375.0
R191	337029	6154185	133.0
R192	337285	6154099	137.5
R193	336409	6154096	160.0
R194	331054	6153814	365.6
R195	336568	6153739	144.8
R196	337026	6153602	142.2
R197	330100	6153445	361.0
R198	337335	6153353	150.0
R199	337122	6153138	150.2
R200	336470	6153015	162.7
R201	336813	6152991	157.7
R202	330483	6152933	354.6
R203	337181	6152750	151.1
R204	336593	6152713	162.7
R205	337069	6152684	151.4
R206	337166	6152664	151.3
R207	337097	6152616	151.5
R208	337293	6152599	150.9
R209	331371	6152551	387.9
R210	329974	6152531	392.0
R211	336497	6152054	164.0
R212	336852	6151779	156.4
R213	329880	6151688	420.0
R214	329793	6151437	409.0
R215	330408	6151392	396.0
R216	331520	6151224	405.5

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R217	327429	6151210	456.5
R218	336472	6150939	163.5
R219	332184	6149775	381.1
R220	337559	6148655	149.4
R221	336572	6147291	141.7
R222	335870	6147188	151.0
R223	336032	6147186	149.0
R224	336072	6146757	156.0
R225	335978	6146702	156.2
R226	335944	6146692	156.6
R227	335722	6146677	151.5
R228	336114	6146097	155.8
R229	335874	6145796	162.6
R230	324395	6145191	364.5
R231	334727	6144498	183.6
R232	324396	6144116	363.8
R233	330229	6142660	316.6
R234	322190	6142615	380.0
R235	324908	6142495	362.2
R236	333351	6142134	165.5
R237	333356	6142082	166.4
R238	331176	6141988	235.8
R239	333257	6141821	159.1
R240	329702	6141730	229.2
R241	329640	6141705	239.3
R242	333324	6141654	154.0
R243	325199	6141590	336.3
R244	332920	6141481	147.5
R245	331827	6141031	178.0
R246	330177	6140985	221.3
R247	331727	6140922	179.0
R248	331850	6140429	162.9
R249	333210	6140321	128.1
R250	331707	6140271	171.4
R251	323195	6140235	334.0
R252	330546	6140229	156.9
R253	333276	6140176	129.2
R254	326627	6140083	305.3
R255	330747	6139989	144.0
R256	330655	6139947	135.1
R257	332838	6139657	122.1
R258	321978	6138889	350.0

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R259	321807	6138398	361.5
R260	324229	6138097	341.9
R261	332374	6137942	97.0
R262	322749	6137609	342.5
R263	322814	6137604	341.3
R264	323024	6136869	386.7
R265	322784	6136548	377.4
R266	326921	6136081	317.6
R267	322708	6136046	380.0
R268	333783	6134806	90.0
R269	333580	6134571	90.0
R270	332263	6134012	101.2
R271	323402	6133352	366.0
R272	324600	6132060	294.2
R273	338846	6160718	133.6
R274	321570	6138703	348.2
R275	330327	6141804	238.0
R276	331674	6141119	186.1
R277	329607	6143031	338.4
R278	335753	6146645	154.1
R279	330515	6150972	400.5
R280	336473	6152856	164.6
R281	337776	6154534	125.7
R282	338678	6160450	140.0
R283	339084	6160556	139.6
R284	331697	6154015	365.0
R285	329900	6152159	415.4
R286	332056	6141882	187.7
R287	323346	6144796	400.9
R288	325566	6141979	317.6
R289	323446	6144544	409.4
R290	330898	6140260	164.0
R291	332375	6153261	394.0
R292	336776	6155190	160.0
R293	319488	6138405	385.3
R294	319164	6135556	430.0
R295	319769	6135332	450.0
R296	320393	6139315	394.0
R297	320037	6140223	424.6
R298	319102	6140351	438.4
R299	318232	6139320	461.9
R300	318803	6139305	419.0

WTG ID	Easting (m)*	Southing (m)*	Elevation (m ASL)
R301	321252	6140784	390.0
R302	321211	6142055	400.4
R303	319060	6141597	424.6
R304	319418	6141667	407.1
R305	318296	6140626	461.8
R306	319319	6142681	439.1
R307	321205	6142387	390.0
R308	321540	6142712	383.6
R309	321423	6142568	387.8
R310	321949	6142793	379.6
R311	321641	6142991	382.6
R312	322341	6143506	370.0
R313	322187	6143277	370.0
R314	322603	6144067	400.0
R315	322352	6144578	390.0
R316	319831	6141715	400.7

*UTM (south)-WSG84 Zone: 54

ghd.com

The Power of Commitment

Palmer Wind Farm Variation Application

Traffic Impact Assessment

Final Report

Prepared for: Tilt Renewables

Date: 27 February 2024

Ref: 300304884

Stantec Australia Pty Ltd

Stantec

Revision

Revision	Date	Comment	Prepared By	Approved By	Reviewed By
A-Dr	23 November 2023	Draft	Joshua Carroll	Luke Smith	Paul Froggatt
B-Dr	17 January 2024	Draft	Joshua Carroll	Luke Smith	Paul Froggatt
C-Dr	7 February 2024	Draft	Joshua Carroll	Luke Smith	Paul Froggatt
01-Fin	27 February 2024	Final	Joshua Carroll	Luke Smith	Paul Froggatt

Joshua Carroll & Paul Froggatt

For and on behalf of

Stantec Australia Pty Ltd

L5, 75 Hindmarsh Square, Adelaide SA 5000

Acknowledgment of Country

Stantec would like to acknowledge the Traditional Owners of the lands on which this report was prepared, the Wurundjeri people of the Kulin Nation and the Kaurna people of the Adelaide Plains. We pay respects to Elders past, present and emerging, and extend that respect to all Aboriginal and Torres Strait Islander peoples.

Limitations

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Appendices

Appendix A. Transport Route Assessment – iCubed Consulting

1. Introduction

1.1 Background & Proposal

Stantec has been engaged by Tilt Renewables to prepare a Traffic Impact Assessment (TIA) for the Variation Application in respect of the development plan consent for the Palmer Wind Farm (PMWF, the Project), located approximately 50km east of the Adelaide CBD.

Investigations into the Project were commenced in 2009, with a Development Application lodged with the Mid-Murray Council pursuant to the *Development Act 1993* in February 2014 for a layout of 114 turbines. Following grant of the development plan consent in December 2015, the consent was appealed, and the Project was updated to address matters raised. This resulted in a 103-turbine layout being approved at the Environment, Resources and Development (ERD) Court in March 2018. The Project was further challenged at the Supreme Court and the Supreme Court upheld the decision of the ERD Court in November 2019, supporting the grant of the original development plan consent subject to additional conditions. Based on the final Supreme Court ruling, the 'planning approval' documentation comprised the document titled 'ERD Court Orders' and the Amended Consolidated Particulars of Development, referred to as 'exhibit 2R1'.

Following the Supreme Court decision, Tilt Renewables has since undertaken a review of the design and layout of the approved Project to take full advantage of the favourable wind conditions of the Project Area and advances in wind turbine technology since the Development Application was lodged in 2014.

Since the initial application was lodged with Mid Murray Council, the *Development Act 1993* has been replaced by the *Planning, Development and Infrastructure Act 2016* (PDI Act). A new Planning and Design Code (P&D Code) was implemented following the introduction of the new PDI Act.

Tilt Renewables is lodging a Variation Application pursuant to the PDI Act to amend the approved Project with a reduced Project Area, a reduction in the maximum number of turbines, an increase in the maximum blade tip height, and associated changes to the internal wind farm infrastructure within the Project Area.

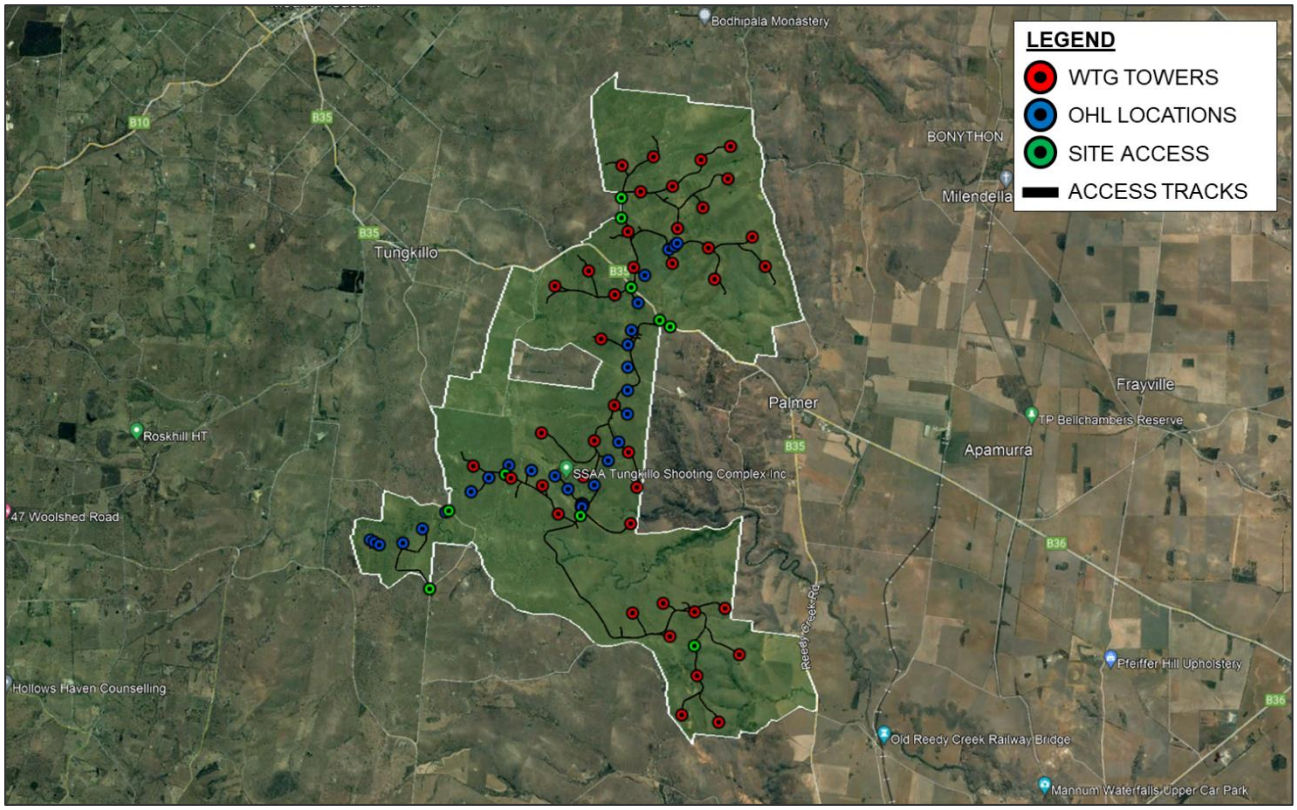
Following consultation with Mid Murray Council and the Department for Trade and Investment (Planning and Land Use Services directorate), the Minister for Planning called in the Project for the Variation Application to be assessed by the State Planning Commission.

The Variation Application provides for the following changes to the Approved Project:

- Reduction in the number of proposed WTGs from 103 to 40;
- An increase in the maximum blade tip height from 165m to 220m;
- An increase in the hub height from 100m to 130m; and
- An increase in the blade length from 65m to 90m.

The proposed changes aim to optimise the development given the advancements in wind turbine technology since the original project received approval, whilst adhering to recent changes to the Planning and Design Code. The Project Area layout for the Varied Project can be observed in Figure 1.1.

Figure 1.1 Varied Project Area Layout - 40 Turbines



Source: Tilt Renewables.

1.2 Purpose & Structure of this Report

As part of this Traffic Impact Assessment, Stantec will assess the following:

- Provide an updated review of the existing conditions relating to traffic volumes, crash data and route restrictions;
- Review previously prepared and approved documents relating to the traffic and access considerations;
    - Define previous project constraints; and
    - Define previously prepared and approved mitigation techniques.
- Document the revised project-related traffic generated by the Varied Project;
- Undertake an updated road link assessment for all state and local roads surrounding the Project Area;
- Undertake a comparative assessment between the previously approved project (103 WTG's) and the varied project (40 WTG's) utilising the aforementioned key criteria and the Traffic Impact Assessment (TIA) undertaken by GHD in 2014; and
- Identify methods and strategies to reduce any identified transport impacts for the Varied Project.

It is noted that a conservative impact assessment has been undertaken, assuming that the existing baseline traffic volumes would be maintained for all future design horizons. Project traffic volumes have been overlaid on top of existing baseline traffic.

1.3 References & Supporting Data

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

- Transport Route Assessment, iCubed Consulting, dated 26 February 2024;
- Palmer Wind Farm Traffic Impact Assessment, GHD, dated 29 July 2014;
- Shadow Flicker and Blade Glint Assessment, GHD, dated 08 November 2023;
- ERD Court of South Australia Orders, dated 7 March 2018; and
- South Australian Government Data Directory, online resource.

1.4 Key Terminology

The following terms will be adopted throughout the TIA report:

- *Approved Project:* refers to the previously assessed and approved PMWF from 2018.
- *Varied Project:* current Project being assessed.
- *PMWF (the Project):* Palmer Wind Farm.

1.5 Planning Approval Conditions

The ERD Court of South Australia Orders, dated 7 March 2018, pertaining to the transport-related matters are detailed below in Table 1-1.

Table 1-1 ERD Court Orders

No.	ERD Court Orders	TIA Reference
3	A driver safety assessment report that identifies appropriate mitigation measures (if any) shall be submitted to the Council. The Council shall confirm its satisfaction with this additional information prior to the granting of Development Approval or, in the case of a staged approval, prior to Development Approval for the first stage.	Section 8
13	A Traffic Management Plan for the proposal shall be submitted to the Council. The Council shall confirm its satisfaction with this additional information, having consulted with the Department of Planning, Transport and Infrastructure, prior to the granting of Development Approval or, in the case of a staged approval, prior to Development Approval for the first stage. This plan shall incorporate the following points: • The final access route for the Varied Project Area; • Details of all road upgrades required to facilitate the development; • Details of delivery times; • Details of proposed road closures and their management; • Details of permits required; • Details of all required road signs and advisory signs; • A route risk assessment for roads intended for transportation of over-dimensional/over mass wind fair components.	Section 8.2 Appendix A
17	All access points serving the temporary construction facilities (including but not limited to, workers compounds and batching facilities) located on, or requiring access to, arterial roads shall be located to the satisfaction of the Council, having consulted with Department of Planning, Transport and Infrastructure, to ensure road safety is maximised during the construction phase of the project. All temporary access points shall be decommissioned to Department of Planning, Transport and Infrastructure requirements at the applicant's cost.	Section 8
20	The applicant shall notify the Commissioner of Highways by submitting a "Notification of Works Impacting Department of Planning, Transport and Infrastructure Roads" form at least five (5) working days before construction works begin. This form is available from the following internet address: https://www.sa.gov.au/topics/transport-travel-and-monitoring/transport-industry-services/road-construction-and-maintenance/getting-permission-to-carry-out-roadworks	Section 8.3
21	All vehicles shall enter and exit to/from arterial roads in a forward direction.	Section 8.2
22	All car parking facilities shall be designed and constructed in accordance with AS/NZS 2890.1:2004 and 2890.6.2009.	Section 8.2
23	All heavy vehicle manoeuvring areas shall be consistent with AS 2890.2.2002.	Section 8.2

1.6 Authority Liaison

1.6.1 Mid-Murray Council (MMC)

Consultation with Mid-Murray Council has been undertaken throughout the development of the TIA, with a summary provided below in Table 1-2.

Table 1-2 MMC Consultation Summary

Date	Description

01 August 2023	Direct consultation has been undertaken with the Mid Murray Council (MMC) to determine the works required to fulfill the Driver Safety Assessment as per Condition 3 outlined in the ERD court orders dated 7 March 2018. Representatives from Stantec, Tilt Renewables and MMC held an online discussion on Wednesday 2 August 2023 to confirm the following items will form part of the Driver Safety Assessment to fulfill Condition 3.
	• The Driver Safety Assessment will be added as a section within the Traffic Impact Assessment, and will address:
	  ○ Turn Warrant Assessments on all external roads to determine upgrade requirements.
	  ○ Construction Traffic Management techniques to be implemented during the construction to ensure the safety of motorists and workers travelling through the project site.
	  ○ Sightline Assessments for site access locations.
	  ○ Direct reference to the shadow and flicker assessment being undertaken to fulfill Condition 5.c.
	• It is noted that MMC confirmed numerous items raised in the Road Safety Audit undertaken by HDS Australia in 2015 have been addressed. Outstanding items should be confirmed with MMC and documented in the TIA (this report).

30 October 2023	MMC provided written confirmation of the below traffic assumptions outlined by Stantec.
	• All existing traffic on local roads surrounding the project site currently operate at 50 vehicles per day;
	  ○ Assume 20% of these vehicles are heavy vehicles to account for the increase in machinery during peak periods;
	  ○ Assume 10% of these movements occur during a single peak hour to inform intersection assessments – we will conservatively align the existing peak hour with the anticipated peak hour during wind farm construction;
	  ○ Assume 2% annual traffic growth;
	It should be noted that MMC reserves the right to review these assumptions as they were only estimates provided in the first instance.

1.6.2 Department for Infrastructure and Transport (DIT)

Consultation with DIT has been undertaken throughout the development of the TIA, with a summary provided in Table 1-3.

Table 1-3 DIT Consultation Summary

Date	Description
20 November 2023	Pre-lodgement meeting – attended by DIT and other approving and referral authorities. It was noted that an Infrastructure Deed between Tilt Renewables and MMC exists, and it should be reviewed as part of the detailed project planning to ensure that the current road conditions and proposed access routes remain relevant to the Project.
23 January 2024	Meeting with DIT to present variation application TIA and to consider the Randell Road site access locations and operation. A summary of the key discussion points is outlined below: • Future turning treatments, operation of the slow vehicle turn out lanes adjacent access 3 and traffic management strategies on Randell Road to be investigated in the Traffic Management Plan; • DIT raised a query regarding the turning movement impacts on vegetation at the site access locations on Randell Road. These upgrades to road intersections, including where vegetation may be impacted, has been identified as part of the swept path analysis undertaken within the Transport Route Assessment by iCubed Consulting and are referenced in the body of this report. It was raised by Tilt Renewables / Stantec that the site access locations on Randell Road are consistent with those proposed under the Approved Project. • DIT raised a query regarding the interaction and impact of construction-related traffic on farming stock and large machinery within the vicinity of the Varied Project Area. The TIA accounts for traffic generated by farming activities during peak season as part of the existing background traffic volumes. These volumes have been confirmed and agreed to with MMC and are discussed in the body of this report. The management of interactions between construction-related traffic, and farming stock and large machinery will be investigated in the Traffic Management Plan. • DIT raised a query regarding the impact on the guardrail should Site Access 4a be utilised to facilitate construction vehicle movements. It was noted that should this access be utilised, further consultation with DIT will be required to ensure the impact on the guardrail is managed appropriately. • DIT noted the practice of batching plant related vehicles crossing Randell Road should be taken into consideration and addressed in the Traffic Management Plan (TMP).

2. Project Description

2.1 Project Overview

The Varied Project will consist of a wind energy facility comprising up to 40 wind turbine generators (WTGs). Turbines will be three-bladed and the maximum height to the tip of the rotor at its highest extent will not exceed 220m. Although WTG tower base configurations are yet to be finalised, the turbines will most likely consist of five (5) tubular steel tower sections, which could be up to 30 metres (based on a typical long section of a 130m tower), with a mounted nacelle containing the generator, gear box and electrical equipment. Hardstand crane pads will be located at the base of each turbine tower.

WTG sites will be accessed via a network of new access tracks and sections within the Wind Farm Area. New access tracks will be up to 10m wide to allow access for construction and for ongoing maintenance throughout the life of the Wind Farm. In total, approximately 65km of access tracks will be constructed to facilitate movement within the Wind Farm.

The Project Area will also likely include the following facilities:

- One (1) operations and maintenance facilities;
- Two (2) temporary substation construction compounds;
- Up to five (5) temporary construction laydown areas; and
- Two (2) concrete batching plants (up to 3).

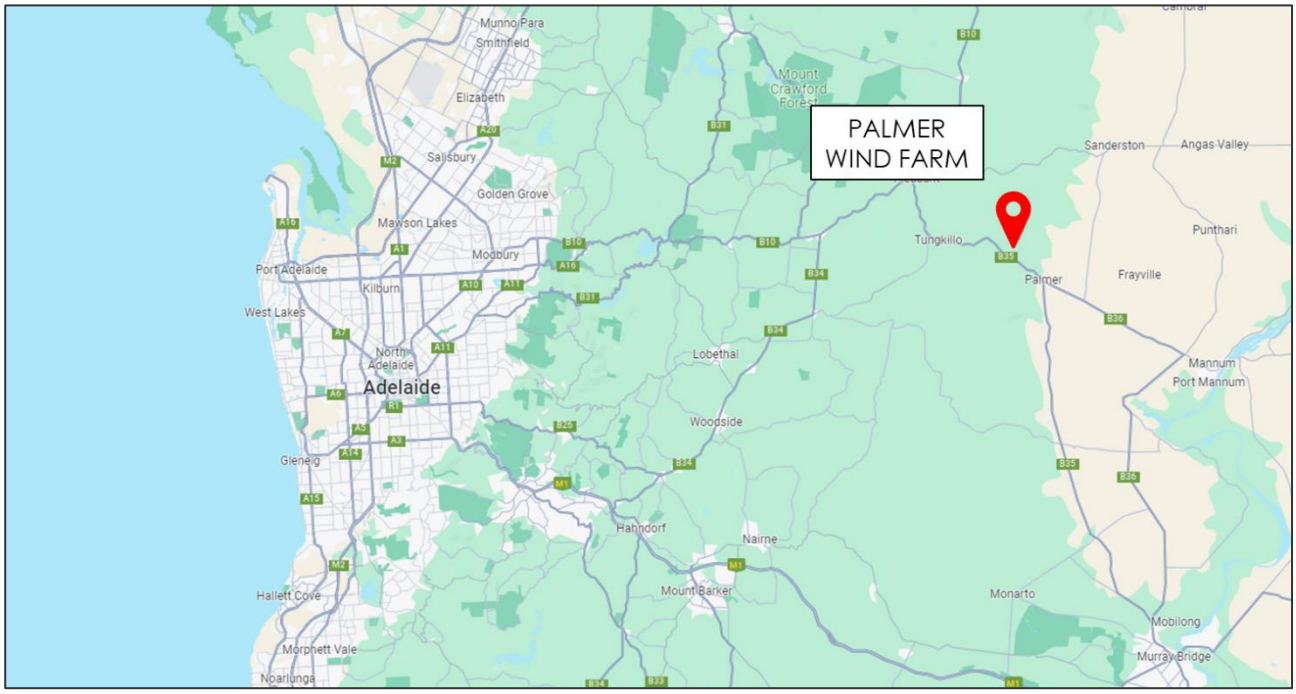
Two (2) site access locations are to be provided along Randell Road to facilitate workforce and construction vehicle traffic. All temporary infrastructure will be removed at the end of the construction period and the sites rehabilitated if required.

The Wind Farm will have a minimum operating life of 30 years.

2.2 Project Location

The PMWF is proposed to be located approximately 50km east of the Adelaide CBD, with the Varied Project comprising of 40 WTGs across a ~6,000ha Project Area. Figure 2.1 below provides an overview of the Project Area within the wider local context.

Figure 2.1 Project Location



Source: www.google.com/maps

2.3 Project Schedule

The construction of the Varied Project is anticipated to occur over a 24-month period consisting of three (3) major development periods. These development periods are:

- Site Establishment: Months 0 – 3.
- Civil Construction: Months 3 – 18.
- Testing & Commissioning: Months 18 – 24.

It should be noted that this project schedule, provided by Tilt Renewables, is indicative and subject to change prior to the commencement of construction.

2.4 Proposed Access Arrangements

Across the Varied Project area, several accesses are proposed to facilitate the movement of project-related traffic throughout the construction period. These accesses can be broken into three categories: access points, crossing points and transmission line access points.

An overview of the proposed site access locations is shown below in Figure 2.2, with a summary provided in Table 2-1.

Figure 2.2 Site Access Location Summary

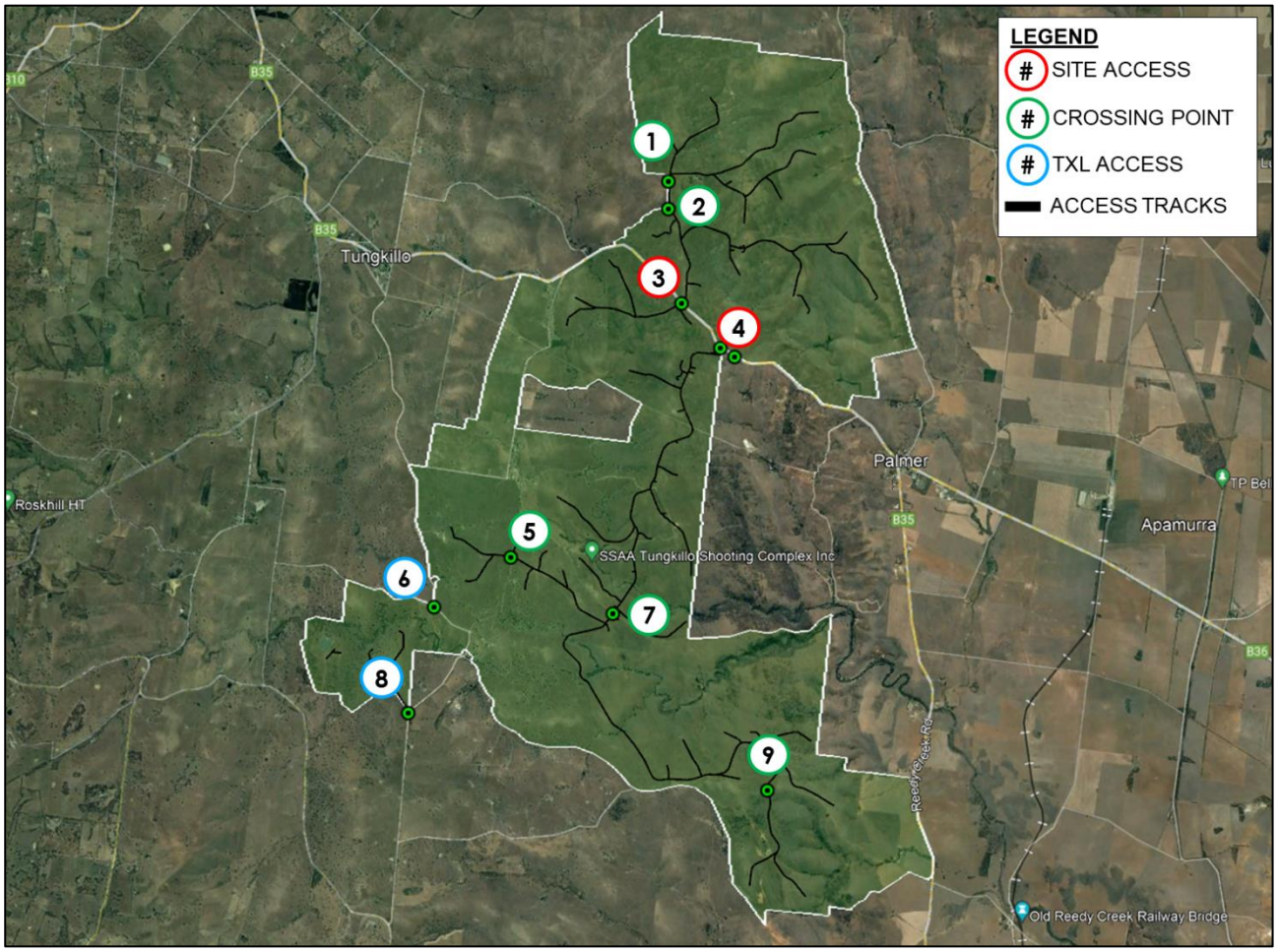


Table 2-1 Site Access Locations – Summary

Access Number	Description	Access Type
Site Access 1	Access via private roadway – to be managed internally.	Crossing Point
Site Access 2	Access via Borthwick Brae Road – subject to MMC approval.	Crossing Point
Site Access 3	Access via Randell Road – subject to DIT approval.	Site Access
Site Access 4	Access via Randell Road – subject to DIT approval. Two options currently being explored (see Figure 2.3).	Site Access
Site Access 5	Access via Hentschke Road – subject to MMC approval.	Crossing Point
Site Access 6	Access via Brinkworth Road – subject to MMC approval.	Transmission Line Access Point
Site Access 7	Access via Camel Hump Road – subject to MMC approval.	Crossing Point
Site Access 8	Access via Brinkworth Road – subject to MMC approval.	Transmission Line Access Point
Site Access 9	Access via Bottroff Hill Road – subject to MMC approval.	Crossing Point

2.4.1 State-Controlled Roads

The two (2) site access points proposed to be located off Randell Road to service construction activities in the area are consistent with the locations in the Approved Project. Currently, two (2) options are being explored for Site Access 4. Details regarding the site access locations are shown below in Figure 2.3.

Figure 2.3 Randell Road Site Access Locations



Source: NearMaps.

For the purposes of this assessment, Site Access 4a and 4b will simply be referred to as Site Access 4 as there will be no operational differences regarding the construction traffic required to access the Project Area from this location.

Turning movement assessments for each of the proposed Site Access locations on Randell Road have been undertaken as part of the Transport Route Assessment by iCubed Consulting. Details regarding intersection upgrades and impacts to vegetation can be found in Section 5 of this report, attached as Appendix A.

Further discussion regarding the suitability of the Site Access locations is provided below in Section 8.

2.4.2 Local Council Roads

As shown above in Figure 2.2, six (6) access points are proposed to be located off several Council-owned roads to service construction activities in the Varied Project area. Four (4) of these Council-owned access locations will merely be used as crossing points to service the accompanying internal access tracks, whilst the remaining two (2) locations will be utilised as site access locations to service the transmission line construction works. Further discussion regarding the suitability of the Site Access locations can be observed below in Section 8.

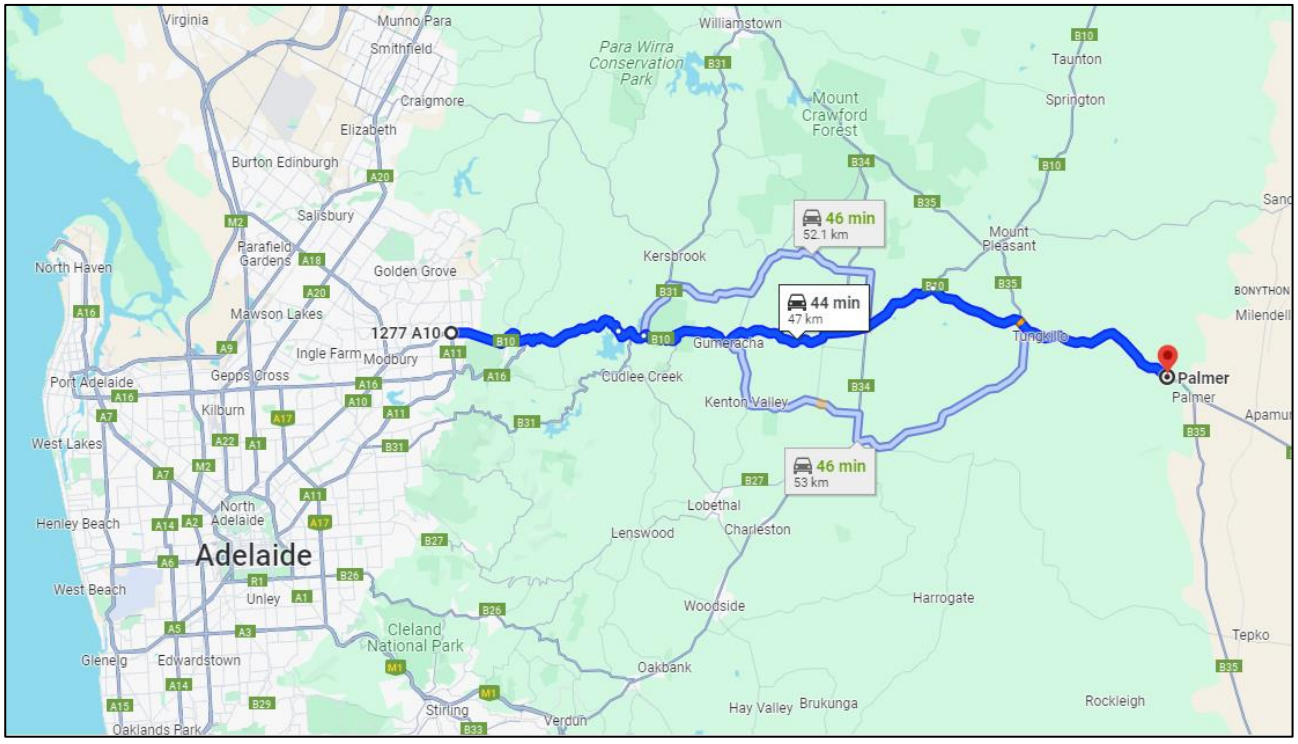
2.5 Anticipated Haul Movements & Routes

The following light vehicle, heavy vehicle and oversize overmass (OSOM) haul routes have been provided by Tilt Renewables. It should be noted that the light and heavy vehicle routes are subject to change once a final supplier has been appointed for the Project.

2.5.1 Light & Heavy Vehicle Routes

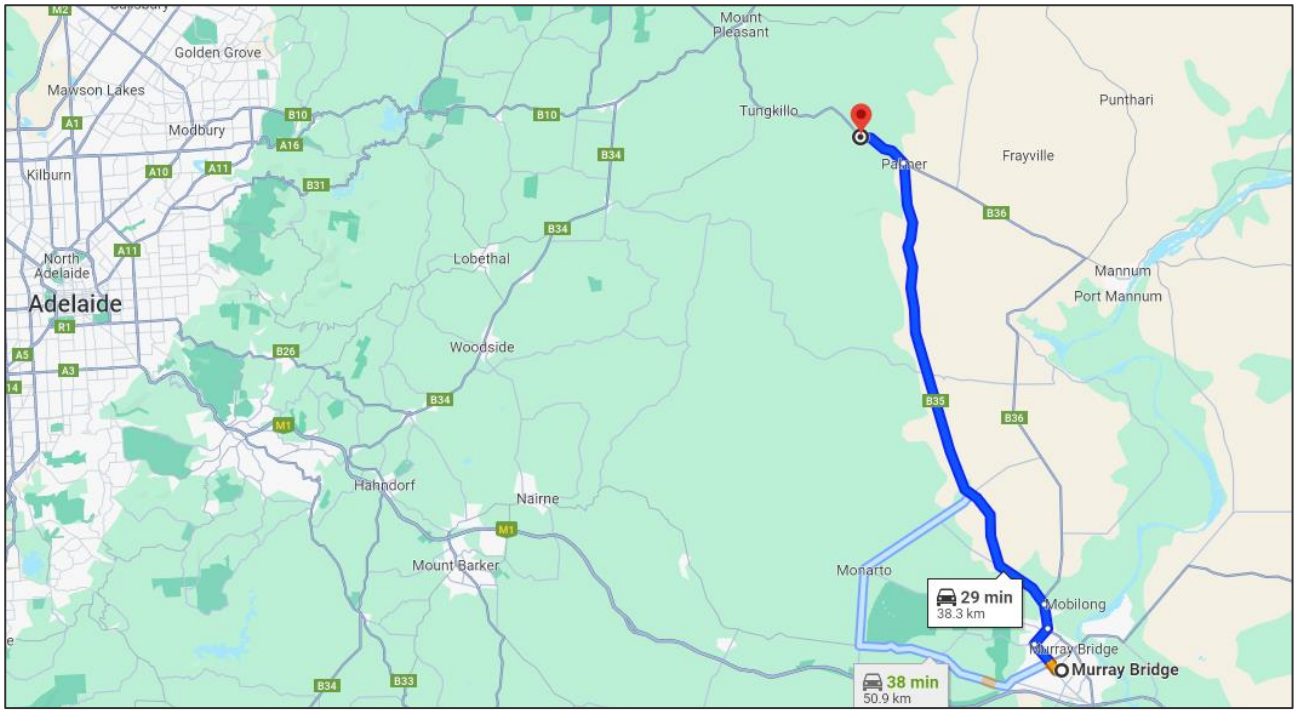
The routes outlined below are indicative based on the general catchment area and best available information of likely quarry locations for heavy vehicles movements at the time of writing.

Figure 2.4: Light Vehicle Route 1 – From Greater Adelaide



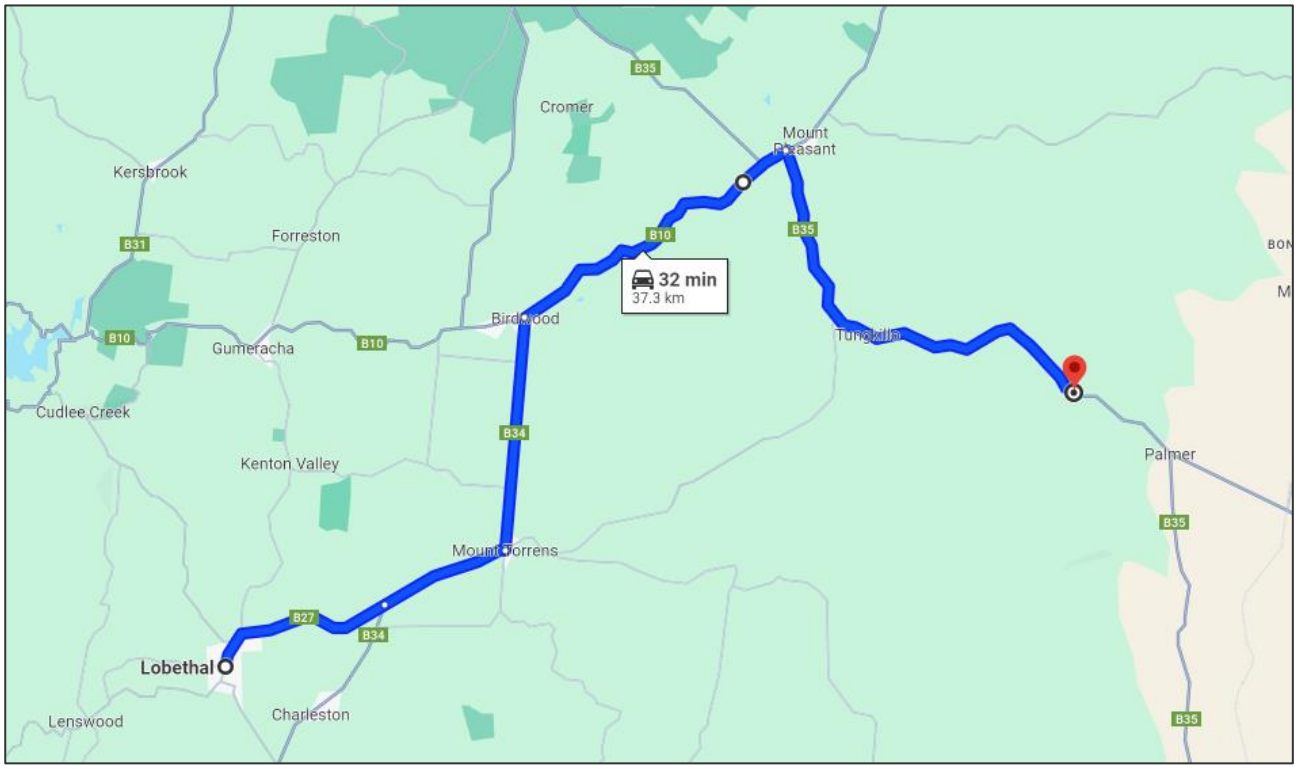
Source: www.google.com/maps

Figure 2.5: Light Vehicle Route 2 – From Murray Bridge



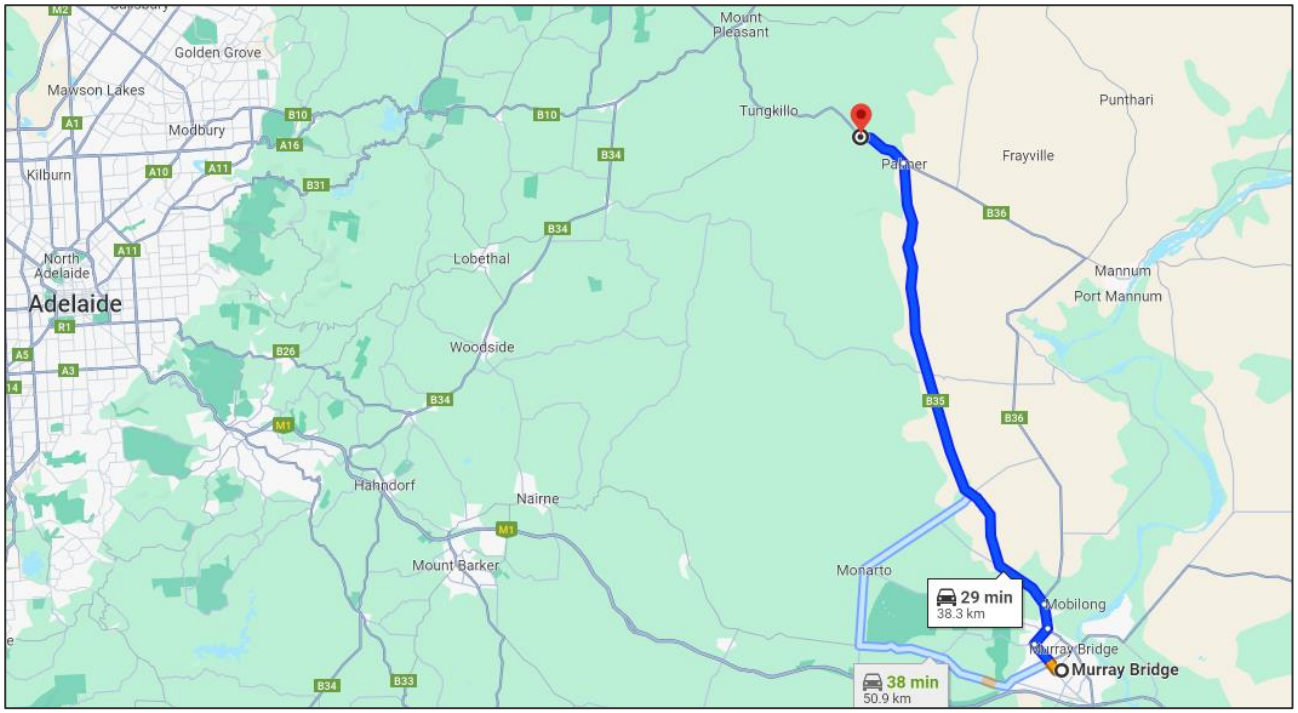
Source: www.google.com/maps

Figure 2.6: Heavy Vehicle Route 1 – From Lobethal



Source: www.google.com/maps

Figure 2.7: Heavy Vehicle Route 2 – From Murray Bridge

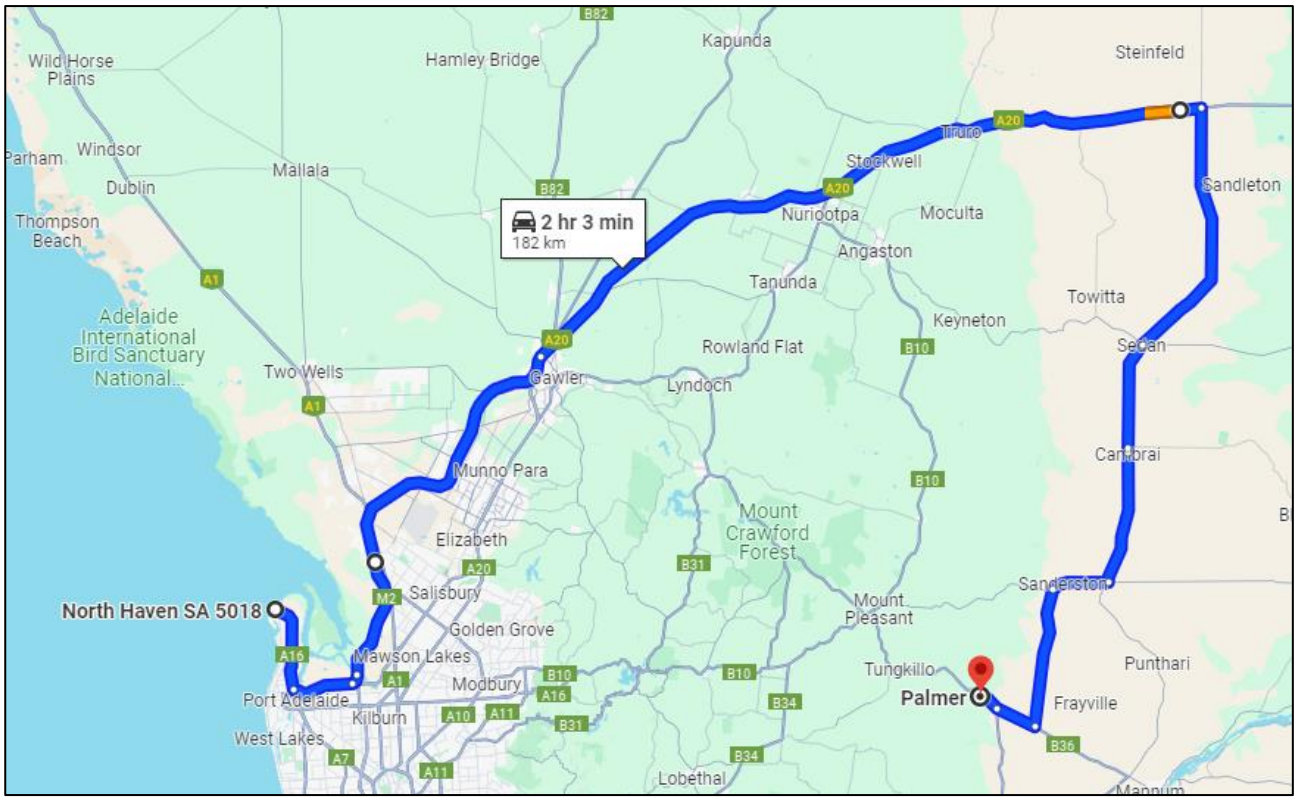


Source: www.google.com/maps

2.5.2 OSOM Haul Routes

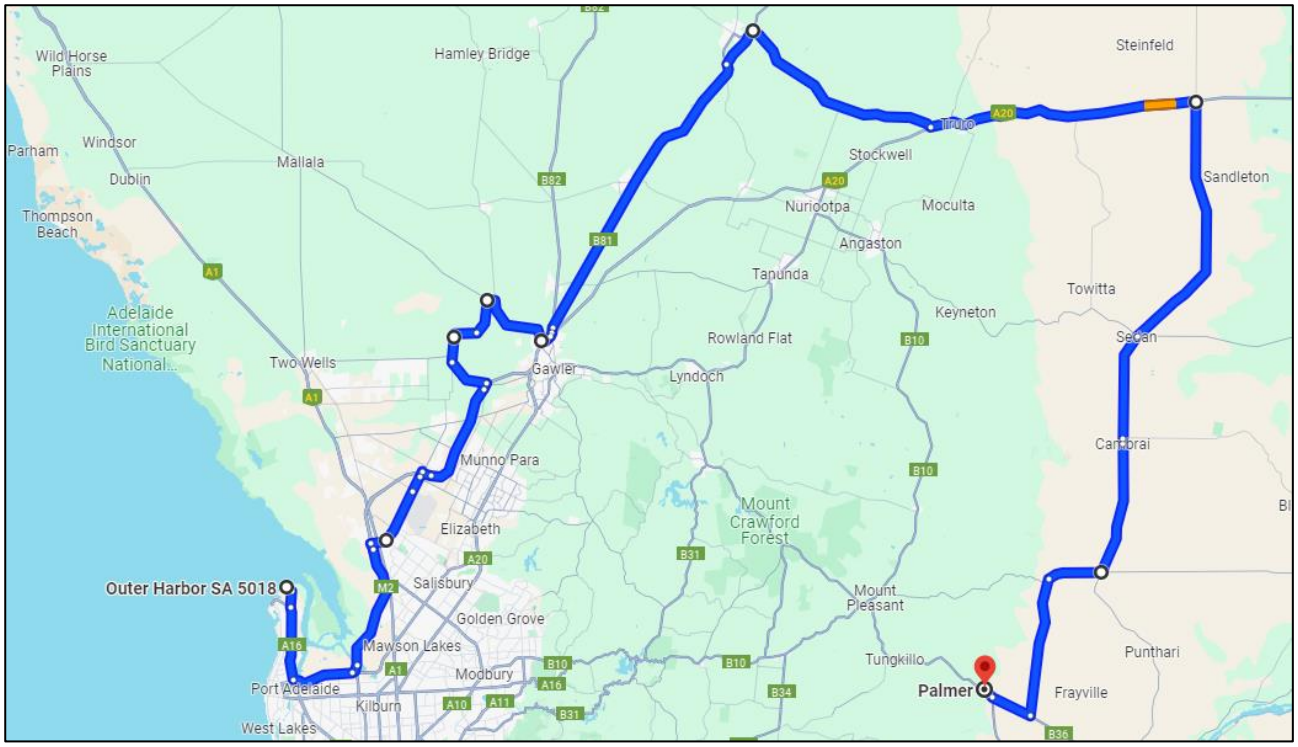
All proposed OSOM haulage routes are detailed within the Transport Route Assessment undertaken by iCubed Consulting, dated 26 February 2024. The proposed OSOM haulage routes from the iCubed Consulting report have been extracted and are documented below in Figure 2.8 to Figure 2.12.

Figure 2.8: Proposed Blade Truck and Trailer Transportation Route 1



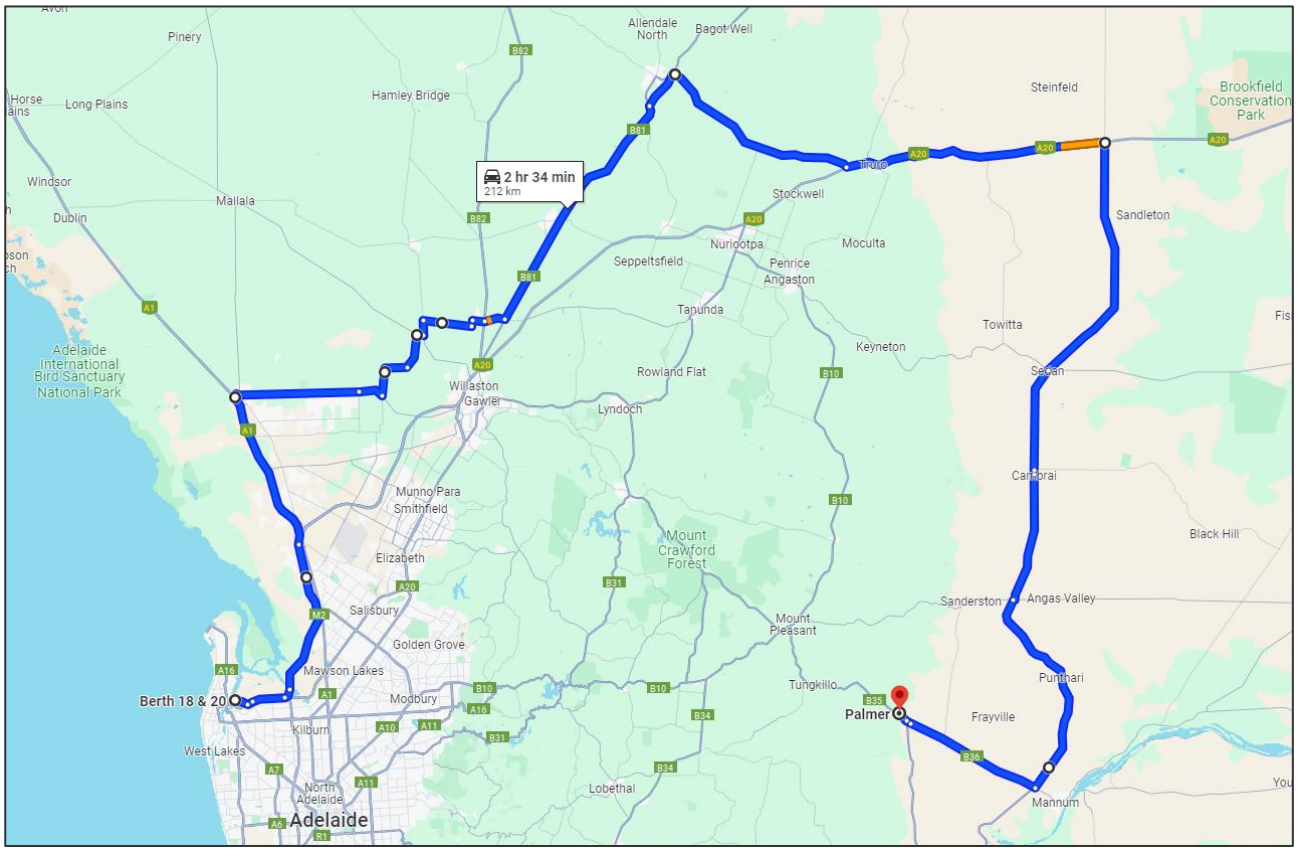
Source: Transport Route Assessment, iCubed Consulting.

Figure 2.9: Proposed Tower Truck and Trailer Transportation Route 2A



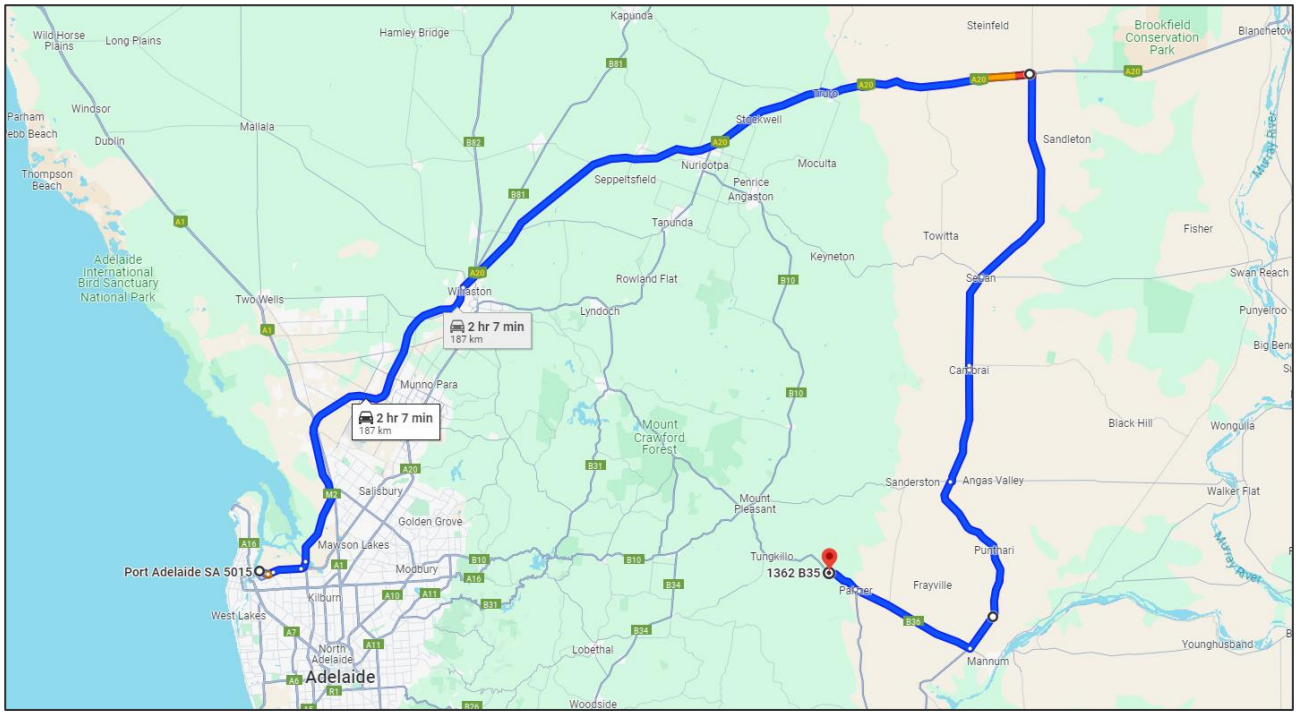
Source: Transport Route Assessment, iCubed Consulting.

Figure 2.10: Proposed Tower Truck and Trailer Transportation Route 2B



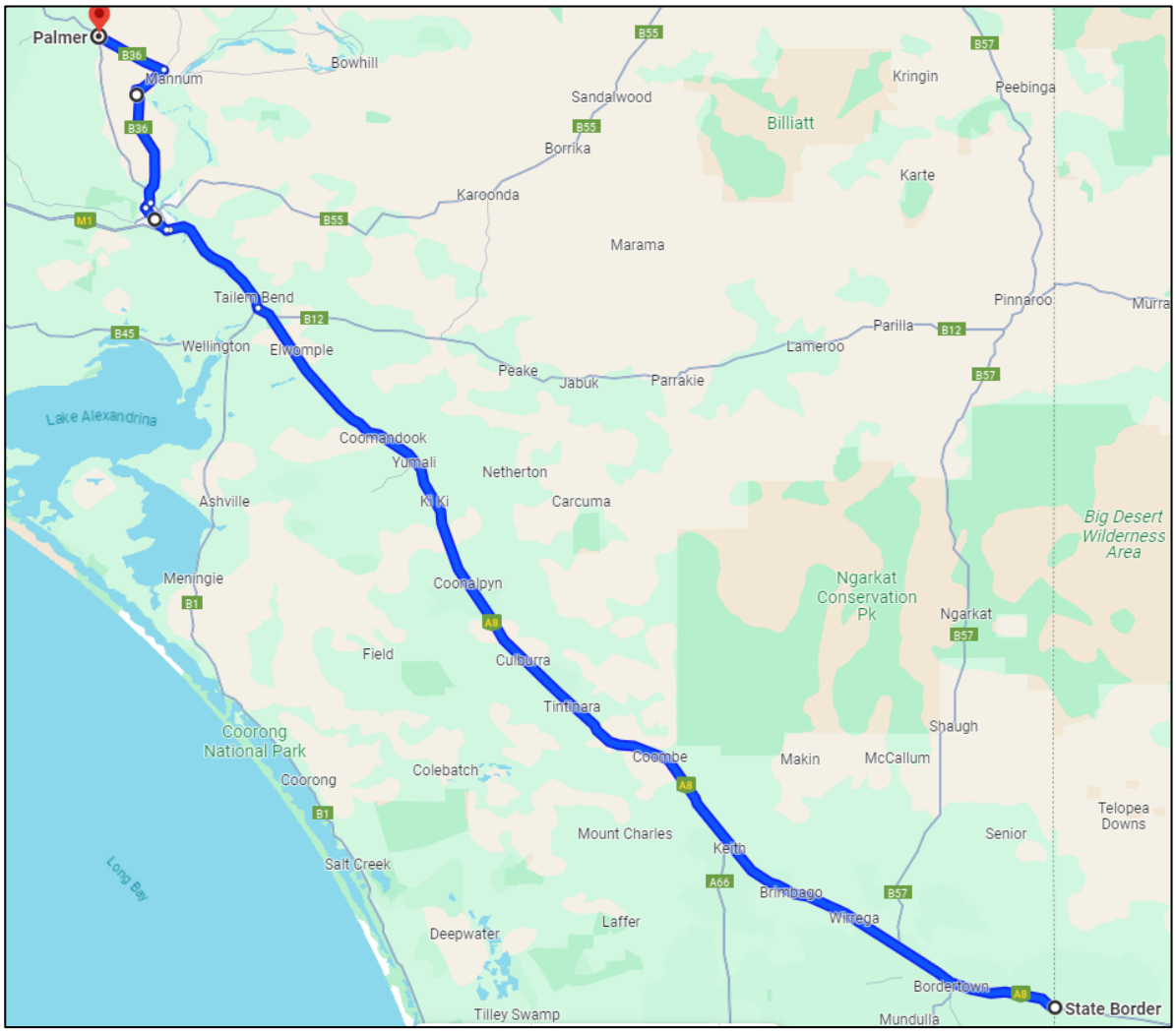
Source: Transport Route Assessment, iCubed Consulting.

Figure 2.11: Proposed Tower Truck and Trailer Transportation Route 3



Source: Transport Route Assessment, iCubed Consulting.

Figure 2.12: OSOM Transformer Route



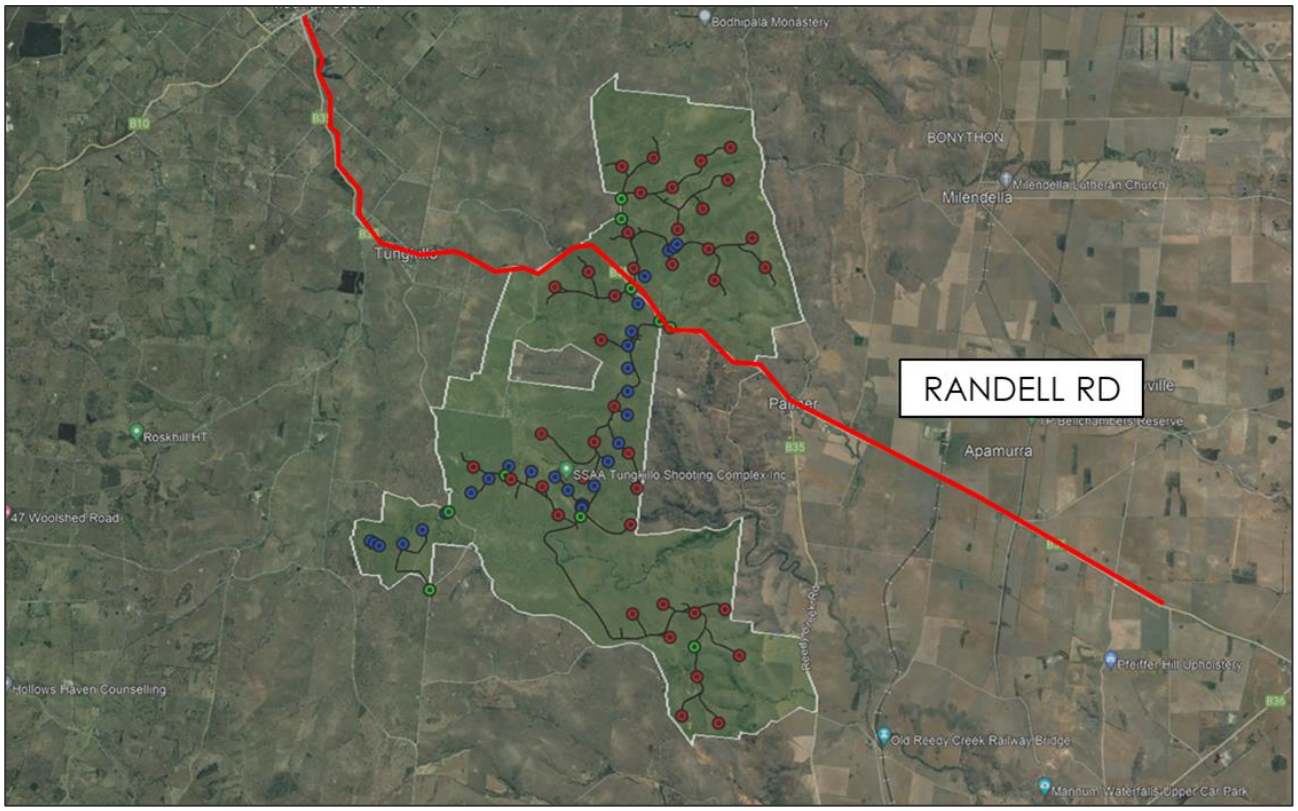
Source: Transport Route Assessment, iCubed Consulting.

3. Existing Conditions

3.1 Road Network

The major transport route in the vicinity of the PMWF is Randell Road which runs in an approximately east-west direction, with direct site access to both the north and south. Figure 3.1 and Figure 3.2 below detail the location of Randell Road, and a typical road cross section within the Project Area vicinity.

Figure 3.1: Randell Road extent through PMWF



Source: Tilt Renewables.

Figure 3.2: Randell Road looking east



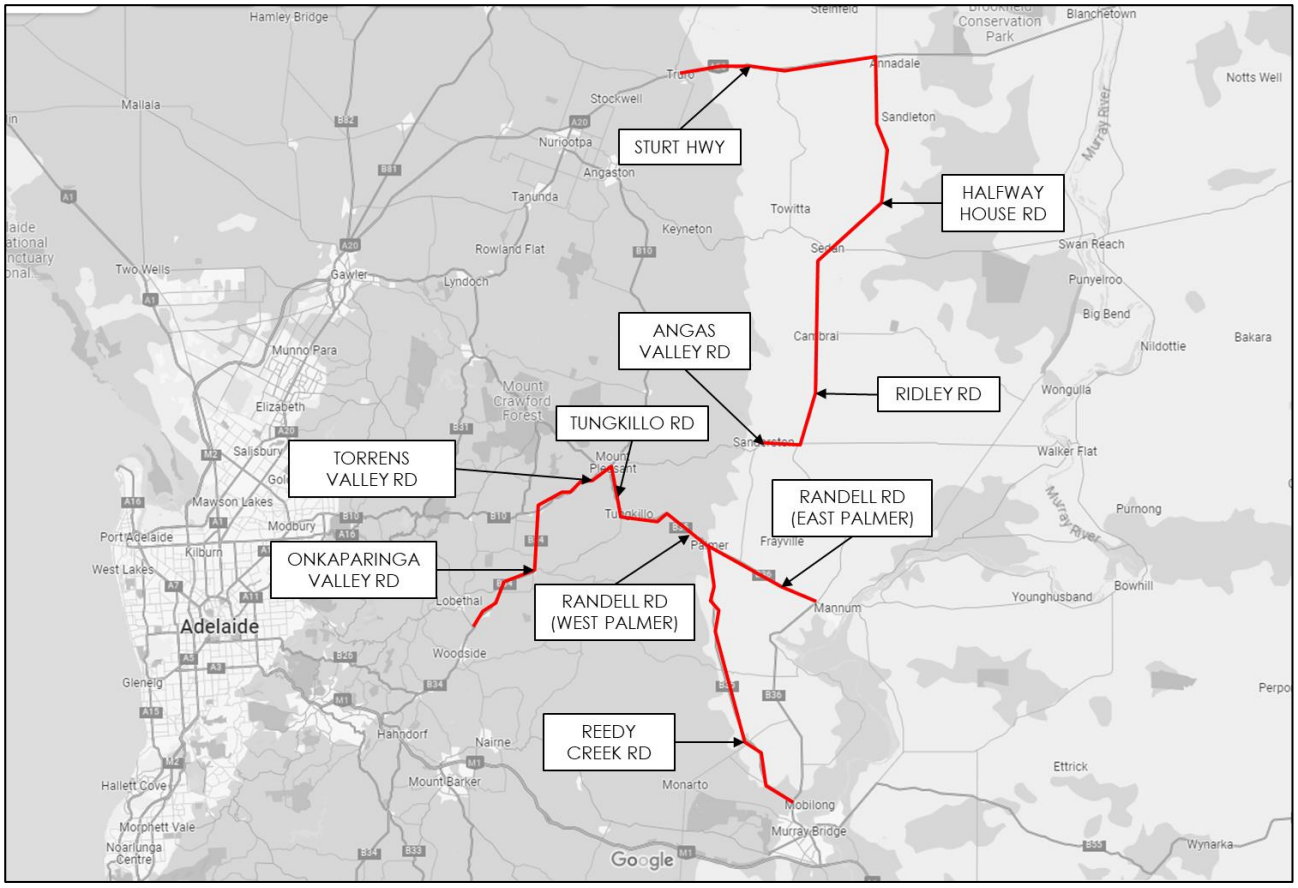
Source: www.google.com/maps

3.2 Baseline Traffic Volumes & Growth

3.2.1 State-Controlled Roads

The annual average daily traffic (AADT) volumes on the state-controlled roads along the proposed haulage routes identified in Section 2.5 for the PMWF have been sourced from the South Australian Government Data Directory, using traffic census data from 2019 – 2022. The road segments have been highlighted on Figure 3-3, with the corresponding traffic volumes summarised in Table 3-1.

Figure 3-3: AADT Census Data – Road Segments



Source: Nearmaps

Table 3-1: Annual Average Daily Traffic

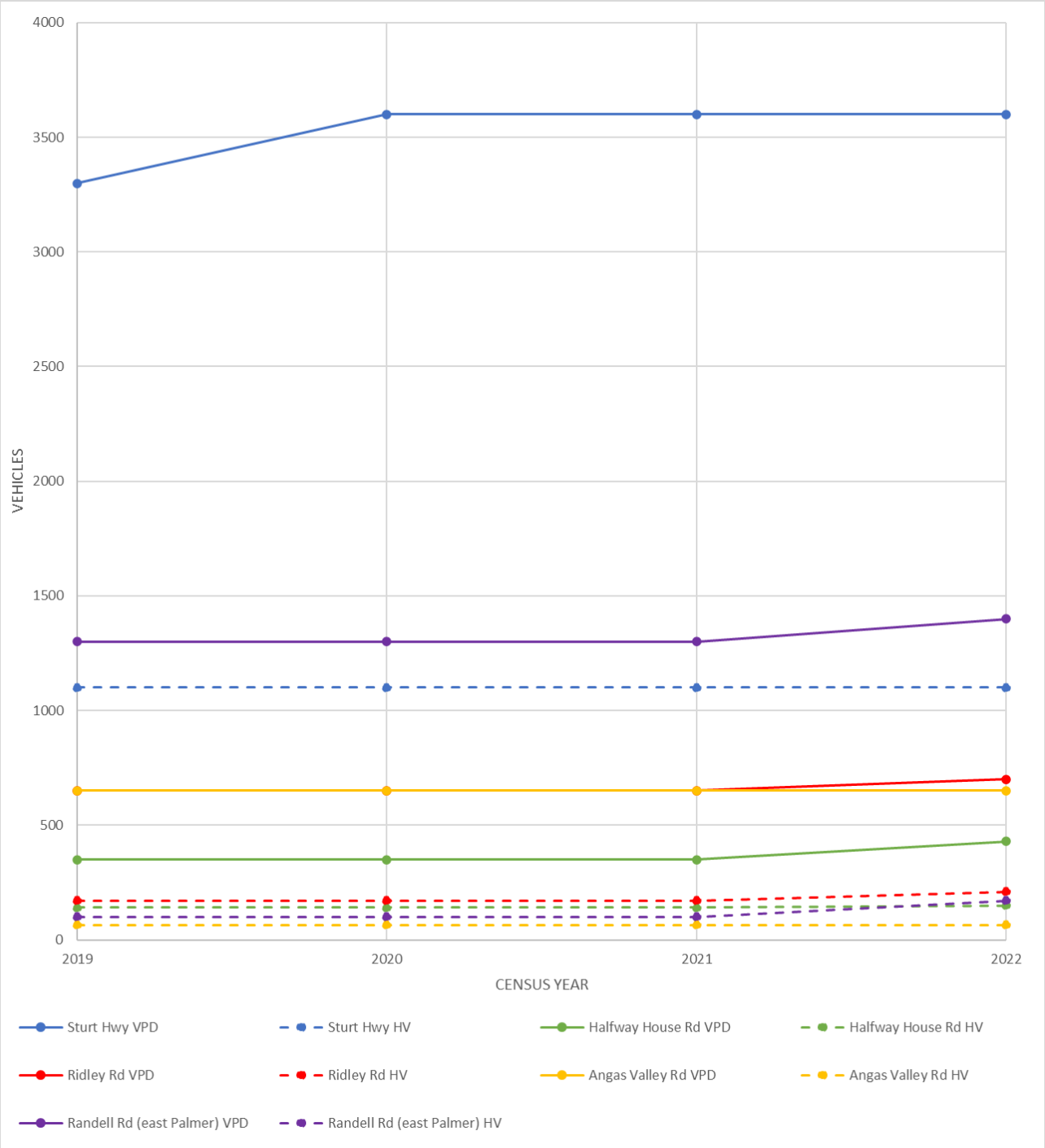
Count Site ID	Road Name	2019 AADT	2020 AADT	2021 AADT	2022 AADT	Traffic Route
1	Sturt Highway	3,300 vpd (33.5% Heavy Vehicles)	3,600 vpd (30.5% Heavy Vehicles)	3,600 vpd (30.5% Heavy Vehicles)	3,600 vpd (30.5% Heavy Vehicles)	From Port Adelaide
2	Halfway House Road	350 vpd (40% Heavy Vehicles)	350 vpd (40% Heavy Vehicles)	350 vpd (40% Heavy Vehicles)	430 vpd (35% Heavy Vehicles)	From Annadale
3	Ridley Road	650 vpd (26% Heavy Vehicles)	650 vpd (26% Heavy Vehicles)	650 vpd (26% Heavy Vehicles)	700 vpd (30% Heavy Vehicles)	From Annadale
4	Angas Valley Road	650 vpd (10% Heavy Vehicles)	650 vpd (10% Heavy Vehicles)	650 vpd (10% Heavy Vehicles)	650 vpd (10% Heavy Vehicles)	From Annadale
5	Randell Road (East Palmer)	1,300 vpd (7.5% Heavy Vehicles)	1,300 vpd (7.5% Heavy Vehicles)	1,300 vpd (7.5% Heavy Vehicles)	1,400 vpd (12% Heavy Vehicles)	From Mannum
6	Randell Road (West Palmer)	2,200 vpd (12.5% Heavy Vehicles)	2,200 vpd (12.5% Heavy Vehicles)	2,200 vpd (12.5% Heavy Vehicles)	2,300 vpd (14.5% Heavy Vehicles)	From Tungkillo
7	Tungkillo Road	1,200 vpd (13.5% Heavy Vehicles)	1,200 vpd (13.5% Heavy Vehicles)	1,200 vpd (13.5% Heavy Vehicles)	1,200 vpd (13.5% Heavy Vehicles)	From Tungkillo
8	Reedy Creek Road	1,400 vpd (10% Heavy Vehicles)	1,400 vpd (10% Heavy Vehicles)	1,400 vpd (10% Heavy Vehicles)	1,400 vpd (10% Heavy Vehicles)	From Murray Bridge
9	Torrens Valley Road	3,200 vpd (10.5% Heavy Vehicles)	3,200 vpd (10.5% Heavy Vehicles)	3,200 vpd (10.5% Heavy Vehicles)	3,200 vpd (10.5% Heavy Vehicles)	From Adelaide / Lobethal
10	Onkaparinga Valley Road	2,500 vpd (9% Heavy Vehicles)	2,500 vpd (9% Heavy Vehicles)	2,500 vpd (9% Heavy Vehicles)	2,500 vpd (9% Heavy Vehicles)	From Lobethal

NOTE: AADT values stated above represent bi-directional traffic.

3.2.2 Traffic Growth – State-Controlled Roads

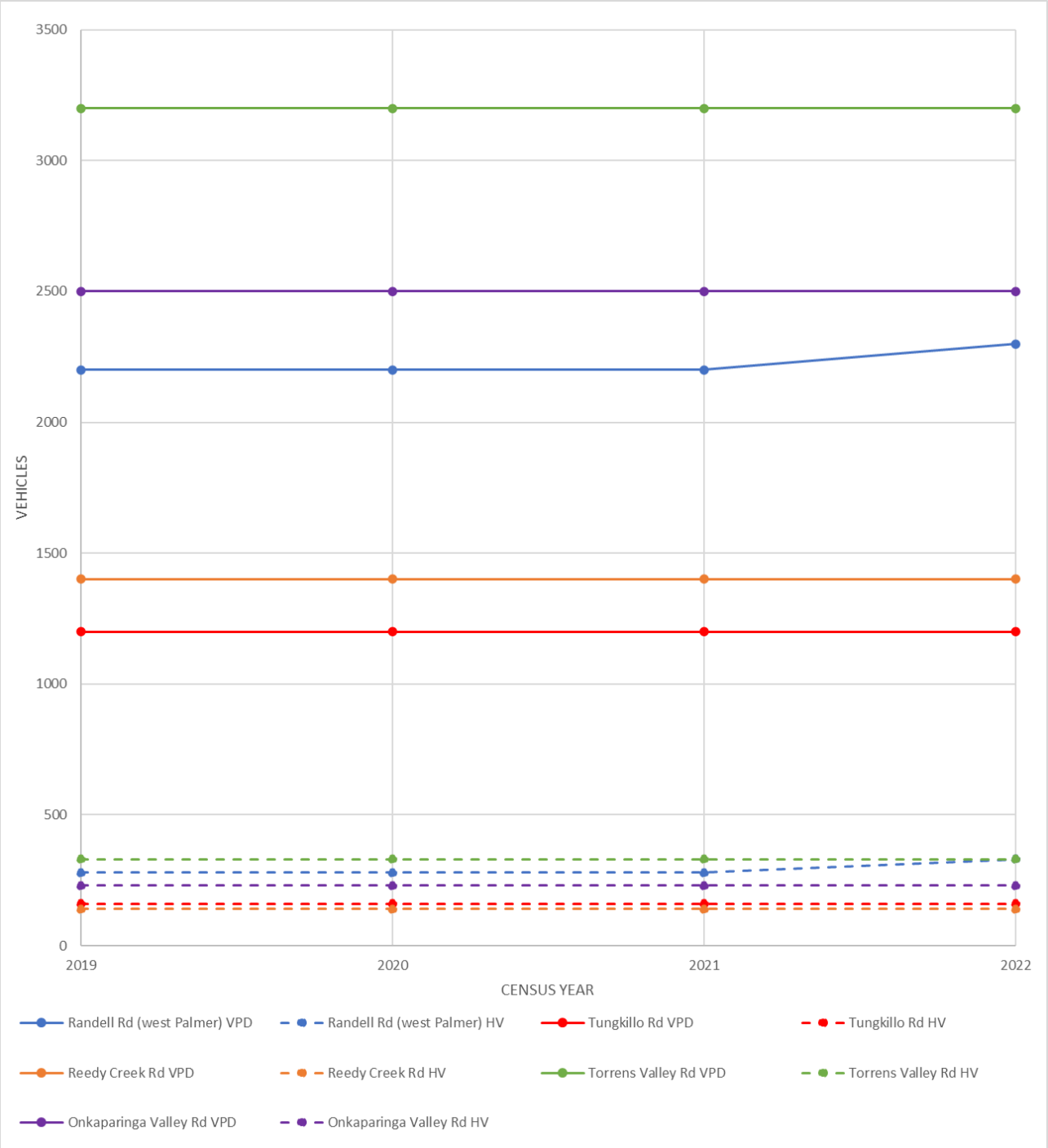
The South Australian traffic census data for previous years has been reviewed to understand the traffic growth patterns on the state-controlled road network, within close proximity to the PMWF Project Area. Figure 3-3 illustrates the road segments where data was sourced, whilst Figure 3-4 and Figure 3-5 illustrate the corresponding traffic volumes for the previous four-year period, for total vehicles and heavy vehicles.

Figure 3-4: Traffic Growth Patterns – Total Vehicles & Heavy Vehicles (1)



Source: South Australian Government Data Directory.
VPD: vehicles per day.
HV: Heavy vehicles.

Figure 3-5: Traffic Growth Patterns – Total Vehicles & Heavy Vehicles (2)



Source: South Australian Government Data Directory.
VPD: vehicles per day.
HV: Heavy vehicles.

The data shown in Figure 3-4 and Figure 3-5 demonstrate that the AADT during the previous four-year period has fluctuated, with no obvious significant growth. As a conservative measure, a traffic growth factor of 3% per annum has been applied for the analysis purposes of this assessment.

A summary of the calculated 2024 AADT volumes is shown below in Table 3-2.

Table 3-2: Calculated 2024 AADT Volumes

Count Site ID	Road Name	Existing 2022 AADT	Calculated 2024 AADT
1	Sturt Highway	3,600 vpd (30.5% Heavy Vehicles)	3,820 vpd (33.5% Heavy Vehicles)
2	Halfway House Road	430 vpd (35% Heavy Vehicles)	457 vpd (40% Heavy Vehicles)
3	Ridley Road	700 vpd (30% Heavy Vehicles)	743 vpd (30% Heavy Vehicles)
4	Angas Valley Road	650 vpd (10% Heavy Vehicles)	690 vpd (10% Heavy Vehicles)
5	Randell Road (East Palmer)	1,400 vpd (12% Heavy Vehicles)	1,486 vpd (12% Heavy Vehicles)
6	Randell Road (West Palmer)	2,300 vpd (14.5% Heavy Vehicles)	2,441 vpd (14.5% Heavy Vehicles)
7	Tungkillo Road	1,200 vpd (13.5% Heavy Vehicles)	1,274 vpd (13.5% Heavy Vehicles)
8	Reedy Creek Road	1,400 vpd (10% Heavy Vehicles)	1,486 vpd (10% Heavy Vehicles)
9	Torrens Valley Road	3,200 vpd (10.5% Heavy Vehicles)	3,395 vpd (10.5% Heavy Vehicles)
10	Onkaparinga Valley Road	2,500 vpd (9% Heavy Vehicles)	2,653 vpd (9% Heavy Vehicles)

NOTE: Growth factor of 3% per annum applied over 2 years, 2022 to 2024. Maximum HV% from 2019-2022 period taken as HV% for 2024 AADT.

3.2.3 Council Roads

Given the lack of available traffic volume data for Council-owned roads surrounding the Varied Project Area, the following conservative assumptions have been agreed upon with MMC (refer to Section 1.6.1) and will be applied to inform the traffic analysis for the Varied Project:

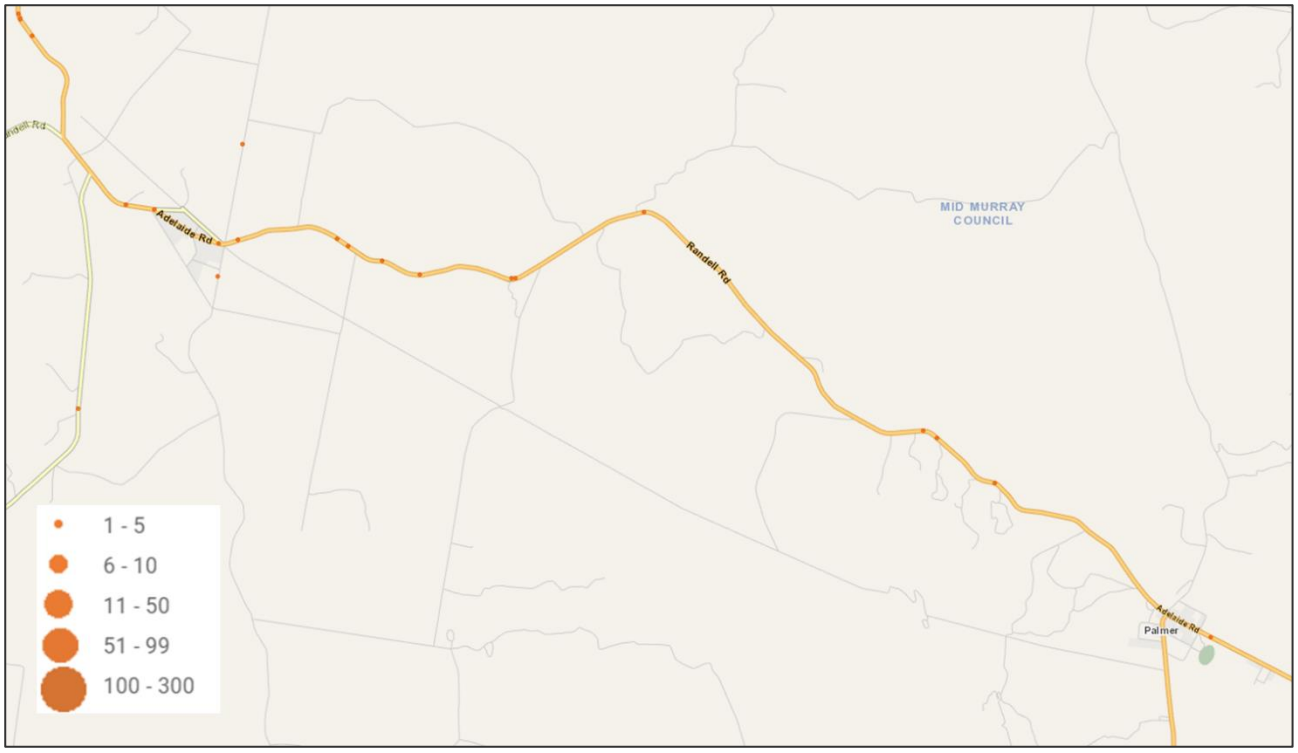
- All existing traffic on local roads surrounding the Project Area currently operate at 50 vehicles per day;
    - Assume 20% of these vehicles are heavy vehicles to account for the increase in machinery during peak periods;
    - Assume 10% of these movements occur during a single peak hour to inform intersection assessments;
    - Assume 2% annual traffic growth;

3.3 Local Crash History

The crash history data has been sourced from 'Location SA Map Viewer' (https://location.sa.gov.au/viewer/?map) within the local context of the PMWF Project Area. Figure 3.6 outlines the crash data history from 2017 to 2021 and includes all types of crashes such as Property Damage Crashes, Injury Crashes and Fatal Crashes.

From Figure 3.6 below, it can be observed there were multiple crashes within the study area during 2017 – 2021 however no area can be considered a hot spot. When reviewing the crash type data via the Location SA Map Viewer, the majority of crashes resulted in damage to property with only one (1) serious injury crash recorded in the area captured.

Figure 3.6 – Crash History Data



Source: Location SA Map Viewer

4. Project Traffic

4.1 Traffic Assumptions

Tilt Renewables have provided estimates of the external traffic generated during the construction phase of the Varied Project. Assumptions have been made regarding both the workforce traffic, construction-related traffic and transmission line construction traffic. These assumptions have been developed in consultation with the proponent and have been derived based on the best available knowledge of the Project at the time of preparing this report.

To maintain consistency between previously undertaken assessments, the assumptions adopted by GHD as part of the 2014 TIA report have been adopted as part of this assessment. Within the 2014 report, GHD adopted the following assumptions:

- Conservative assumption of a 24-month construction period;
- 22 working days per month;
- Maximum 200 personnel on-site per day;
    - Assuming there is a level of car-pooling and the average vehicle occupancy is 1.5 people per vehicle, a maximum of 270 daily two-way movements can be determined.
- All concrete materials will be sourced externally and transported to site to be processed at the on-site concrete batching plants;
- All road upgrade materials are to be sourced externally;

In addition to the above, the following assumptions will also form part of the traffic analysis:

- The selected turbines will comprise of five (5) tower sections;
- All water required as part of the construction process will be sourced off-site;
- Two (2) concrete batching plants will be established on-site;

4.1.1 Light Vehicle Traffic Assumptions

Light vehicles accessing the Project Area will largely consist of the workforce associated with the civil construction works. There is however a proportion of light vehicles consisting of local trades and pilot vehicles which will access the Project Area on an as needed basis such that their working hours will vary significantly from the majority of the civil workforce.

The following assumptions have been made regarding the workforce-generated light vehicle traffic for the PMWF during the peak construction phase.

- Workforce locations / trip origins:
    - 80% from Adelaide; and
    - 20% from Murray Bridge.
- Workforce vehicle occupancy and mode of travel:
    - Vehicles assumed occupancy of 1.5 people per vehicle.
- Workforce arrival and departure times:
    - Estimated departure to site to occur from 5:30am to 6:30am;
    - Estimated departure from site to occur from 4:00pm to 6:00pm.

For the purposes of this assessment, it has been assumed that 80% of the peak daily light vehicle traffic will arrive at / depart from the Project Area, coinciding with the external network peak hour. This accounts for the proportion of light vehicles such as local trades and pilot vehicles accessing the Project Area sporadically throughout the course of the working day.

4.1.2 Heavy Vehicle & OSOM Traffic Assumptions

The following assumptions have been made regarding the construction traffic generated by the PMWF during the peak construction phase:

- Construction-generated trips averaged out and evenly distributed across the specified timeline within the construction phases noted in section 2.3 above;
- Given there are likely to be multiple nominated heavy vehicle routes, it has been conservatively assumed that heavy vehicle arrival and departures will be evenly split on the external network such that 50% will arrive from / depart to the east and west respectively;
- All OSOM vehicles will utilise the nominated OSOM routes as outlined in Section 2.5.2.

For the purposes of this assessment, it has been assumed that 30% of the peak daily heavy vehicle and OSOM traffic will arrive at / depart from Project Area, coinciding with the external network peak hour. This is a conservative assessment given the arrival / departure patterns of the heavy / OSOM vehicle traffic is not likely to align with typical external peak periods.

4.1.3 Overhead Transmission Line Traffic Assumptions

The following assumptions have been made regarding the construction traffic generated by the Overhead Transmission Line (OHL) works during the peak construction phase:

- OHL construction-generated trips averaged out and evenly distributed across the specified timeline within the construction phases noted in section 2.3 above;
- Anticipated delivery routes and vehicle movements for OHL components have been provided by Tilt Renewables as part of this assessment. OHL-related traffic will form part of the overall traffic volumes generated during the PMWF construction discussed in the subsequent sections of this report;
- All light vehicle assumptions outlined in Section 4.1.1 are applicable for OHL light-vehicle traffic; and
- All peak hour loading factors for light and heavy vehicles are applicable to OHL-related traffic.

4.2 External Traffic Generation

Table 4.1 below provides a summary of the anticipated external vehicle movements generated during the Varied Project construction phase.

Table 4.1: Total External Traffic Generation

Vehicle Movements	Vehicle Class	Approximate Trips
Wind Farm Construction Staff (all)	Light	62,400
Miscellaneous deliveries	Heavy	6,782
Materials deliveries	Heavy	11,413
Equipment deliveries	Heavy	203
Equipment deliveries	OSOM	5
Batch plant deliveries	Heavy	2,459
Wind Turbine Components	Light	2,184
Wind Turbine Components	Heavy	129
Wind Turbine Components	OSOM	462
OHL Heavy Vehicles	Heavy	364
OHL Construction Staff	Light	570

From Table 4.1 above, a summary of the total one-way trips generated by the Varied Project development can be observed below in Table 4.2.

Table 4.2: Total One-Way Trips

Vehicle Class	One-Way Trips
Heavy	21,350
Light	65,154
OSOM	467
Total One-Way Trips	86,970

From information provided by Tilt Renewables, Table 4.3 below provides a breakdown of the construction vehicle movements anticipated across the 24-month period of the Varied Project for the wind farm component.

Table 4.3: External Traffic Splits Across Development Periods – Wind Farm

Vehicle Class	Site Establishment (Months 0-3)	Civil Construction (Months 3-18)	Testing & Commissioning (Months 18-24)
Heavy	20 %	75 %	5 %
Light	15 %	75 %	10 %
Oversize Overmass (OSOM)	0 %	85 %	15 %

Further information from Tilt Renewables in Table 4.4 below provides a breakdown of the OHL vehicle movements anticipated across the 6-month construction period.

Table 4.4: External Traffic Splits Across Development Periods – OHL

Vehicle Class	Site Establishment (Month 3)	Civil Construction (Months 3-8)
Heavy	60 %	40 %
Light	20 %	80 %

4.3 External Traffic Distribution

4.3.1 Wind Farm

With reference to the haulage routes outlined above in Section 2.5 and the assumptions outlined in Section 4.1, the external traffic generated by the Varied Project for the Wind Farm will be distributed on the state-controlled network using the summary provided below in Table 4-5.

Table 4-5: External Traffic Distribution – Wind Farm

Count Site ID	Road Name	Proportion of Varied Project Traffic
1	Sturt Highway	100% OSOM
2	Halfway House Road	100% OSOM
3	Ridley Road	100% OSOM
4	Angas Valley Road	100% OSOM
5	Randell Road (East Palmer)	100% OSOM
6	Randell Road (West Palmer)[1]	100% LV 100% HV 100% OSOM
7	Tungkillo Road	80% LV 50% HV
8	Reedy Creek Road	20% LV 50% HV
9	Torrens Valley Road	80% LV 50% HV
10	Onkaparinga Valley Road	50% HV

1. *Assumed all Varied Project traffic will enter the site via Site Access 3 or 4 from Randell Road.*

4.3.2 OHL Traffic Generation

With reference to the assumptions outlined in Section 4.1.3, the external traffic generated by the Varied Project for the OHL will be distributed on the Council-controlled network using the details provided by Tilt Renewables shown below in Table 4.6 along with the assumptions outlined in Section 4.1.

Table 4.6: External Traffic Distribution – OHL

Road	Vehicle Category	Approximate Total One-Way Trips
Electranet Road	Light	200 trips
	Heavy	78 trips
Brinkworth Road (Instance 1)	Light	270 trips
	Heavy	249 trips
Brinkworth Road (Instance 2)	Light	100 trips
	Heavy	37 trips

For the purposes of this assessment, it has been conservatively assumed that all OHL-related traffic will mirror the light and heavy vehicle routes utilised by the Wind Farm construction traffic.

5. Traffic Impacts

5.1 Peak Daily Traffic

With consideration for the information provided in Section 2.3 and Section 4.2 addressing the traffic generated as part of the Varied Project for both the Wind Farm and the OHL, the peak daily traffic scenario can be determined to occur during Project month 3.

Table 5.1 below summarises the breakdown of the external traffic generated during the peak scenario.

Table 5.1: Peak Daily Traffic Scenario

	Light Vehicles	Heavy Vehicles	OSOM Vehicles	Total Vehicles	HV%
One-Way Trips	152 trips	74 trips	2 trips	228 trips	33%

5.2 Peak Hourly Traffic

In adopting the assumptions detailed above in Section 4.1 regarding peak hourly traffic generation, the total peak hourly volumes can be determined, and are summarised below in Table 5.2.

Table 5.2: Peak Hourly Traffic Scenario

Vehicle Class	Peak Hourly Project Traffic
Light Vehicles	122 peak hour trips
Heavy & OSOM Vehicles	61 peak hour trips
Total Peak Hour Trips	183 trips

5.3 State-Controlled Road Network

The peak daily and peak hourly traffic generated on the external state-controlled network can be determined using the information provided in Table 4-5, Table 5.1 and Table 5.2 respectively. All results are summarised below in Table 5-3.

Table 5-3: State-Controlled Roads – Peak Daily & Hourly Project Traffic

Count Site ID	Road Name	Peak Daily Project Traffic				Peak Hourly Project Traffic			
		LV	HV	OSOM	Total	LV	HV	OSOM	Total
1	Sturt Highway	-	-	2 trips	**2 trips**	-	-	2 trips	**2 trips**
2	Halfway House Road	-	-	2 trips	**2 trips**	-	-	2 trips	**2 trips**
3	Ridley Road	-	-	2 trips	**2 trips**	-	-	2 trips	**2 trips**
4	Angas Valley Road	-	-	2 trips	**2 trips**	-	-	2 trips	**2 trips**
5	Randell Road (East Palmer)	-	-	2 trips	**2 trips**	-	-	2 trips	**2 trips**
6	Randell Road (West Palmer)	152 trips	74 trips	2 trips	**228 trips**	122 trips	59 trips	2 trips	**182 trips**
7	Tungkillo Road	122 trips	37 trips	-	**159 trips**	97 trips	30 trips	-	**127 trips**
8	Reedy Creek Road	30 trips	37 trips	-	**67 trips**	24 trips	30 trips	-	**54 trips**
9	Torrens Valley Road	122 trips	37 trips	-	**159 trips**	97 trips	30 trips	-	**127 trips**
10	Onkaparinga Valley Road	-	37 trips	-	**37 trips**	-	30 trips	-	**30 trips**

5.4 Council-Controlled Road Network

The peak hourly traffic generated along the external Council-controlled network can be determined using the information provided in above in Table 4.6 along with the peak hour loading factors outlined in Section 4.1. Peak hourly traffic volumes are shown below in Table 5-4.

Table 5-4: Council-Controlled Roads – Peak Daily & Hourly Project Traffic

Road Name	Peak Daily Project Traffic			Peak Hourly Project Traffic		
	LV	HV	Total	LV	HV	Total
Electranet Road	2 trips	2 trips	**4 trips**	2 trips	2 trips	**4 trips**
Brinkworth Road (Instance 1)	3 trips	7 trips	**10 trips**	2 trips	5 trips	**2 trips**
Brinkworth Road (Instance 2)	1 trip	1 trip	**2 trips**	1 trip	1 trip	**2 trips**

NOTE: Subject to minor rounding of trip values for reporting purposes.

6. Road Link Assessment

6.1 Context of Road Assessment

The following section has been prepared to assess anticipated Varied Project impacts on the road network with due consideration of forecast traffic volumes "with" and "without" the Varied Project. This assessment has been undertaken which defines the impact assessment area to be:

> *"All road links where the development traffic exceeds 5% of the base traffic in either direction on the link's annual average daily traffic (AADT) in the year of opening of each stage"*

As such, the following has been considered as part of this assessment:

- Anticipated AADT for 2024 on each of the state-controlled roads as summarised in Table 3-2; and
- The traffic impact as discussed in Section 5.

6.2 State Controlled Road Network

Table 6-1 summarises the comparison of baseline traffic to Varied Project traffic, to determine whether the 5% traffic impact threshold is exceeded.

Table 6-1: Road Link Assessment (State-Controlled Network) – Impact Identification Table

Count Site ID	Road Name	Calculated 2024 AADT	Peak Daily Project Traffic	% Increase	Proportional Impact > 5%
1	Sturt Highway	3,820 vpd (33.5% Heavy Vehicles)	4 vpd (100% Heavy Vehicles)	0.10%	No
2	Halfway House Road	457 vpd (40% Heavy Vehicles)	4 vpd (100% Heavy Vehicles)	0.88%	No
3	Ridley Road	743 vpd (30% Heavy Vehicles)	4 vpd (100% Heavy Vehicles)	0.54%	No
4	Angas Valley Road	690 vpd (10% Heavy Vehicles)	4 vpd (100% Heavy Vehicles)	0.58%	No
5	Randell Road (East Palmer)	1,486 vpd (12% Heavy Vehicles)	4 vpd (100% Heavy Vehicles)	0.27%	No
6	Randell Road (West Palmer)	2,441 vpd (14.5% Heavy Vehicles)	456 vpd (58% Heavy Vehicles)	18.68%	Yes
7	Tungkillo Road	1,274 vpd (13.5% Heavy Vehicles)	317 vpd (17% Heavy Vehicles)	24.90%	Yes
8	Reedy Creek Road	1,486 vpd (10% Heavy Vehicles)	135 vpd (45% Heavy Vehicles)	9.07%	Yes
9	Torrens Valley Road	3,395 vpd (10.5% Heavy Vehicles)	317 vpd (17% Heavy Vehicles)	9.34%	Yes
10	Onkaparinga Valley Road	2,653 vpd (9% Heavy Vehicles)	74 vpd (100% Heavy Vehicles)	2.79%	No

As observed above in Table 6-1, only four (4) of the state-controlled roads trigger the >5% impact. Of these four (4) roads, a significant proportion of the additional vehicles generated on these links consist of light vehicle traffic. Tungkillo Road in particular, whilst observing an increase of 24.9% during peak construction periods, will consist of 83% additional

light vehicles. As such, given the large proportion of light vehicle movements and relatively low existing volumes, these impacts would be considered relatively minor in this instance.

6.3 Council Controlled Road Network

Given the low-level peak daily volumes generated on the Council-controlled network as shown above in Table 5-4, with a maximum increase of 20 vehicles per day observed on Brinkworth Road (Instance 1), the impact on the network is not likely to be considered significant.

It should be noted that many of the proposed site access locations identified above in Figure 2.2 (located on Page 7) will act as crossing points over Council-controlled roads for the Wind Farm construction related traffic. Construction traffic crossing Council roads at the proposed site access locations would be expected to have limited operational impact on the Council-controlled network, associated with the traffic management for vehicle crossing movements.

7. Comparative Impact Assessment

7.1 Traffic Impact Assessment (2014) – GHD Report Approved Project

The section detailed below has been extracted from the 2014 GHD Traffic Impact Assessment in respect to the vehicle movements for the Approved Project.

The primary impact, in terms of road network performance and safety, will be during the 18 to 24 month construction period where a large number of vehicle movements will be generated over a short period of time.

The total one-way vehicle trips estimated for the construction phase of the proposed wind farm are shown to be reasonably significant, comprising of approximately:

- ***2,554** over mass and over dimensional trips;*
- ***49,293** truck trips; and*
- ***105,600** car trips.*

The above listed trips however, will occur over a minimum 18 month period. When broken down to average trips per month and per day the impacts on the road network are shown to be more reasonable. The average daily trips are:

- ***6 over mass and over dimensional trips**. If these trips are carried out during off-peak hours and are delivered to Palmer from Port Adelaide, the impacts on the road network would be minimised. It should be noted that this number accounts for loaded vehicles accessing the site and unloaded vehicles leaving the site. It is likely that the over mass vehicles will be within mass limits once unloaded and a number of the over dimensional vehicles will be within legal size requirements once unloaded, hence this figure is very conservative;*
- ***124 truck trips**. The average number of daily truck trips on the surrounding road network could be further reduced if materials for concrete and pavement could be sourced on site or from a nearby location. The implementation of a temporary storage area for equipment and vehicles within the temporary construction compound would also further assist in reducing the number of heavy vehicle trips generated; and*
- ***267 car trips**. These trips will primarily be associated with employees arriving to/from work. Carpooling should be encouraged amongst employees.*

The above estimated worst case increase in daily traffic volumes will be approximately 365 additional vehicles per day (vpd) on the key roads surrounding the proposed wind farm site. The key issue to be addressed is that over 25% of vehicle movements associated with the construction of the proposed wind farm will be heavy vehicle movements. This will be managed through the development of a detailed Traffic Management Plan (TMP). It should be noted that these figures are conservative and are representative of the "worst case scenario". The trips are able to be reduced if measures are in place such as sourcing locally produced quarried materials. During the operations phase the proposed wind farm is designed for stand-alone remote operation. Generally, the proposed wind farm will operate unattended for most of its operational life and accordingly the traffic associated with the long-term operation of the wind farm will be minimal.

7.2 Comparative Review

Table 7-1 below provides an overview of the traffic impacts associated with the Approved Project TIA (2014 GHD Report) compared to the Varied Project TIA (current assessment).

Table 7-1: Comparative Assessment

	Approved Project – 103 WTG Layout	Varied Project – 40 WTG Layout	Difference
Total One-Way Trips	105,600 LV Trips 49,293 HV Trips 2,554 OSOM Trips	65,154 LV Trips 21,350 HV Trips 467 OSOM Trips	-40,446 LV Trips -27,943 HV Trips -2,087 OSOM Trips
Average Peak Daily Trips	267 LV Trips 124 HV Trips 6 OSOM Trips	152 LV Trips 74 HV Trips 2 OSOM Trips	-115 LV Trips -50 HV Trips -4 OSOM Trips

As observed above, there is a significant reduction in both the total one-way trips (70,476 trips) and peak daily trips (167 trips) associated with the Varied Project when compared to the Approved Project. Such a reduction in the total construction traffic will have the following effects:

- Reduced overall impact on the external State and Council controlled road networks, particualrly in regards to pavement degradation and through vehicle movements.
- A reduction in peak daily volumes will benefit local residents who rely on the local road network for daily commutes, school pick-up / drop-off and agriculture machinery movements.

8. Driver Safety Assessment

8.1 Overview

In direct consultation with MMC, it was determined that the Driver Safety Assessment required to fulfil ERD Court Order 3 would address:

- Turn warrant assessments on all external roads to determine upgrade requirements.
- Construction traffic management techniques to be implemented during the construction to ensure the safety of motorists and workers travelling through the project site.
- Sightline assessments for site access locations.
- Direct reference to the shadow flicker assessment being undertaken to fulfill Condition 5.c.

8.2 Traffic Management Plan

As part of ongoing works for the Varied Project, a Traffic Management Plan (TMP) will be required to ensure the ERD Court Orders are satisfied. The TMP should include, but not be limited to, the following details:

- The final access routes for the Varied Project;
- Details of all road upgrades required to facilitate the Varied Project;
- Details of delivery times;
- Details of proposed road closures and their management;
- Details of permits required;
- Details of all required road signs and advisory signs;
- Swept path assessments for all surrounding intersections and proposed site access locations;
- Detailed site access layout plans;
    - Consideration will be given to delivery routes, the potential for conflicting movements between construction-related vehicles, existing road layout and existing road infrastructure.
- Safety and mitigation measures to be implemented during the construction phase;
    - Inclusive of but not limited to potential speed reductions, temporary traffic management treatments and management of interactions with general local traffic.
- Turn warrant assessments on the surrounding state-controlled intersections; and
- On-site car parking review.

8.3 Notification of Works

As per the ERD Court Order Item 20, "*The applicant shall notify the Commissioner of Highways by submitting a "Notification of Works Impacting Department of Planning, Transport and Infrastructure Roads" form at least five (5) working days before construction works begin.*"

8.4 Site Access Review – State-Controlled Network

8.4.1 Assessment Methodology

Stantec has undertaken a site inspection on Tuesday 14 November, 2023 to review the nominated site access locations for the Varied Project, located on Randell Road west of Palmer. Please note only the site accesses located along state-controlled roads have been considered as part of this assessment.

As part of this assessment, the following was considered:

- Horizontal and vertical alignment of Randell Road with respect to the three (3) proposed Site Access Locations;
- The grade of Randell Road within the vicinity of the Project Area; and
- Any sightline impeding structures inclusive of vegetation, powerpoles, signage, property etc.

Following this inspection, each Site Access has been reviewed in accordance with *Section 3.3 of Guide to Road Design Part 4A: Unsignalised and Signalised Intersections (Austroads 2017)*. As part of this assessment, consideration must be given to the approach sight distance (ASD) and the safe intersection sight distance (SISD)

8.4.2 Assessment Assumptions

The assessment has been based on a design speed of 110 km/h (posted speed 100 km/h) and reaction time of 2.5 seconds. Grade adjustments have been applied to site access 4A and 4B based on a worst case of 8% as a detailed grade check has not been completed. At site access 3, the accesses are on a section where there is no significant grade, however traffic approaching from west/north (from Tungkillo) is on a steep upgrade prior to the point where the vehicles would first see the site accesses. An 8% grade adjustment has therefore been applied only in this direction at Site Access 3. An overview of the site access locations is shown below in Figure 8.1.

Figure 8.1 Randell Road Site Access Locations



Source: NearMaps.

8.4.3 Assessment Findings

Table 8-1 summarises the sight distances determined for each site access locations and direction based on a combination of site measurements, photographs and aerial mapping.

Table 8-1: Sight Distance Assessment

Access Location	East/South		West/North	
	Required (m)	Available (m)	Required (m)	Available (m)
4A	276 m	310 m	338 m	220 m
4B	276 m	398 m	338 m	194 m
3 (North)	300 m	130 m	276 m	213 m
3 (South)	300 m	156 m	276 m	213 m

Site Access 4 (A & B)

From the identified sight distances, Site Access 4A and 4B can both achieve the required sight distance to the east even without the allowance for the upgrade. Neither location can achieve the required sight distance to the west/north based on the standard posted speed of 100 km/h. It should be noted that the bend just to the west of location Site Access 4B has an advisory speed of 75 km/h. Applying an interpolated design speed of 85km/h and downgrade adjustment would require a sight distance of 220 metres (197.5m + 22.5m) which is achieved at Site Access 4A but not Site Access 4B. Site Access 4B would require a maximum design speed of 80 km/h (posted speed 70 km/h) to be close to achieving the required sight distance.

Site Access 3

At site access 3, the sight distance is constrained in both directions. To the east there is a significant hidden dip that would remove sight distance between vehicles for a number of seconds. Looking from the north side of site access 3, the distance to the east is further reduced by a slight bend and vegetation close to the edge of the road. With vegetation clearance, a similar sight distance to that on the north side can probably be achieved. To the west, sight distance from both the north and south accesses is constrained by the crest of the hill at the end of the upgrade section, limiting the sight distance to around 213 metres. There are no advisory speed limits on this section of the road. A temporary work zone speed limit of 80 km/h (90 km/h design speed) during the construction period would reduce the sight distance requirements from the west to 210 metres (226m -16m), which is achieved. However, this would only be beneficial if traffic were restricted to exiting from the north access and turning left towards Palmer as the sight distance to the east would remain well below the required SISD even with a temporary speed restriction. This would be unlikely to affect the larger trucks as the OSOM route indicates vehicle movements to and from the east, however many of the smaller vehicles would be expected to arrive to and depart from the west.

A temporary work zone speed limit of 60 km/h (design speed 70 km/h) would require an SISD of 151 metres that is likely to match the available sight distance to the east, assuming vegetation clearance was feasible.

8.4.4 Assessment Recommendations

The following summary confirms the position for the site accesses based on the sight distance assessment:

- Site access 4A achieves sight distance based on the 110 km/h design speed to the east and the 75 km/h advisory speed plus 10 km/h to the west
- Site access 4B achieves sight distance based on the 110 km/h design speed to the east and would require a posted 70 km/h work zone speed limit to achieve sight distance to the west
- Site access 3 would require a temporary work zone speed of 60 km/h (70 km/h design speed) to achieve sight distance to the east with additional vegetation trimming on the north side to the east of the access. A 60 km/h work zone speed limit would achieve sight distance to the west.

Further investigation of mitigation measures to accommodate site access locations will be addressed during the preparation of the Traffic Management Plan once all access locations and routes have been finalised.

8.5 Site Access Review – Council-Controlled Network

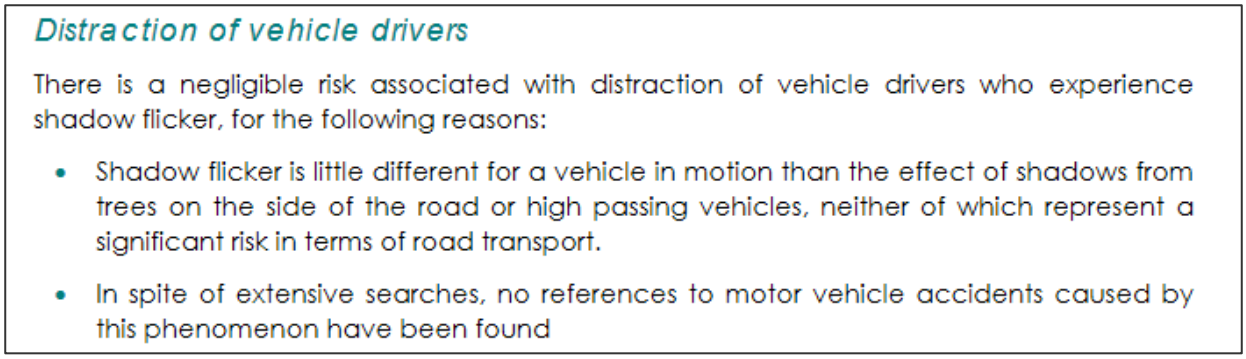
As outlined above in Section 6.3, site accesses located along Council-controlled roads will act as crossing points for construction traffic. A detailed review of the individual Council-controlled site access locations has not been undertaken as part of this assessment and should be considered as part of the proposed future Traffic Management Plan. Measures to ensure these locations are managed appropriately may include but not be limited to traffic controllers, advanced waring signage and site access upgrades.

8.6 Shadow Flicker Discussion

The shadow flicker assessment undertaken by GHD dated on 8 November 2023, indicated areas whereby shadows would be cast across the road network across a single year period. Further details regarding the associated impacts of shadow flicker can be found in the GHD report.

Previous research on the impact of shadow flicker was consolidated into guidelines prepared by the former Environment Protection and Heritage Council in 2010. The guidelines identified that there was negligible risk of driver distraction from shadow flicker from wind turbines in comparison to similar flicker arising from other more common sources. Figure 8.2 provides an extract from the guidelines.

Figure 8.2 – Driver Distraction



Distraction of vehicle drivers

There is a negligible risk associated with distraction of vehicle drivers who experience shadow flicker, for the following reasons:

- Shadow flicker is little different for a vehicle in motion than the effect of shadows from trees on the side of the road or high passing vehicles, neither of which represent a significant risk in terms of road transport.
- In spite of extensive searches, no references to motor vehicle accidents caused by this phenomenon have been found

Source: Environment Protection and Heritage Council - National Wind Farm Development Guidelines (Draft, July 2010)

9. Conclusion

Based on the preceding analysis we conclude that:

- The Varied Project is anticipated to generate the following one-way movements per vehicle category:
  - 65,154 Light Vehicles;
  - 467 OSOM Vehicles; and
  - 21,350 Heavy Vehicles.
- The peak daily traffic volumes are expected to occur during month 3 of construction;
  - During this period, a total of 228 one-way trips are expected to occur consisting of:
    - 152 Light Vehicles;
    - 2 OSOM Vehicles; and
    - 74 Heavy Vehicles.
- There is a significant reduction in both the total one-way trips (70,476 trips) and peak daily trips (167 trips) associated with the Varied Project when compared to the Approved Project. Such a reduction in the total construction traffic will have the following effects:
  - Reduced overall impact on the external State and Council controlled road networks, particularly in regards to pavement degradation and through vehicle movements.
  - A reduction in peak daily volumes will benefit local residents who rely on the local road network for daily commutes, school pick-up / drop-off and agriculture machinery movements.
- Only four (4) of the state-controlled roads trigger a >5% impact. Of these four (4) roads, a significant proportion of the additional vehicles generated on these links consist of light vehicle traffic. Tungkillo Road, in particular, whilst observing an increase of 24.9% during peak construction periods, will consist of 83% additional light vehicles. As such, given the large proportion of light vehicle movements and level of existing volumes, these impacts would be considered relatively minor in this instance.
- Given the low-level peak daily volumes generated on the Council-controlled network, with a maximum increase of 20 vehicles per day observed on Brinkworth Road (Instance 1), the impact on the network is not considered significant.

Appendix A. Transport Route Assessment – iCubed Consulting

Transport Route Assessment

Palmer Wind Farm

Prepared for:

renewables



Prepared By	Patrick Milner
Released By	Marcus Palmer
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Version	Version Date	Revision History
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1.1	23/07/2023	Updated following Client Comments
1.2	01/12/2023	Variation and Client Comment Updates
1.3	23/01/2024	Additional Tower Route Option
1.4	15/02/2024	Updating site boundary and turbine layout
1.5	20/02/2024	Additional Component Route Option
1.6	26/02/2024	Updating Tilt Comments

STATEMENT OF LIMITATION

Data and conclusions of this report are the findings and opinions of icubed consulting and are not an expressed or implied representation, warranty or guarantee. This report has been prepared for Tilt Renewables Pty Ltd. icubed Consulting does not accept liability for any third party's use or reliance on this report.

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1 Introduction

icubed consulting was commissioned by Tilt Renewables Pty Ltd (Tilt) to undertake a Transport Route Assessment for the proposed Palmer Wind Farm (PWF) located at Randell Rd, Palmer South Australia.

This report details the results of this assessment, including an evaluation of:

- Existing conditions of the proposed transport route from the Port of Adelaide to the site;
- The key intersections and turning movements the vehicles will undertake;
- The most appropriate turning paths for the trucks to undertake at these key locations;
- Intersections along the proposed transport route using Vehicle Swept path analysis;
- Any road or intersection upgrades required to enable transportation of vehicles to the site; and
- A route from the Victorian border to site for Transformer vehicles.

Preliminary investigations were conducted from a desktop study using aerial and street view imagery, as well as a site visit by an icubed consulting engineer driving the proposed route to the site.

Of the multiple elements of wind farm infrastructure to be transported, turbine blades present the biggest logistical challenge, as they must be transported as a single piece. Tower sections also present a logistical challenge due to the loaded vehicle height conflicting with overpass clearances.

Although some conflicts exist, it is considered that a viable route to the site is available, subject to resolving the potential conflicts with the relevant stakeholders.

1.1 Limits of Report

The above tasks have been carried out based on information supplied by other members of the project team, and information from relevant authorities. These are detailed in the report.

While icubed consulting has taken care in the preparation of this report, it neither accepts liability nor responsibility whatsoever in respect of:

- Any use of this report by any third party; and
- Any third party whose interests may be affected by any decision made regarding the contents of this report.

2 Existing Conditions

2.1 Site Location

The Palmer Wind Farm site is located near Palmer in South Australia, approximately 50km east of Adelaide.

The main site access points are from Randell Rd, which runs east-west through the proposed site. Two site access points are nominated on this road, providing access to both the north and south of the site. A third site access point at the northern end of the project layout was investigated off Angas Valley Rd, though an updated site layout does not utilize this option. Milendella Rd runs north-south to the east of the Palmer Wind Farm (PWF) site and Oversize Overmass (OSOM) approach from the north along this road in the proposed port to site route.



Figure 1: Site Locality Plan and Road Network (Google Earth, 2024)

3 Proposed Development

3.1 Description of Proposed Development

The proposed development will comprise of a Wind Turbine Generator (WTG) Facility, which is intended to be built in a single stage.

At this stage, the WTG facility will comprise of up to 40 WTGs spread across the site, with each having a nominal ground to hub height of 126m and an approximate name plate capacity of 7.2MW, combining for an overall capacity of up to 288MW. The WTG tower base configuration is still to be finalised, but the WTG blade configuration will be up to 90m in length.

The proposed site layout is attached in Appendix A.

4 Oversize Transport Route

4.1 Proposed Oversize Transportation Routes

The proposed transportation route for loaded vehicles under a height of 5.2m, including blades, is shown in Figure 2. A detailed list of this route is described in Table 1. This route is not viable for the transportation of vehicles with height greater than 5.2m due to several height constraining overpasses. As such, two alternative routes (Route 2A and Route 2B) have been proposed which provide detours in order to avoid vertically restricting overpasses. In addition to this, an alternative route (Route 3) has been identified that uses Ridley Road instead of Milendella Road, as shown in Figure 4. Details of this route can also be found in Table 1.

Figure 3 depicts potential port to site option Route 2A and Figure 4 depicts Route 2B for vehicles over a height of 5.2m. Route 2A utilises detours from the Northern Expressway and Sturt Highway to avoid overpasses possessing potential vertical constraints. Route 2B utilises the Port Wakefield Highway and a detour around Gawler before rejoining Route 2A. Route 2A and Route 2B follow Route 1 where possible, except where vertical pinch points limit passage due to the height of the Tower components. Detour options for loaded vehicles with heights greater than 5.2m were not driven during the site visit, and road conditions should be validated by the transport contractor prior to confirmation of the route for use. Specific detours are shown in greater detail within Appendix E.

It is not yet confirmed which port berth will used for the transportation of WTG components. Route 1 and Route 2A propose a potential route utilising Victoria Road, whilst Route 2B and Route 3 show a potential route utilising Berth 18 & 20 and Eastern Parade.

Whilst there are several local roads which can provide access to the site (refer to Figure 1), Randell Rd contains the nominated access point for the purpose of this investigation. Three site access points are nominated on Randell Rd for the project and entry to site with blade vehicles are depicted within plans in Appendix B for Entry Point 1 and 2. Site entry from Angas Valley Rd was also investigated as part of the port to site route assessment, though this does not remain a current option as the project site boundaries were reduced.

The site entry points have been assessed for the purposes of completing the port to site study and shall be reassessed as the internal access track layout and acquisition of on-site survey is further developed. The transport routes are to be confirmed prior to construction.

icubed note that an alternative port to site route, utilising the South-Eastern Highway and travelling through Murray Bridge to site, was considered as part of this assessment. This route was deemed unviable due to numerous vertical constraints (overpasses) along the route, as well as multiple pinch points at intersections within Adelaide and Murray Bridge anticipated to require significant upgrade works. As such, a detailed assessment for this route has not been included within this report.

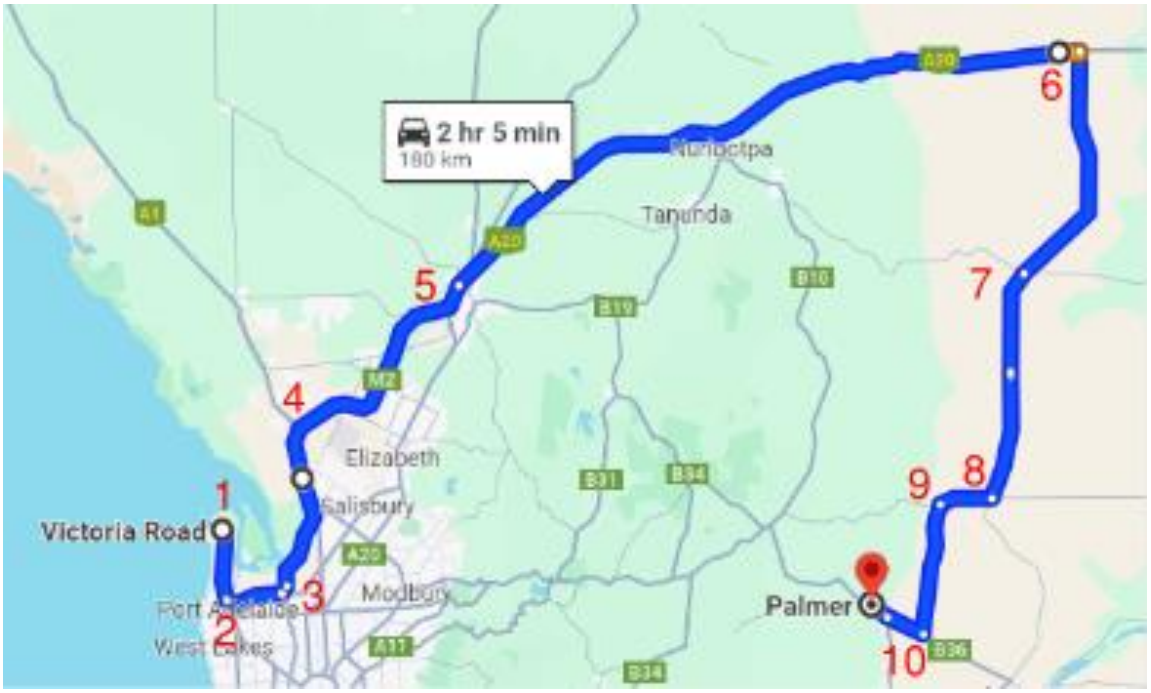


Figure 2: Proposed Route 1 for Max Loaded Vehicle of 5.2m (Google Maps, 2024)
GPS LINK - https://maps.app.goo.gl/C8VLJkdCtGArJp4y9

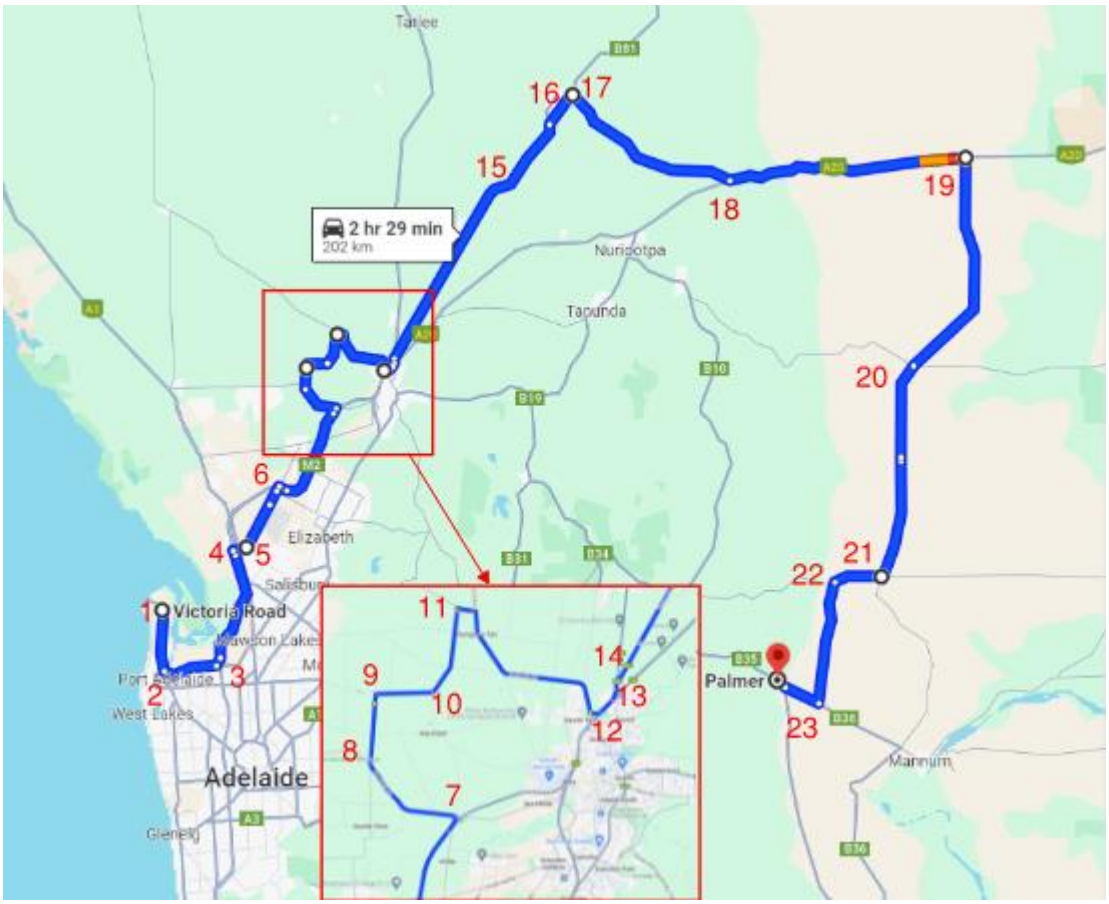


Figure 3: Proposed Route 2A for vehicles exceeding 5.2m (Google Maps, 2024)
GPS LINK - https://maps.app.goo.gl/fJXH7HvBPCKUMsNR8

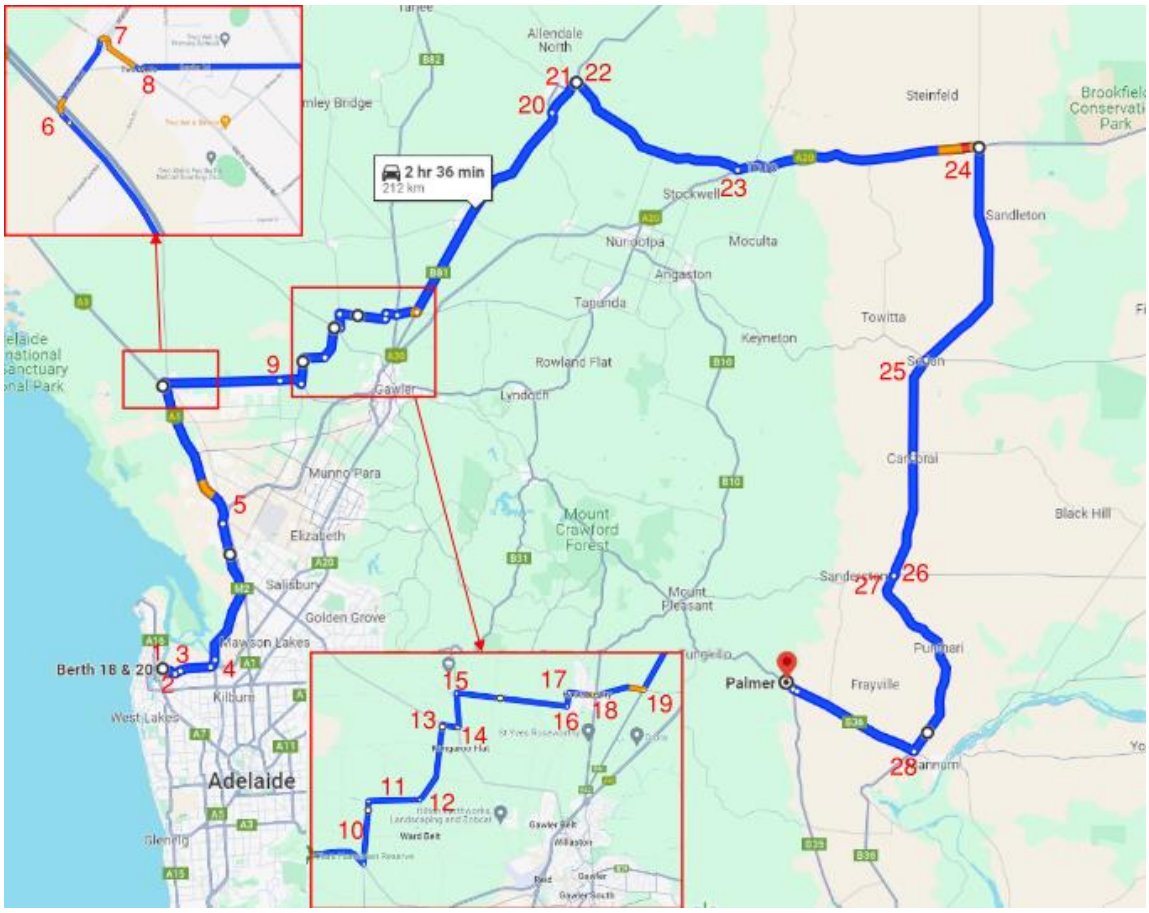


Figure 4: Proposed Route 2B for vehicles between 5.2m and 6.3m in height (Google Maps, 2024)
GPS LINK - https://maps.app.goo.gl/PQarXL5BxXqRKqt1A



Figure 5: Proposed Alternative Route 3 for Max Loaded Vehicle of 5.2m (Google Maps, 2024)
GPS LINK - https://maps.app.goo.gl/WGwN2vp8hGEUDdRY9

Table 1: Oversize Transportation Routes

<table>
<tr><th rowspan="2">Route Description</th><th colspan="2">Constituting Roads</th></tr>
<tr><th colspan="2">Route 1 (Max loaded vehicle height 5.2m)</th></tr>
<tr><td rowspan="5">Port of Adelaide to Palmer Wind Farm</td><td colspan="2">1.Victoria Road
2.Port River Expressway
3.North-South Motorway
4.Northern Expressway
5.Sturt Highway
6.Halfway House Road
7.Ridley Road
8.Angas Valley Road
9.Milendella Road
10.Randell Road</td></tr>
<tr><td>Route 2A</td><td>Route 2B (Max loaded vehicle height 6.3m)</td></tr>
<tr><td>1.Victoria Road
2.Port River Expressway
3.North-South Motorway
4.Waterloo Corner Road (Detour 1)
5.Heaslip Road
6.Northern Expressway
7.Two Wells Road (Detour 2)
8.Wilkinson Road
9.Hatcher Road
10.Oates Road
11.Redbanks Road
12.Sturt Highway
13.Horrocks Highway (Detour 3)
14.Thiele Highway
15.East Terrace
16.Thiele Highway
17.Truro Road
18.Sturt Highway
19.Halfway House Road
20.Ridley Road
21.Angas Valley Road
22.Milendella Road
23.Randell Road</td><td>1.Berth 18 & 20
2.Eastern Parade
3.Port River Expressway
4.North-South Motorway
5.Port Wakefield Highway (Detour 1)
6.Mallala Road
7.Old Port Wakefield Road
8.Gawler Road
9.Two Wells Road
10.Wilkinson Road
11.Hatcher Road
12.Oates Road
13.Redbanks Road
14.Mudla Wirra Road
15.College Road
16.Cliff Road
17.Gartrell Street
18.Roseworthy Road
19.Thiele Highway
20.East Terrace
21.Thiele Highway
22.Truro Road
23.Sturt Highway
24.Halfway House Road
25.Ridley Road
26.Angas Valley Road
27.Ridley Road
28.Randell Road</td></tr>
<tr><td colspan="2">Route 3 Alternate Ridley Road Route</td></tr>
<tr><td colspan="2">1. Berth 18 & 20 and Eastern Parade
2-8. Same as Route 1
9.Ridley Road
10.Randell Road</td></tr>
</table>

The assessment undertaken considers a one-way (eastbound) trip only.

4.2 Design Vehicles

The longest vehicle expected to deliver components to site during construction of the facility will be a WTG Blade Trailer vehicle as shown indicatively in Figure 6, which is capable of carrying a 90m long turbine blade. Given the large geometry of the blade trailer vehicle, it has been considered that upgrade works that cater for the blade vehicle will provide for a worst-case scenario for turns.

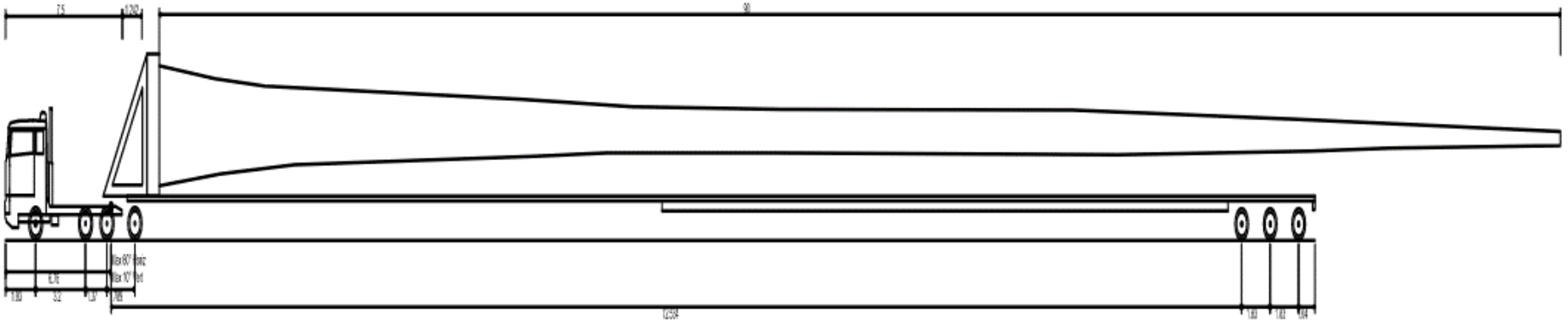
The tower section transportation vehicles will likely be the tallest, shown indicatively in Figure 7, and will provide a worst-case scenario for the transportation of other components restricted by height constraining overpasses.

Other large vehicles that are likely during construction are OSOM vehicles for deliveries of other turbine components, delivery vehicles associated with construction of the substation facilities, crane component delivery vehicles, and B-Double vehicles for other material deliveries. Whilst final dimensions for all componentry associated with the project are unconfirmed, it has been assumed that these will not geometrically govern the route to site. The Transformer components will travel to site using a different route, discussed below in Section 7.

Discussion relating to vehicle weight is included within Section 4.7.

Table 2: Design Vehicle Dimensions

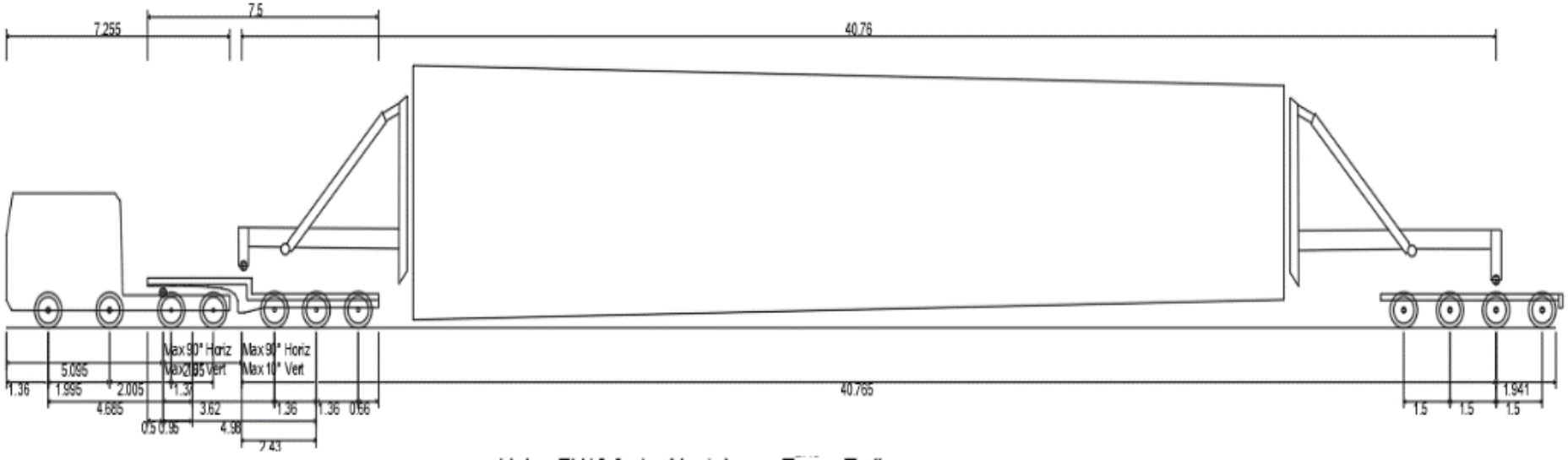
	Blade Vehicle	Tower Vehicle	Transformer Vehicle
Type of vehicle	Blade trailer	Nooteboom Trailer	Transformer Trailer
Length (m)	99.75	50.531	49.6
Width (m)	2.591	2.55	4.8
Height (m)	3.628	6.5	5.28
Weight (approx.) (tonnes)	41	90	162



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

Figure 6: Dimensions of Oversize Vehicle for WTG Blade Transportation



Volvo FH16 8x4 + Nooteboom Tower Trailer	
Overall Length	50.351m
Overall Width	2.550m
Overall Body Height	6.500m
Min Body Ground Clearance	0.198m
Max Track Width	2.550m
Lock-to-lock time	6.00s
Wall to Wall Turning Radius	9.800m

Figure 7: Dimensions of Oversize Vehicle for WTG Tower Section Transportation

4.3 Transport Permits

The use of oversize vehicles in transportation of WTG components will require the Contractor's appointed transportation company to apply for permits to the National Heavy Vehicle Regulator (NHVR). As part of obtaining the oversize permits, the proposed transport route will be assessed by NHVR and other referred assessors such as the Department for Infrastructure and Transport.

4.4 Oversize Length Assessment

To check the suitability of the transport route, Vehicle Tracking software within AutoCAD was used to run vehicle swept paths for the largest expected oversize vehicles (refer Section 4.2) for the Wind Farm development at various intersections or sharp curves. The swept paths were used to identify whether existing intersections or sharp curves along the transportation route provide enough area for oversize vehicles to make turns or whether intersection upgrades are required to enable the oversize vehicles to travel to site. Table 3 summarises the road intersections and curves that were reviewed as potential areas of concern along the transport route for the blade vehicles. This assessment was completed for intersections/horizontal constraints identified on Route 1.

Swept Path Drawings for all identified locations are included within Appendix B.

Table 3: Assessed Transport Route Locations

Location No.	Location Description	Map Reference Coordinates	Vehicle Manoeuvre	Modifications Required
Transportation Route 1				
1	Sturt Highway / Halfway House Road, Annadale	-34.39136, 139.35024	Right turn	Yes
2	Ridley Road / Angas Valley Road, Angas Valley	-34.75541, 139.26340	Right turn	Yes
3	Angas Valley Road / Milendella Road, Sanderston	-34.76057, 139.21189	Left turn	Yes
4	Milendella Road / Randell Road, Palmer	-34.86575, 139.19466	Right turn	Yes
5	Randell Road / Site Entrance Two, Palmer	-34.83677, 139.13028	Left turn	Yes
6	Randell Road / Site Entrance Three, Tungkillo	-34.82975, 139.12190	Left turn	Site Entrance
7	Victoria Road Corner, Birkenhead	-34.83780, 138.50294	Left turn	Yes

Note that if the easement from SA Water is unable to be secured as an agreed site entry for the wind farm, then Site Entrance Two will need to be moved to an alternate location along Randell Rd. The geometry requirements for the intersection would remain the same, with a 60m bend radius perpendicular from the existing road. The 'Site Entry 1' intersection in Appendix F, Figure 28 provides an indicative likely footprint of a new intersection off Randell Rd. This should be validated by further swept path analysis of the new intersection location if required.

Route 3 also contains two additional turns that should be investigated further through swept path analysis, but have not been completed for this report. These are identified below in Table 4 with street view provided in Appendix C. These turns could result in fewer road upgrades and less land acquisition when compared to the sharper turns presented as location number 3 and 4 in Table 3.

Table 4: Route 3 Recommended Turns to be Assessed

Location No.	Location Description	Map Reference Coordinates	Vehicle Manoeuvre
Transportation Route 3			
1	Angas Valley Road / Ridley Road	-34.39136, 139.35024	Left turn
2	Ridley Road / Randell Road	-34.90433, 139.28294	Right turn

4.5 Overhead Obstruction Assessment

A desktop review has been carried out on each of the overpasses along the routes to ensure adequate vertical clearance is available. All overpasses along the anticipated transport routes have been identified, with heights given where available. Table 5 summarises the heights of the overpasses along the transport routes for Route 1. Other overhead obstructions (overhead lines, vegetation, etc.) should be assessed once a delivery contractor is engaged. Obvious signage has also been listed.

No clear overhead obstructions were identified along the Detour sections shown in Route 2A, Route 2B and Route 3.

Table 5: Review of Overhead Obstructions Along the Oversize Transportation Blade Route (Route 1)

Obstruction No.	Location Description	Map Reference Coordinates	Signed Overpass Height (m)
Transportation Route 1			
1	Francis Street Signage	-34.84028, 138.51680	Not Available
2	Hanson Road Overpass	-34.83361, 138.54552	6 (Bypass Available)
3	Port River Express Signage	-34.83303, 138.55676	Not Available
4	Port River Express Signage	-34.83268, 138.55952	Not Available
5	North-South Motorway Signage	-34.82908, 138.56226	Not Available
6	North-South Motorway Signage	-34.82450, 138.56239	Not Available
7	Bolivar Road Overpass	-34.76633, 138.59032	6.5
8	Waterloo Corner Road Overpass	-34.73286, 138.57663	6.5
9	North-South Motorway Signage	-34.71641, 138.57207	Not Available
10	Port Wakefield Road Overpass	-34.70487, 138.57268	6
11	Penfield Road Overpass	-34.68462, 138.60021	5.3
12	Heaslip Road Overpass	-34.67922, 138.62335	5.3
13	Curtis Road Overpass	-34.66268, 138.65481	5.3
14	Angle Vale Road Overpass	-34.63605, 138.67058	5.3
15	Redbanks Road Overpass	-34.57948, 138.73723	5.2
16	Sir Condor Laucke Way Overpass	-34.46506, 138.95057	5.3

4.6 Bridge and Major Culvert Assessment

A review has been carried out to identify the bridges and major culverts that will be traversed along each of the transport routes. Minor culverts were excluded from the identification process. A detailed survey should be conducted to verify the location and condition of these structures, and further assessment of the loading should be conducted prior to component delivery. Load limits of the bridge structures has been considered sufficient for 59.5 tonnes OSOM loads according to NHVR Route Planner. The identified crossings are listed in Appendix G.

4.7 Mass Limit Assessment

The transport route from the Port of Adelaide to site was assessed using the NHVR Portal and checked with the RAVnet SA OSOM routes, which yielded the same allowed roads and restrictions. The category checked in both NHVR and RAVnet SA was for OSOM 59.5 tonne loads, and Special Purpose Vehicle (SPV) 40 tonnes. From this assessment it was determined that the majority of the roads assessed within the proposed route to site were approved Higher Mass Limit (HML) roads. The roads that were not approved have been listed in Table 6. Areas of roads with NHVR restrictions are listed in Table 7. No additional non approved roads were identified for Route 3.

Table 6: Roads Requiring Higher Mass Limit Permits or Reviews

Road section	Approved Route with Conditions	Approved Route
All Transportation Routes		
Milendella Road	N/A	No
Randell Road	N/A	No

Table 7: NHVR Road Restrictions

Road section	Coordinates	Restriction
Transportation Routes 1 & 2A		
Milendella Road / Randell Road Intersection	-34.86581, 139.19457	No left / right turn from Randell Road onto Milendella Road

The above restriction currently limits the ability for heavy vehicles to turn on to Randell Road from Milendella Road, which is a manoeuvre required for Routes 1 & 2A. It is understood that this restriction is in place due to the tight nature of this bend, limiting the ability of large vehicles to make this turn. As such, modifications are required, which are detailed in Section 4.4 of this report (Location No. 4) and shown in the relevant Swept Path Drawings in Appendix B.

As noted above, there are two roads along the route that are not currently approved as a higher mass limit route. Upon confirmation of the final vehicle configurations, an assessment will be needed to determine whether these vehicles are within the requirements for the heavy vehicle road conditions or are suitable to be on the approved heavy vehicle registry. If required, an application can be arranged to have the relevant roads placed on the register. If Milendella Road is rejected for use, Route 3 provides a viable route to site by continuing on Ridley Rd rather than utilising Angas Valley Rd and Milendella Rd. Ridley Road is an OSOM approved road according to the NHVR Route Planner.

Randell Road provides site entry for the Wind Farm, and thus obtaining approval is paramount to match the current access track design, with no alternative currently identified or considered viable. It is considered unlikely that the roads noted in Table 6 and Table 7 above would be rejected for use following an application for use to the NHVR.

Table 8 summarises the mass limits used in the NHVR assessment. It is anticipated that OSOM vehicles associated with turbine components, crane delivery vehicles and the transformer delivery vehicles would exceed the general mass limits prescribed, and applications for use on unapproved roads (Table 6) will be required.

Table 8: Heavy Vehicle Mass Limits (NHVR, 2016)

Type of Axle Group	Maximum mass (tonnes) permitted under General Mass Limit (GML)	Maximum mass (tonnes) permitted under HML
Single drive axle (dual tyred)	9.0t	10.0t
Tandem axle group (dual tyred)	16.5t	17.0t
Six tyred tandem axle groups	13.0t	14.0t
Tri-axle group (dual tyred)	20.0t	22.5t

5 Road Intersection Upgrades

From a review of the transportation routes, the following upgrade works or temporary works listed in Table 9 were identified as being required to enable blade transportation vehicles to negotiate the roads.

Table 9: Summary of Upgrades to Intersections and Road Curves

Location No.	Location Description	Authority or Land Owner	Modifications Required
Transportation Route 1			
1 (Option 1)	Sturt Highway / Halfway House Road, Annadale	Mid Murray Council	• 3x light poles to be temporarily removed • 1x street signs to be temporarily removed • Gravel widening • 2x guide posts to be temporarily removed
1 (Option 2)	Sturt Highway / Halfway House Road, Annadale	Mid Murray Council	• 2x light pole to be temporarily removed

			• 1x street signs to be temporarily removed • 2x guide posts to be temporarily removed • 1x power pole to be temporarily removed
2	Ridley Road / Angas Valley Road, Angas Valley	Mid Murray Council	• 3x street signs to be temporarily removed • 7x guide posts to be temporarily removed
3	Angas Valley Road / Milendella Road, Sanderston	Mid Murray Council	• 4x street signs to be temporarily removed • 6x guide posts to be temporarily removed
4 (Option 1)	Milendella Road / Randell Road, Palmer	Mid Murray Council	• 1x power pole to be temporarily removed • 2x guide posts to be temporarily removed • Gravel widening
4 (Option 2)	Milendella Road / Randell Road, Palmer	Mid Murray Council	• 4x street signs to be temporarily removed • 7x guide posts to be temporarily removed
4 (Option 3)	Milendella Road / Randell Road, Palmer	Mid Murray Council	• 5x street signs to be temporarily removed • 8x guide posts to be temporarily removed • Gravel widening
5	Randell Road / Site Entrance Two, Palmer	Mid Murray Council	• 1x street signs to be temporarily removed • Minor vegetation trimming / clearing
6	Randell Road / Site Entrance Three, Tungkillo	Mid Murray Council	• Site entrance track
7	Victoria Road Corner, Birkenhead	City of Port Adelaide	• 1x street signs to be temporarily removed • 1x light pole to be temporarily removed

Note: Any clearing / trimming of vegetation is only to occur after relevant vegetation clearing approvals are granted by authorities, where applicable.

5.1 Traffic Control Measures

Traffic Control Measures that will be installed to enable road upgrade works to commence will be determined at a later date by the appointed Civil Contractors' Traffic Management subcontractor. The required traffic controls are not covered within the scope of this report, therefore a traffic management plan detailing these measures will need to be produced in addition to this report.

6 Discussion

This report represents the external Transport Route Study for the proposed Palmer Wind Farm located at Randell Rd, Palmer, South Australia.

This report has identified that seven (7) locations, along the 180km transportation Route 1, have the potential to constrain component delivery due to existing infrastructure or potentially inadequate road width to cater for the expected OSOM transport vehicles. The nominated site entrances may also contain constraints should they be used. These locations were checked using AutoCAD vehicle tracking software in order to identify locations that require a minor to moderate level of upgrade. The upgrades expected are listed in Table 9 and typically require minor works such as temporary removal of street signs, light poles, traffic lights or gravel pavement widening. By carrying out these road upgrades, the OSOM component delivery vehicles are expected to negotiate the transportation route successfully.

To avoid constraints imposed by existing overpasses for loaded vehicles of heights greater than 5.2m, alternate routes to site (Route 2A and Route 2B) has been detailed. All roads associated with these routes are listed within Table 1, with mapping related to these detours provided in Appendix E.

Route 2A utilises three (3) detours to avoid the height constraints. To avoid the Port Wakefield Road Overpass (6.00m), Penfield Road Overpass (5.3m) and Heaslip Road Overpass (5.3m) along Route 1, it is noted that a route via Waterloo Corner Road and Heaslip Road could be taken.

To avoid the Redbanks Road Overpass (5.2m) along Route 1, it is suggested that a detour via Two Wells Road, Wilkinson Road, Hatcher Road, Oates Road, and Redbanks Road be taken if required. This option follows OSOM approved roads according to the NHVR Route Planner. Their suitability shall be validated by a transport contractor prior to confirmation of a final route, and following confirmation of vehicle widths.

To avoid the Sir Condor Laucke Way Overpass (5.3m) along Route 1, it is suggested that a detour via Thiele Highway, East Terrace and Truro Road be taken for the tower component.

The other alternative (Route 2B) is to take Port Wakefield Highway to detour onto Gawler Road, which goes through Two Wells, Gawler and Roseworthy before merging with the Route 2A route on Thiele Highway. This route also avoids all height constraints presented in Route 1.

Route 3 provides an alternative route to enter Randell Road and the site, taking Ridley Road instead of Mindella Road. This could potentially result in less road upgrades and land acquisition compared to location 3 and 4 in Table 9, pending swept path assessment of the relevant manoeuvres.

Through a desktop analysis along the transport routes, the largest vehicles able to travel from the Port of Adelaide to site are shown in Table 10.

Table 10: Maximum Vehicle Heights

Vehicle Type	Max Vehicle Height
Route 1 and 3	5.2m
Route 2A	No obvious height constraints when utilising available detours
Route 2B	6.3m

Note that signboards and power line clearances have not been assessed in detail. It is recommended that additional assessments including surveys and measurements be carried out along these routes to confirm clearances to overpasses and other potentially constraining overhead infrastructure, as well as practicality of negotiating horizontal and vertical curves. It is recommended that once further assessment has been conducted, the proposed transport routes and options within this report be reviewed.

The Transport Route assessed on the NHVR's Portal shows that most roads along Route 1 are approved HML paths. The roads that are not yet HML approved may require permits or approval to be used by OSOM vehicles.

7 Transformer Route Study

7.1 Introduction

To construct the substation needed to transfer energy generated by the wind farm to the National Electricity Market (NEM), large, industrial-scale transformers will be required to step up the voltage. These transformers shall be driven as OSOM loads to the site location. This section details the proposed Transformer route and identifies potential challenges. The scope of this assessment is limited to the route commencing from the Vic/SA border on Dukes Hwy to the site entrances on Randell Rd (refer Figure 8).

7.2 Vehicle Details

Whilst unconfirmed, the current proposed OSOM vehicle transporting the transformers to site will have a maximum height of 5.28m and a maximum width of 4.8m. Since the transformer weighs 150 tonnes, a large trailer with 12 axles has been nominated by the transport contractor. Details can be found in Appendix H below.

7.3 Proposed Route

The transformers will be brought in from Victoria and enter South Australia from the National Highway A8. The proposed route can be found in Figure 8 below. A detailed route is given in Table 11 below.

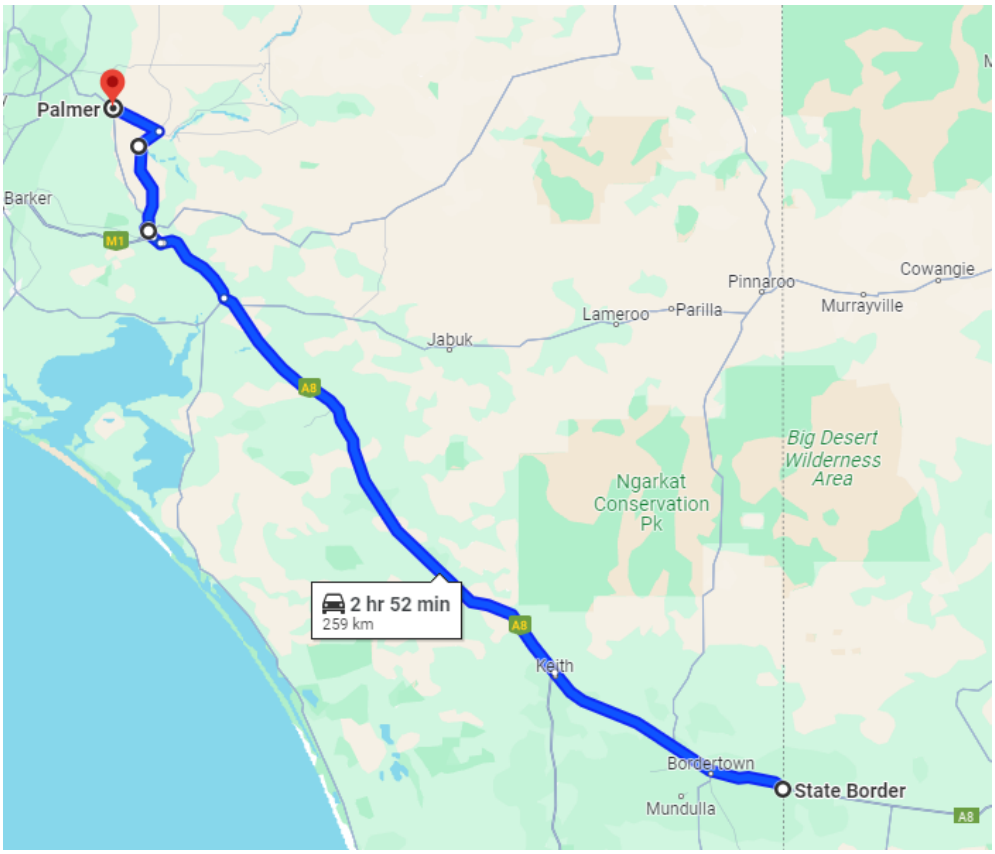


Figure 8: Proposed Route to Site for Transformer Components
GPS Link: https://maps.app.goo.gl/R5hHM68DTTJUdRxP6

Much of the route follows the National Highway A8 northwest to site, for which no horizontal or vertical pinch points have been identified. The proposed route exits the National Highway A8 at Murray Bridge, and multiple manoeuvres are identified between this exit and site. A detailed view of this portion of the route is shown in Figure 9 below, and constraints are identified in Section 7.4 and 7.5.



Figure 9: Detailed view of Transformer Route from Murray Bridge to Site Entry

A suggested route through Murray Bridge follows roads that have been approved for OSOM loads according to the NHVR Route Planner and bypasses roads passing through the centre of the town. Although there are some T-intersections that the Transformer component vehicle will need to navigate, these are generally wide and not constrained by adjacent structures. Minimal, if any, bend widening is anticipated to navigate this route. This will require verification once the final component and vehicle dimensions have been confirmed, to validate any assumptions around intersection upgrade requirements.

Table 11: Transformer Components Transportation Route

Route Description	Constituting Roads
South Australia-Victoria Border to Palmer Wind Farm Site Route for Transformer Components	1. Western Highway/A8 2. Jervois Rd 3. Swanport Rd 4. Hindmarsh Rd 5. Maurice Rd 6. Cypress Terrace 7. Mannum Rd 8. Randell Rd

7.4 Horizontal Pinch Points

The study of the Transformer route does not include swept path analysis, and thus the horizontal pinch points have been assessed visually.

7.4.1 National Highway A8 to Jervois Rd Intersection



Figure 10: National Highway A8 to Jervois Road Intersection Aerial View



Figure 11: National Highway A8 to Jervois Road Intersection Street View

There is a 90-degree bend exiting the Princes Highway/A8, turning right onto Jervois Rd. Some gravel widening of the outside of the turn might be required and some signage temporarily displaced. If an alternative route is required to bypass this pinch point, the Transformer components could leave the National Highway A8 off the opposite lane to enter Swanport Road. This would require temporary contraflow on the National Highway and the closure of the on-ramp but would also allow to bypass the vertical pinch point of the overpass. Once the delivery vehicle is confirmed, swept path analysis can be run to verify if any temporary works are required to navigate this pinch point or if an alternative route needs to be considered.

7.4.2 Jervois Rd to Hindmarsh Rd Intersection



Figure 12: Jervois Rd to Hindmarsh Rd Intersection Aerial View



Figure 13: Jervois Rd to Hindmarsh Rd Intersection Street View

This is a large bend, and no upgrades are expected to be required. This shall be validated by swept path analysis following confirmation of a delivery vehicle. If widening was required, there is generally minimal obstruction on the inside of this bend in order to carry out these temporary works.

7.4.3 Maurice Rd to Cypress Terrace Intersection

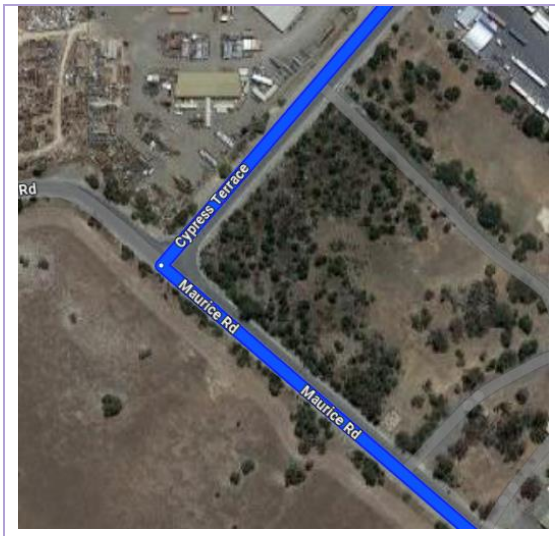


Figure 14: Maurice Rd to Cypress Terrace Intersection Aerial View



Figure 15: Maurice Rd to Cypress Terrace Intersection Street View

This is a large bend, and no upgrades are expected to be required. This shall be validated by swept path analysis following confirmation of a delivery vehicle. If widening is required to navigate this manoeuvre, it should generally be completed to minimise clashes with adjacent fencing and cadastral boundaries.

7.4.4 Cypress Terrace to Mannum Rd Intersection



Figure 16: Cypress Terrace to Mannum Rd Intersection Aerial View



Figure 17: Cypress Terrace to Mannum Rd Intersection Street View

This is a large bend, and no upgrades are expected to be required. This shall be validated by swept path analysis following confirmation of a delivery vehicle. If widening is required, there appears sufficient room within the existing road reserve at the inside of the behind to facilitate this manoeuvre without clashing with private property.

7.4.5 Mannum Rd to Randell Rd Intersection



Figure 18: Mannum Road and Randell Road Intersection Aerial View



Figure 19: Mannum Road and Randell Road Intersection Street View

There is a sharp bend turning left from Mannum Rd onto Randell Rd. Some gravel widening on the inside of the turn and temporary removal of safety markers might be required while the OSOM loads are transiting. If an alternative route is required to bypass this pinch point, the Transformer components could continue straight until turning right onto Angas Valley Road, and then following the same route as the Blade and Tower components to the site entry.

7.5 Vertical Pinch Points

A review of the Structures and Clearances map provided by the Department for Infrastructure and Transport South Australia indicated one (1) vertical pinch point along the proposed route:

Table 12: Vertical Pinch Points for Transformer Components

Location	Height Clearance (m)	Coordinates (decimals)
Murray Bridge – Wellington, Swanport Rd overpasses	5.2	-35.151097, 139.286517



Figure 20: Murray Bridge Overpass Street View

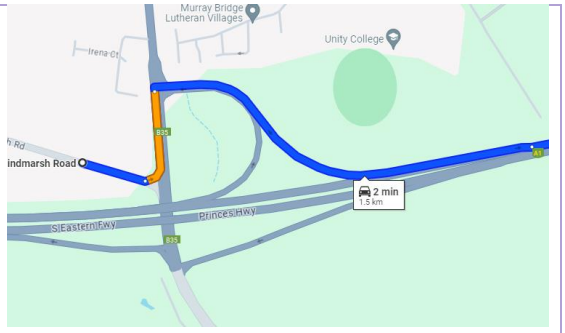


Figure 21: Alternative Route to bypass Murray Bridge overpass

These obstacle heights should be confirmed by survey, and the transport vehicles details established. If the vehicle details outlined in Appendix H are confirmed, then the overpass pinch point would not be practicable as the height clearance of the overpass of 5.2m would be less than the height of the vehicle of 5.28m, and an alternative route would be required. As noted in Section 7.4.1, exiting the Princes Highway in the opposite lane would bypass the underpasses but would require temporary contraflow on the highway as the transport vehicles crossed to the opposite lane. This alternative route would also bypass the horizontal pinch point of

the sharp bend at the intersection of National Highway A8 and Jervois Road. However, this would introduce two (2) additional intersection navigations:



Figure 22: National Highway A8 to Swanport Rd Intersection Street View



Figure 23: Swanport Rd to Hindmarsh Rd Intersection Street View

Both are large bends, and no significant upgrades are expected to be required, other than some potential gravel widening at the inside of the bends. This shall be validated by swept path analysis following confirmation of a delivery vehicle.

7.6 NHVR Portal

A review of the proposed transformer route on the National Heavy Vehicle Regulator portal was conducted for the highest available load category, a 59.5 tonne load. It is noted that the indicative mass of the transformer components is 162 tonnes (as per preliminary equipment documentation from Tilt) so these roads shall be subject to approval following an application to the NHVR to validate their suitability for supporting the equipment.

The review of the proposed transformer route on the NHVR portal showed that the route is approved for OSOM loads except for one (1) section along Randell Rd to the planned site entry. Prior to using this road to transit to the site, Tilt will be required to receive approval from the NHVR as all site entries lie along Randell Road. It is considered unlikely that Randell Road would be rejected for use following an application to the NHVR. No NHVR restrictions on turns or structures for the OSOM category studied were found to be located along the proposed route. Noting the anticipated equipment mass, detailed survey of the structures will be required to ensure that they are able to support the transiting loads.

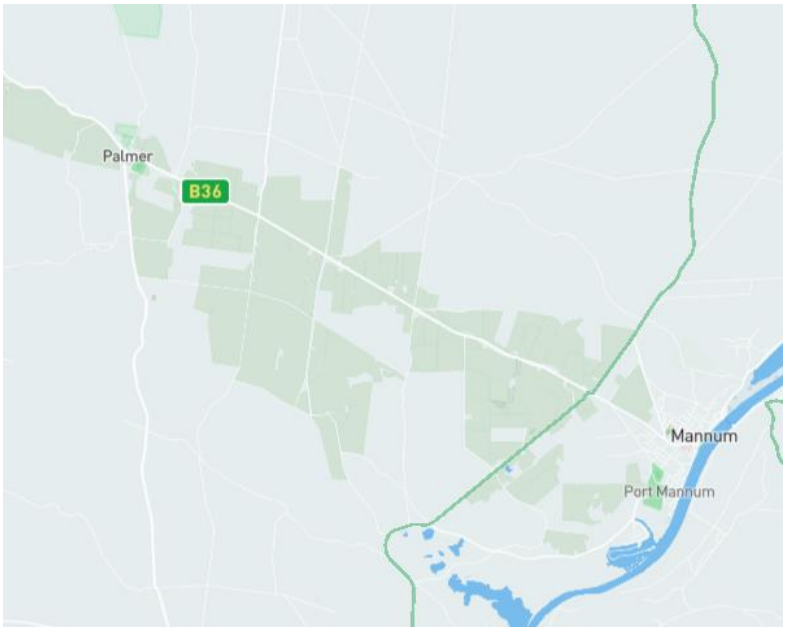


Figure 24: NHVR Route Planner near Randell Rd
Source: NHVR Route Planner



Figure 25: NHVR Route Planner near Murray Bridge
Source: NHVR Route Planner



Figure 26: NHVR Route Planner Legend
Source: NHVR Route Planner

7.7 Bridges and Large Culverts

Along the proposed route, three (3) bridge structures and three (3) large culverts have been identified. Details are shown below:

Table 13: Bridges and Large Culverts for Transformer Components Route

Structure	Name / Obstacle Bridged	Coordinates
Bridge	Swanport Bridge / Murray River	-35.147405, 139.309009
Bridge	N.A. / Rocky Gully Creek	-35.108027, 139.255796
Bridge	N.A / Reedy Creek	-34.937980, 139.228347
Large Culvert	N.A. / N.A.	-34.912469, 139.270112
Large Culvert	N.A. / N.A.	-34.893432, 139.255351
Large Culvert	N.A. / N.A.	-34.856969, 139.171486

These structures will require surveying and further assessment to ensure they can support the load of the transformer components. No publicly available data from the Department for Infrastructure and Transport of South Australia was identified regarding the mass limits of these structures. However, detailed survey will be required to ensure that the structures are viable for the transit of Transformer components, as they are heavier than the heaviest category of OSOM load considered by the NHVR Route Planner. Assessment of the large culverts will also be necessary, as the last two (2) lie along Randell Road, which has not been approved by the NHVR for OSOM loads.

8 Conclusion

The above report identifies that a viable port to site route exists for the Palmer Wind Farm development. WTG component delivery from the Port of Adelaide to site, utilising the Sturt Highway (and other associated roads listed within the report), is considered feasible following some intersection upgrade works to geometrically facilitate OSOM vehicle passage.

icubed note that further actions will be required to allow vehicles to utilise the designated transportation routes from the Port of Adelaide. These actions include:

- Revalidation of geometric assessments associated with the proposed routes following confirmation of the OSOM vehicles to be utilised on the PWF project, updating swept path assessments as necessary if vehicle dimensions are increased.
- Prior to delivery to site, the transport contractor shall conduct a survey of vertical height clearances at confined locations such as bridges, overhead electrical and telecommunication wires or infrastructure or other infrastructure and adequate clearances be checked to be suitable.
- National Heavy Vehicle Regulator permits shall be applied for and obtained by the appointed transportation contractor prior to deliveries to site.
- The load capacities of sections identified along the transportation route (such as, but not limited to, culverts, bridges, unsealed or sealed pavements in poor condition) shall be checked and approved for use by the relevant authority.

This report has been prepared based on assumptions of the configuration of the blade and tower section carrier vehicles with elevated heights and the results of current infrastructure at several points along the route. It is recommended that once the dimensions of the equipment and transportation equipment are confirmed that the clearances and manoeuvrers within this report be reviewed.

Appendix A – Site Plan

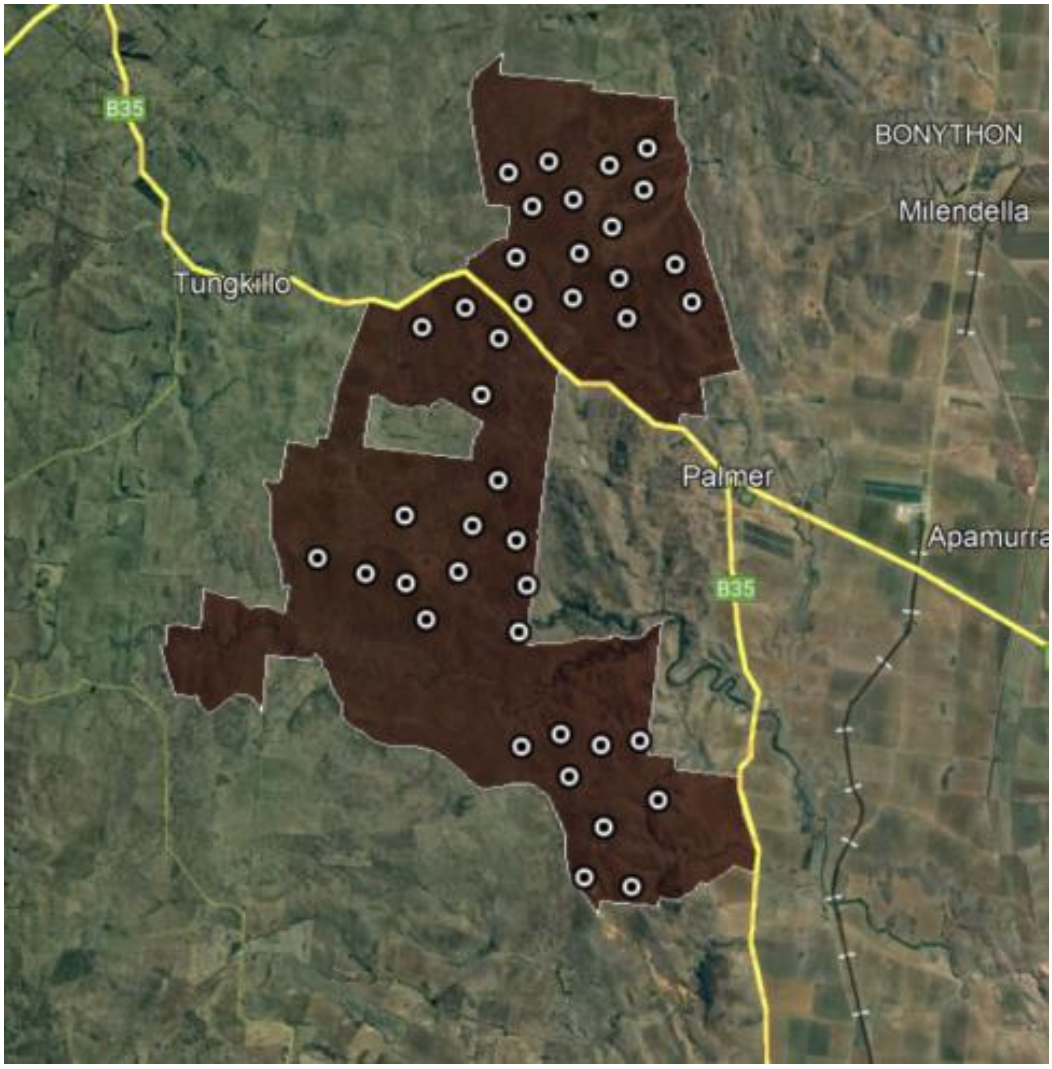


Figure 27: Palmer Wind Farm Proposed Site Boundary and WTG Layout

Appendix B – Vehicle Swept Paths

Plans shown overleaf



NO FEATURE SURVEY COMPLETED FOR SWEPT PATH ANALYSIS. ALL ROAD FURNITURE IDENTIFIED ON PLAN HAVE BEEN ESTIMATED BASED ON AVAILABLE IMAGERY.

AERIAL IMAGERY SHOWN FOR CONTEXT IS NOT UP TO DATE WITH LATEST INTERSECTION UPGRADES TO STURT HIGHWAY AND HALFWAY HOUSE ROAD.

LEGEND

- VEHICLE WHEEL PATH ENVELOPE
- EXTENT OF VEHICLE WHEEL PATH
- OVER-DIMENSIONAL GRAVEL WIDENING
- EXTENT OF GRAVEL WIDENING
- EXTENT AREA TO BE CLEARED (EXTENT OF 90m BLADE)
- EXISTING OVERHEAD POWER LINE
- EXISTING FENCE LINE
- GUIDE POST
- PROPOSED SIGN
- SI — EXISTING SIGN
- LP — EXISTING LIGHT POLE
- PP — EXISTING POWER POLE

NOTES

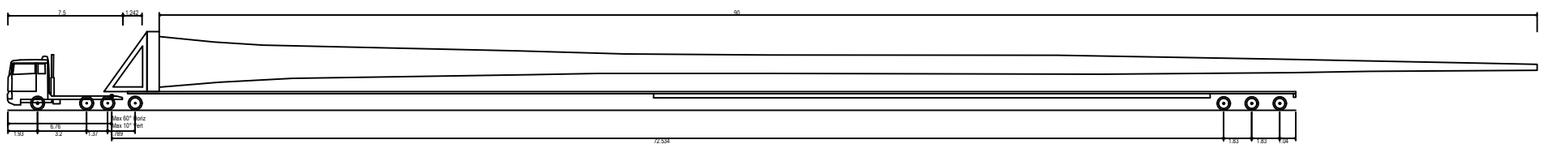
ALL GUIDEPOSTS WITHIN OVER-DIMENSIONAL WHEEL PATH TO BE REMOVED PRIOR TO TRANSPORTATION OF WIND TURBINE BLADES

CLEARING OF VEGETATION SHALL ONLY BE PERFORMED AFTER RELEVANT AUTHORITY APPROVALS ARE OBTAINED, IF REQUIRED FOR ROAD UPGRADE

SURVEY OF HEIGHT CLEARANCES ALONG TRANSPORTATION ROUTE SHALL BE COMPLETED BY THE APPOINTED TRANSPORTATION CONTRACTOR

INTERSECTION 1 - STURT HIGHWAY AND HALFWAY HOUSE ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
B	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	23.05.2022
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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ACN 106 675 156
p 07 3870 8888

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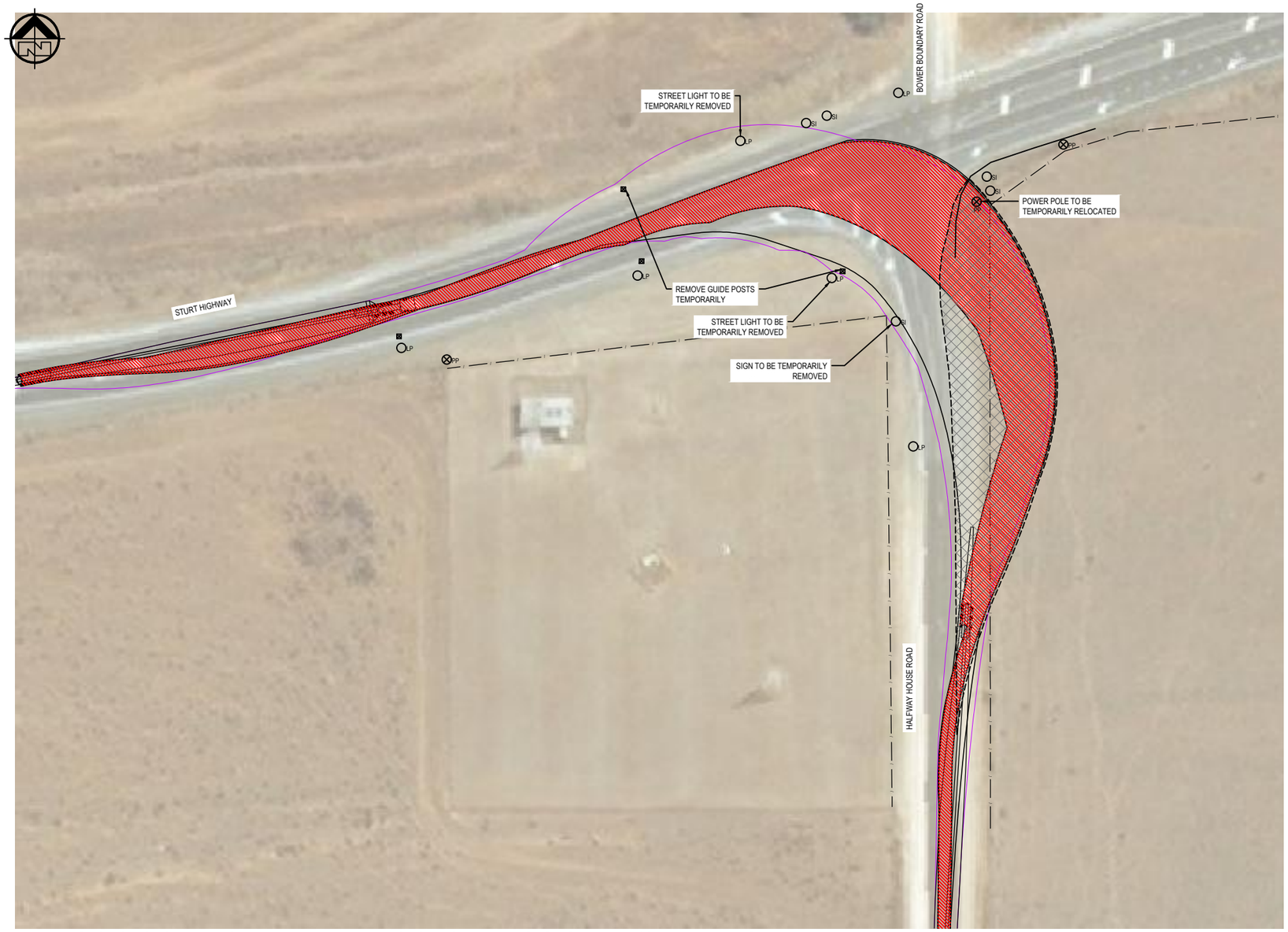
COORDINATE REFERENCE SYSTEM: AS SHOWN

PROJECT: PALMER WIND FARM

TITLE: STURT HIGHWAY / HALFWAY HOUSE ROAD INTERSECTION PLAN OPTION 1

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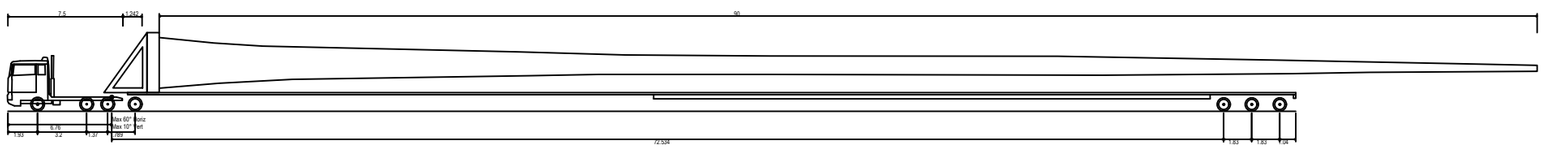
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SCALE 1:500



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Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

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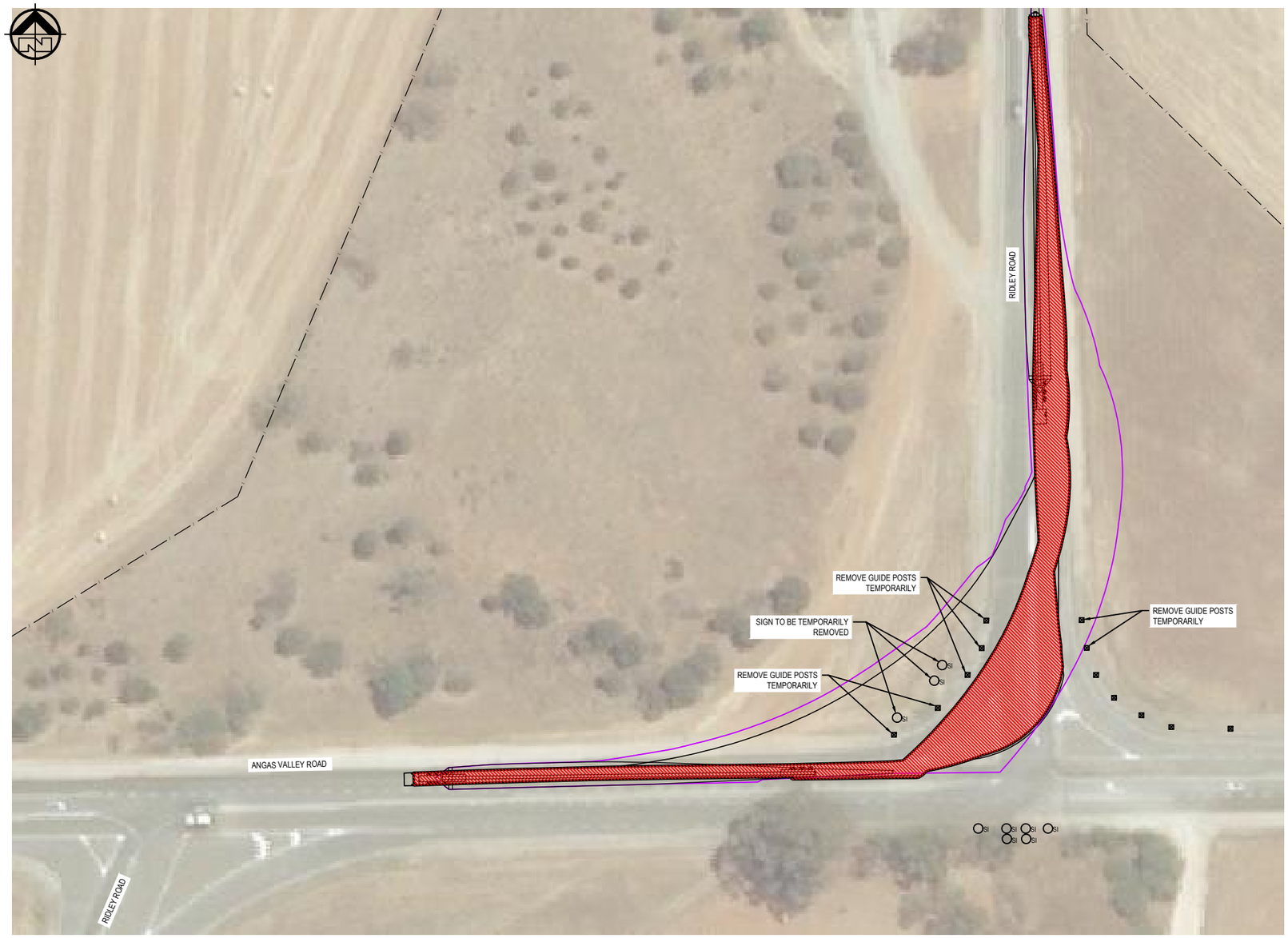
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TITLE STURT HIGHWAY / HALFWAY HOUSE ROAD INTERSECTION PLAN OPTION 2

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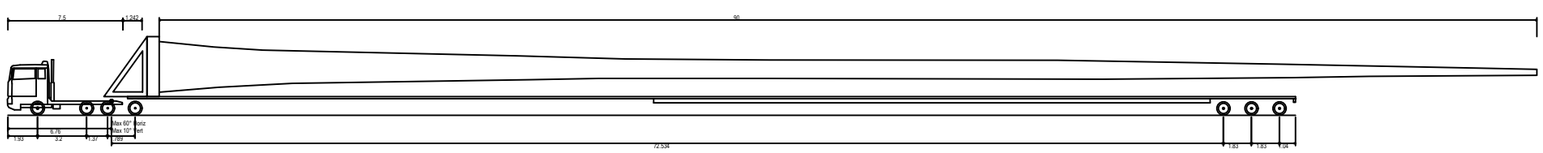
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INTERSECTION 2 - RIDLEY ROAD AND ANGAS VALLEY ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
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A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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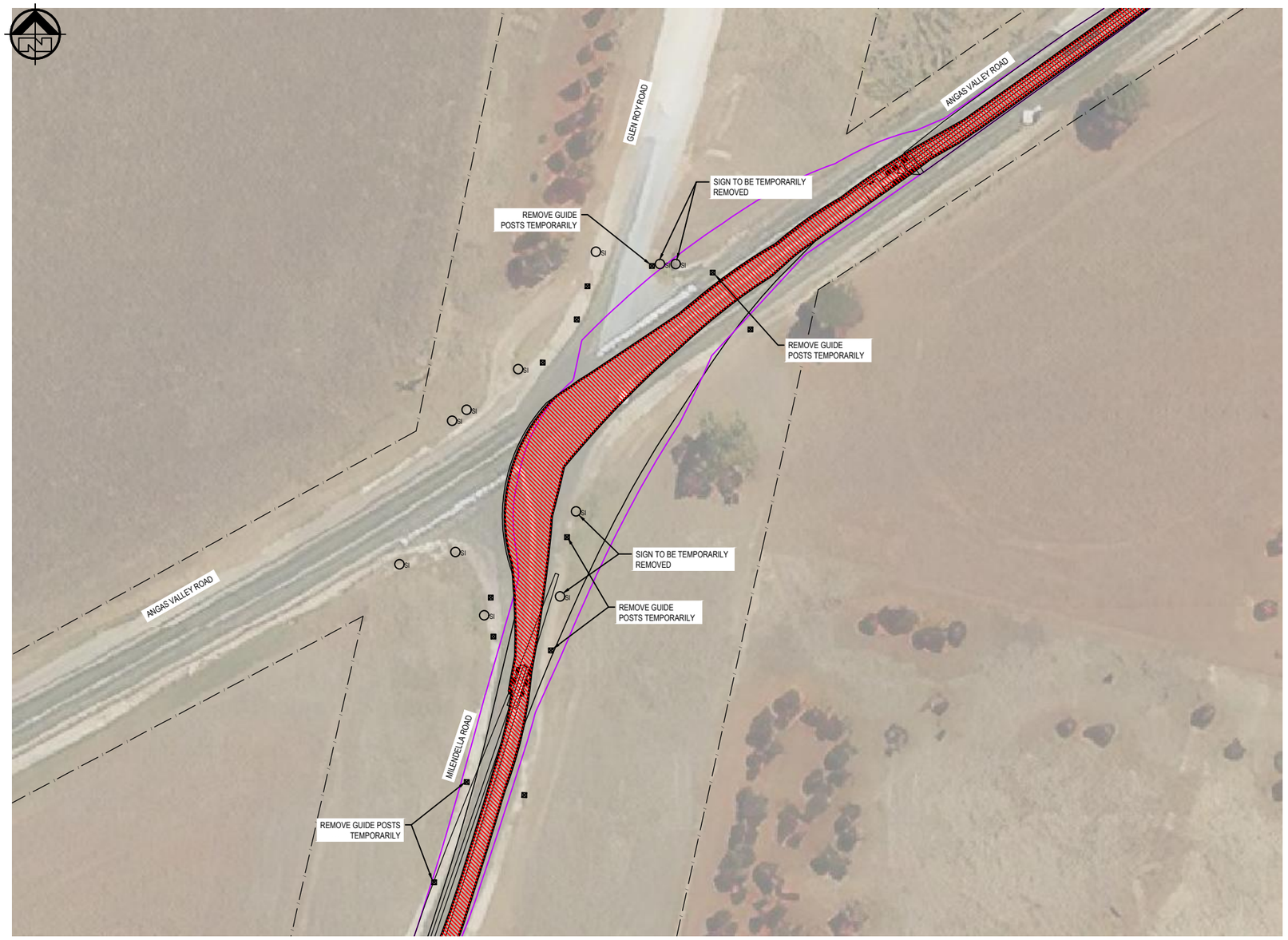
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PROJECT PALMER WIND FARM

TITLE RIDLEY ROAD / ANGAS VALLEY ROAD INTERSECTION PLAN

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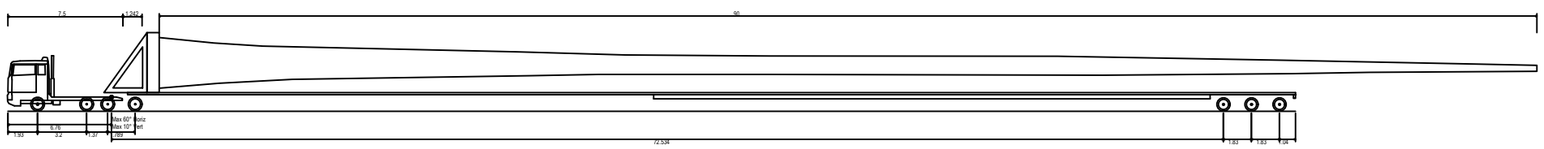
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INTERSECTION 3 - ANGAS VALLEY ROAD AND MILENDELLA ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:400



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
REVISION HISTORY						
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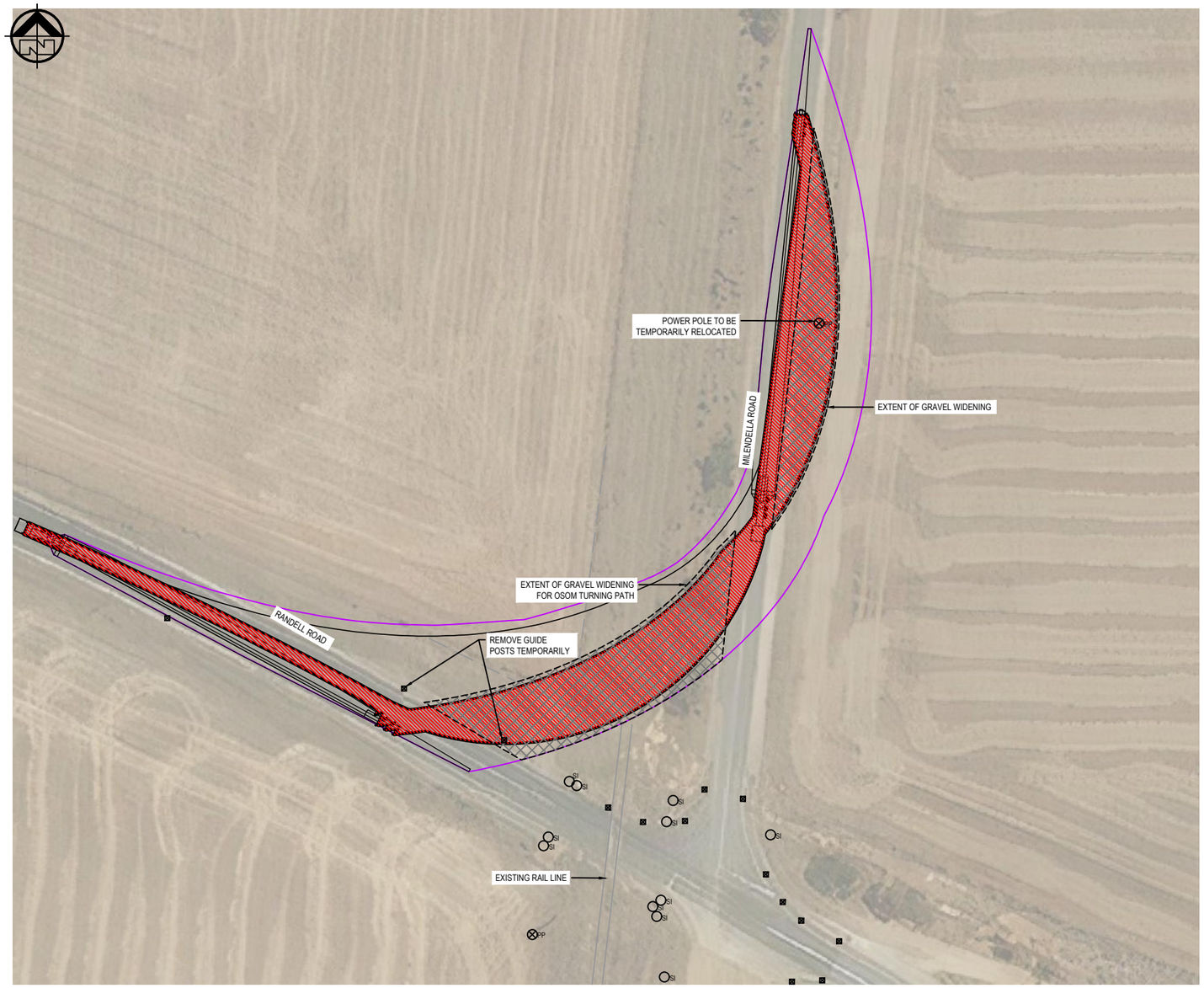
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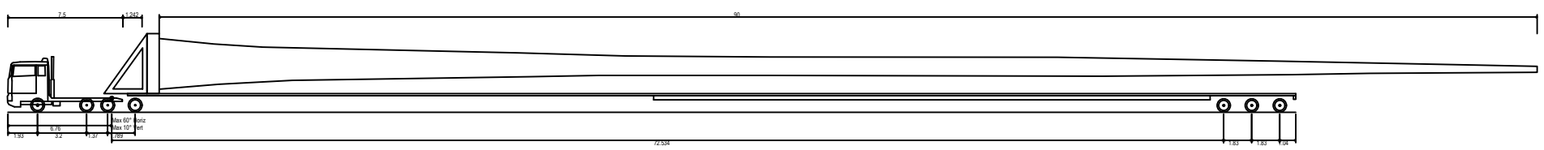
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INTERSECTION 4 - MILENDELLA ROAD AND RANDELL ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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ACN 106 675 156
p 07 3870 8888

SIZE A1 | SCALE AS SHOWN

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COORDINATE REFERENCE SYSTEM AS SHOWN

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TITLE MILENDELLA ROAD / RANDELL ROAD INTERSECTION PLAN OPTION 1

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LEGEND

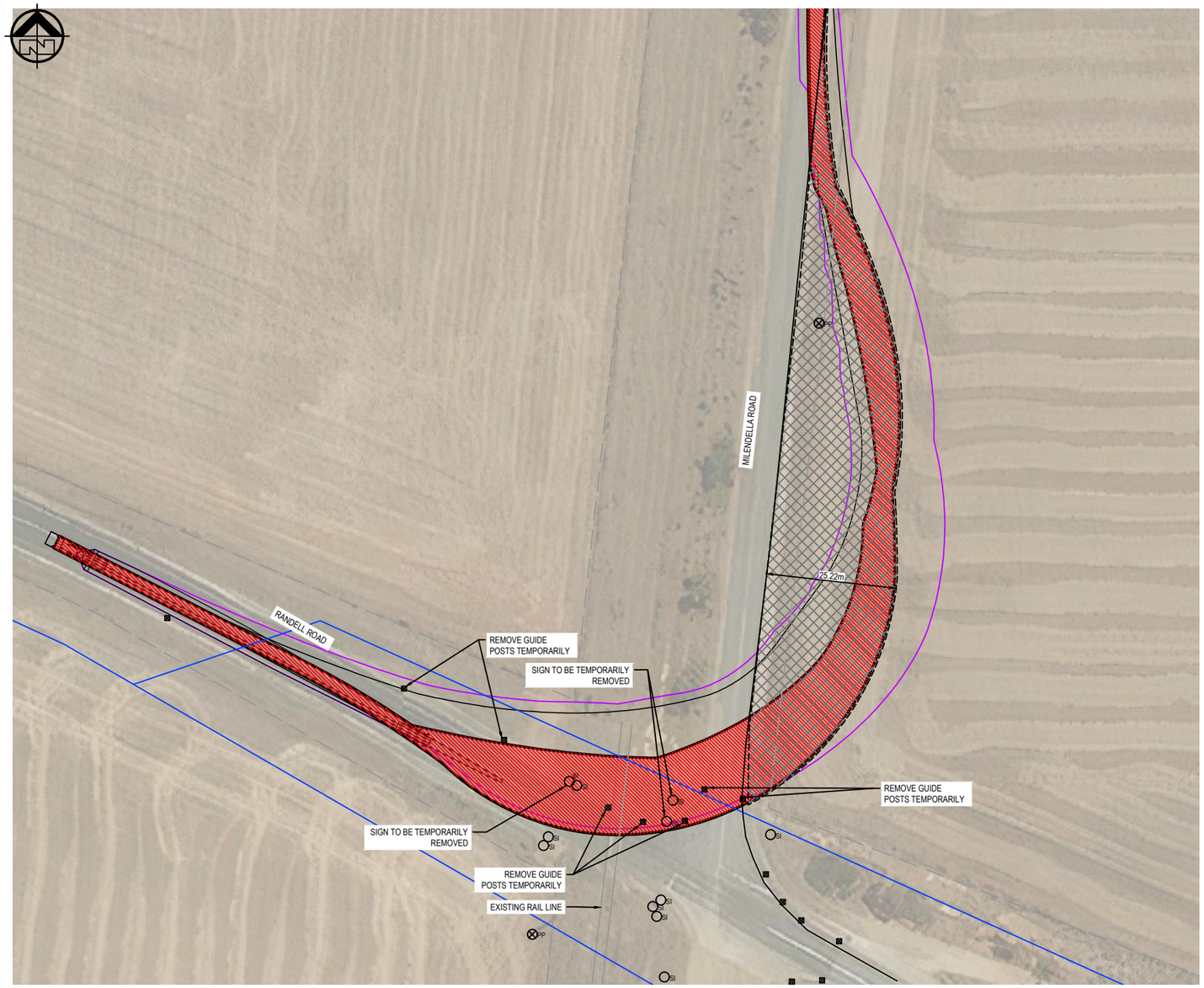
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- EXTENT OF VEHICLE WHEEL PATH
- OVER-DIMENSIONAL GRAVEL WIDENING
- EXTENT OF GRAVEL WIDENING
- EXTENT AREA TO BE CLEARED (EXTENT OF 90m BLADE)
- EXISTING OVERHEAD POWER LINE
- EXISTING FENCE LINE
- GUIDE POST
- PROPOSED SIGN
- EXISTING SIGN
- EXISTING LIGHT POLE
- EXISTING POWER POLE
- ADELAIDE WATER PIPELINE - APPROX. FROM DBYD

NOTES

ALL GUIDEPOSTS WITHIN OVER-DIMENSIONAL WHEEL PATH TO BE REMOVED PRIOR TO TRANSPORTATION OF WIND TURBINE BLADES

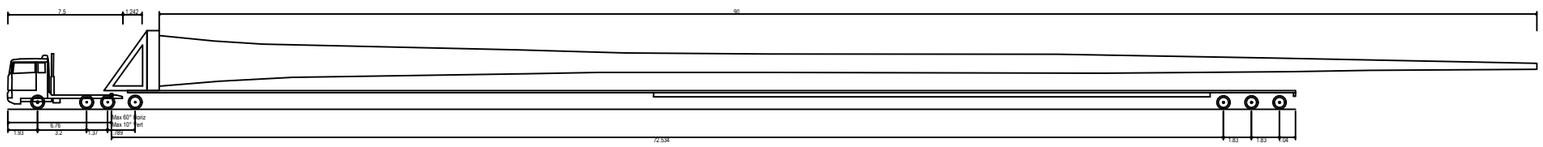
CLEARING OF VEGETATION SHALL ONLY BE PERFORMED AFTER RELEVANT AUTHORITY APPROVALS ARE OBTAINED, IF REQUIRED FOR ROAD UPGRADE

SURVEY OF HEIGHT CLEARANCES ALONG TRANSPORTATION ROUTE SHALL BE COMPLETED BY THE APPOINTED TRANSPORTATION CONTRACTOR



INTERSECTION 4 - MILENDELLA ROAD AND RANDELL ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
B	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	23.05.2022
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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mail@icubed.com.au
ACN 106 675 156
p 07 3870 8888

SIZE A1 | SCALE AS SHOWN

STATUS PRELIMINARY NOT FOR CONSTRUCTION

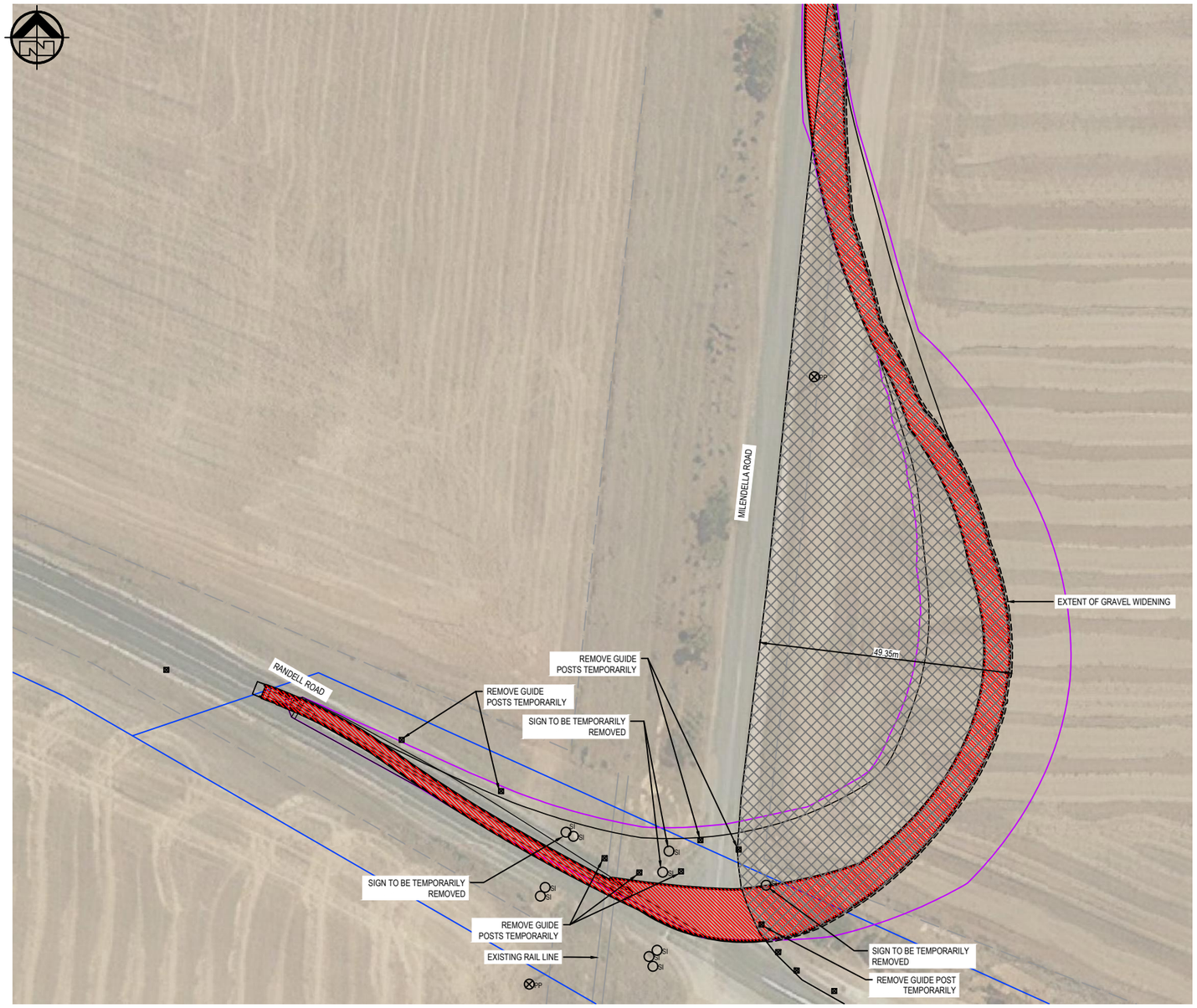
COORDINATE REFERENCE SYSTEM AS SHOWN

PROJECT PALMER WIND FARM

TITLE MILENDELLA ROAD / RANDELL ROAD INTERSECTION PLAN OPTION 2

DRAWING No. 22-053-PWF-DWG-TR004-2 | REV B

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LEGEND

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- EXTENT OF VEHICLE WHEEL PATH
- OVER-DIMENSIONAL GRAVEL WIDENING
- EXTENT OF GRAVEL WIDENING
- EXTENT AREA TO BE CLEARED (EXTENT OF 90m BLADE)
- EXISTING OVERHEAD POWER LINE
- EXISTING FENCE LINE
- GUIDE POST
- PROPOSED SIGN
- SI EXISTING SIGN
- LP EXISTING LIGHT POLE
- PP EXISTING POWER POLE
- ADELAIDE WATER PIPELINE - APPROX. FROM DBYD

NOTES

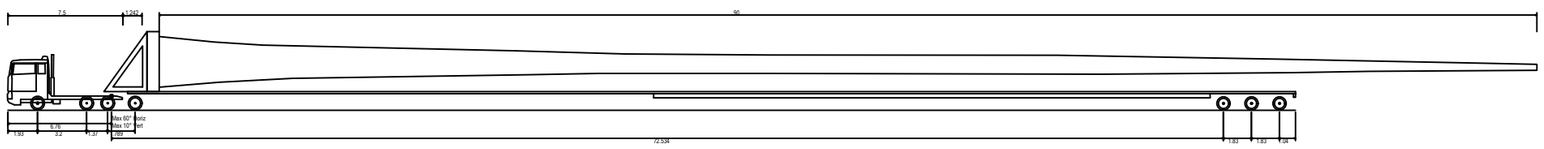
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INTERSECTION 4 - MILENDELLA ROAD AND RANDELL ROAD INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

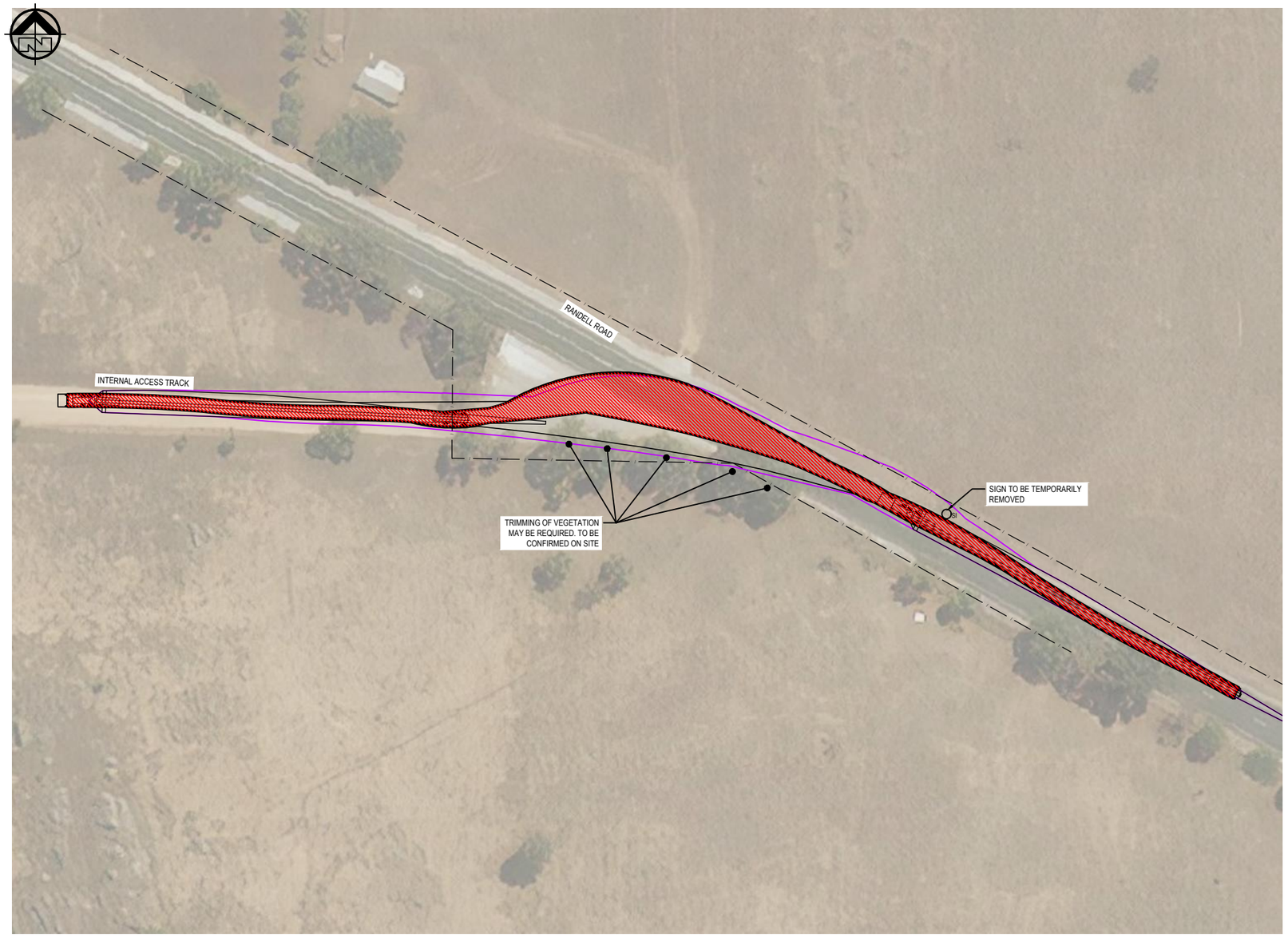
No	DESCRIPTION	DES	DRN	CHK	APP	DATE
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	23.05.2022

REVISION HISTORY

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mail@icubed.com.au
ACN 106 675 156
p 07 3870 8888

SIZE	A1
SCALE	AS SHOWN
STATUS	PRELIMINARY NOT FOR CONSTRUCTION
COORDINATE REFERENCE SYSTEM	AS SHOWN
PROJECT	PALMER WIND FARM
TITLE	MILENDELLA ROAD / RANDELL ROAD INTERSECTION PLAN OPTION 3
DRAWING No.	22-053-PWF-DWG-TR004-3
REV	A

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LEGEND

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- EXTENT OF VEHICLE WHEEL PATH
- OVER-DIMENSIONAL GRAVEL WIDENING
- EXTENT OF GRAVEL WIDENING
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- EXISTING OVERHEAD POWER LINE
- EXISTING FENCE LINE
- GUIDE POST
- PROPOSED SIGN
- SI EXISTING SIGN
- LP EXISTING LIGHT POLE
- PP EXISTING POWER POLE

NOTES

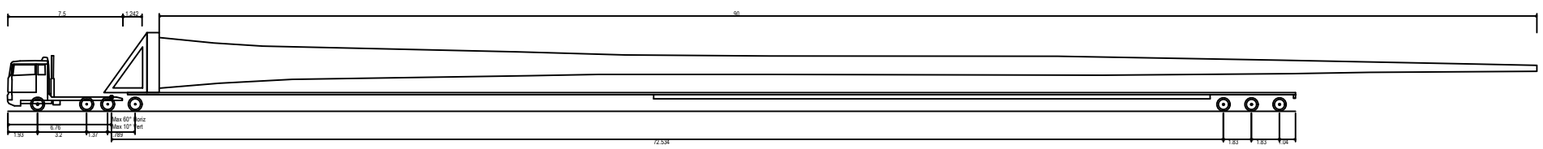
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SURVEY OF HEIGHT CLEARANCES ALONG TRANSPORTATION ROUTE SHALL BE COMPLETED BY THE APPOINTED TRANSPORTATION CONTRACTOR

INTERSECTION 6 - RANDELL ROAD AND SITE ENTRY TWO INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:500



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
B	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	23.05.2022
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

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SIZE A1 | SCALE AS SHOWN

STATUS PRELIMINARY NOT FOR CONSTRUCTION

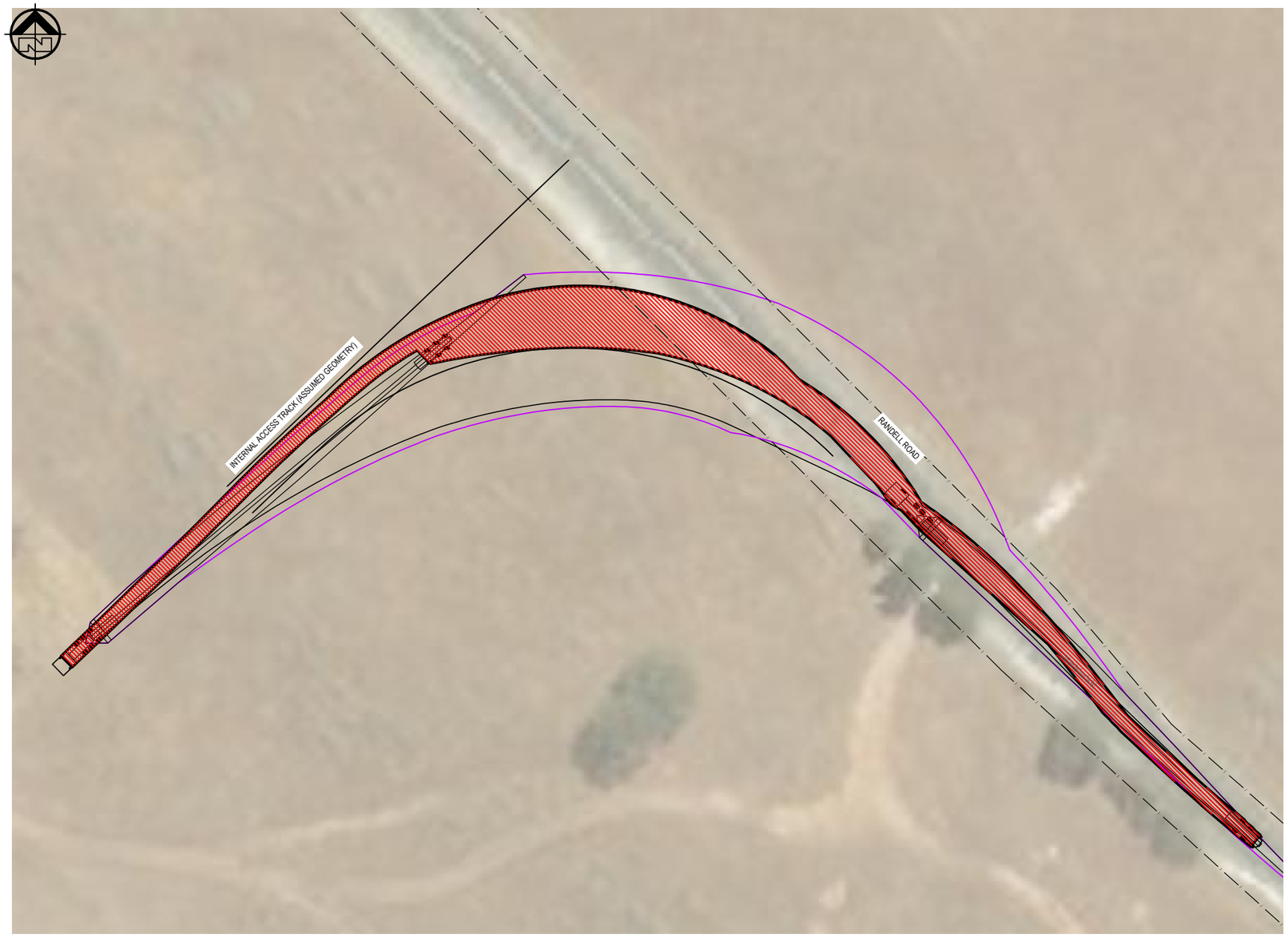
COORDINATE REFERENCE SYSTEM AS SHOWN

PROJECT PALMER WIND FARM

TITLE RANDELL ROAD / SITE ENTRY TWO INTERSECTION PLAN

DRAWING No. 22-053-PWF-DWG-TR006 | REV B

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- EXTENT OF VEHICLE WHEEL PATH
- OVER-DIMENSIONAL GRAVEL WIDENING
- EXTENT OF GRAVEL WIDENING
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- EXISTING OVERHEAD POWER LINE
- EXISTING FENCE LINE
- GUIDE POST
- PROPOSED SIGN
- SI — EXISTING SIGN
- LP — EXISTING LIGHT POLE
- PP — EXISTING POWER POLE

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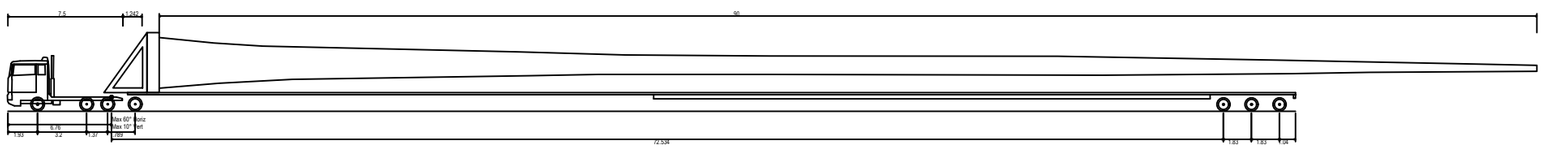
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INTERSECTION 7 - RANDELL ROAD AND SITE ENTRY THREE INTERSECTION PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:400



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
B	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	23.05.2022
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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p 07 3870 8888

SIZE A1 | SCALE AS SHOWN

STATUS PRELIMINARY NOT FOR CONSTRUCTION

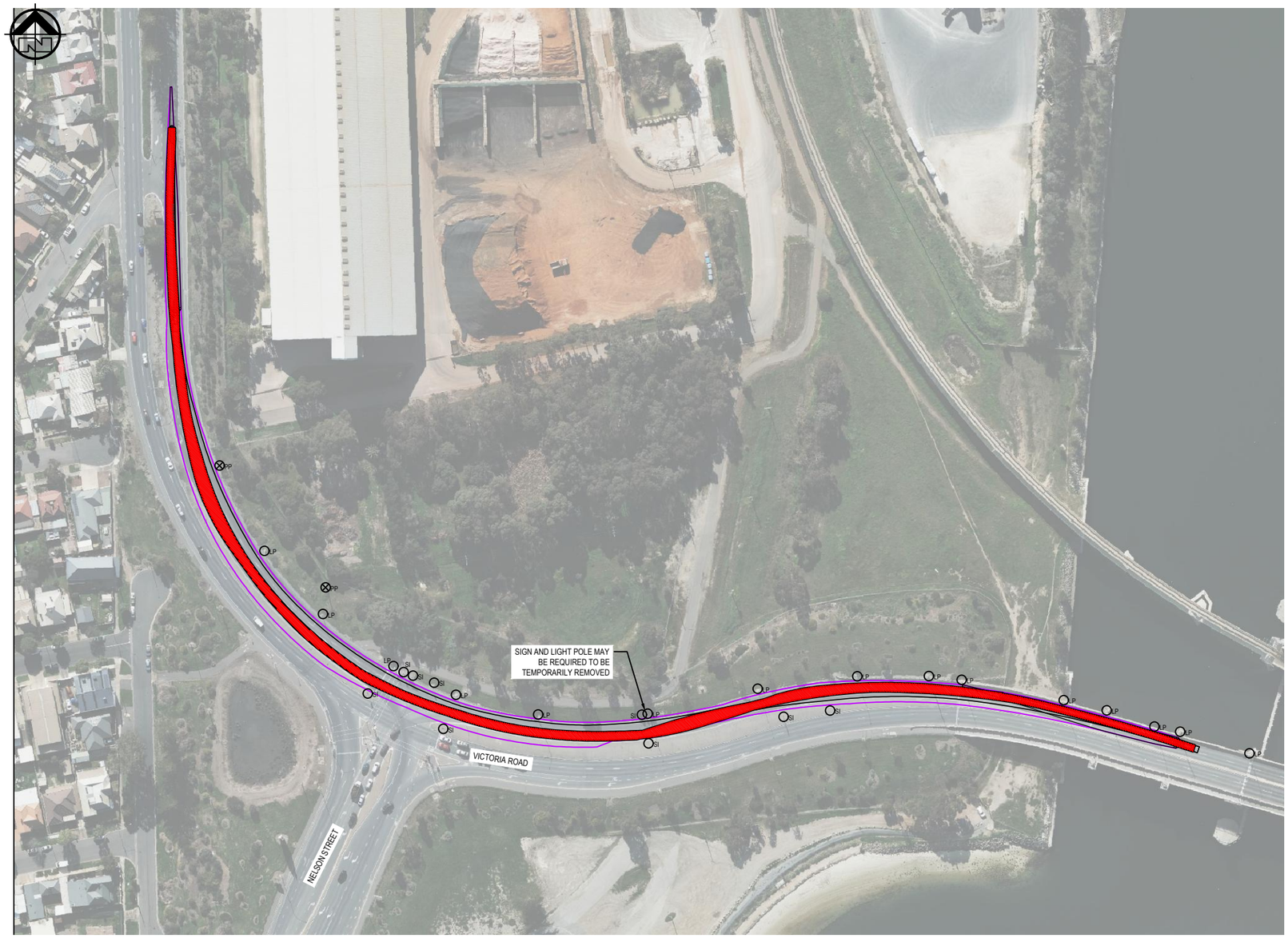
COORDINATE REFERENCE SYSTEM AS SHOWN

PROJECT PALMER WIND FARM

TITLE RANDELL ROAD / SITE ENTRY THREE INTERSECTION PLAN

DRAWING No. 22-053-PWF-DWG-TR007 | REV B

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- EXTENT OF VEHICLE WHEEL PATH
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- EXTENT OF GRAVEL WIDENING
- EXTENT AREA TO BE CLEARED (EXTENT OF 90m BLADE)
- EXISTING OVERHEAD POWER LINE
- GUIDE POST
- PROPOSED SIGN
- SI EXISTING SIGN
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NOTES

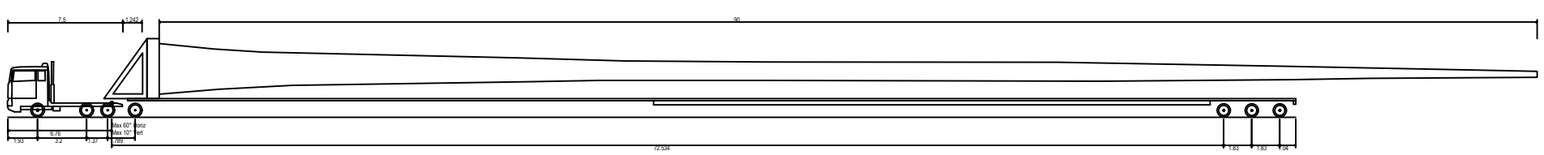
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SURVEY OF HEIGHT CLEARANCES ALONG TRANSPORTATION ROUTE SHALL BE COMPLETED BY THE APPOINTED TRANSPORTATION CONTRACTOR

VICTORIA ROAD TURNING PLAN - 90m BLADE TRUCK AND TRAILER

SCALE 1:1000



22-053 -90m Blade Truck and Trailer_Rev 0

Overall Length	99.75m
Overall Width	2.591m
Overall Body Height	3.628m
Min Body Ground Clearance	0.348m
Max Track Width	2.591m
Lock-to-lock time	2.00s
Max Wheel Angle	60.00°

90m BLADE TRUCK AND TRAILER

No	DESCRIPTION	DES	DRN	CHK	APP	DATE
A	FOR REVIEW	A.P.	A.P.	M.P.	M.P.	06.05.2022

REVISION HISTORY

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ABN 89 106 675 156
PO Box 878
Toowong, Qld 4066
mail@icubed.com.au
ACN 106 675 156
p 07 3870 8888

SIZE	A1
SCALE	AS SHOWN
STATUS	PRELIMINARY NOT FOR CONSTRUCTION
COORDINATE REFERENCE SYSTEM	AS SHOWN
PROJECT	PALMER WIND FARM
TITLE	VICTORIA ROAD TURNING PLAN
DRAWING No.	22-053-PWF-DWG-TR008
REV	A

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Appendix C – Transport Route Images (Google Streetview)



Location 1 (Sturt Highway) – Sturt Highway / Halfway House Road (Right), Annadale



Location 2 (From Ridley Road) – Ridley Road / Angas Valley Road (Right), Angas Valley



Location 3 (From Angas Valley Street) -Angas Valley Road / Milendella Roa (Left), Sanderston



Location 4 (From Milendella Road) – Milendella Road / Randell Road (Right), Palmer



Location 5 (From Angas Valley Road) – Angas Valley Road / Site Entrance One (Left), Sanderston



Location 6 (From Randell Road) - Randell Road / Site Entrance Two (Left), Palmer



Location 7 (From Randell Road) – Randelll Road / Site Entrance Three (Left), Tungkillo



Location 8 (From Victoria Road) – Victoria Road Corner, Birkenhead



Location 1 (From Angas Valley Road) – Angas Valley Highway / Ridley Road (Left), Angas Valley



Location 2 (From Ridley Road) – Ridley Road / Randell Road (Right), Mannum

Appendix D – Transport Route Overpass Images (Google Streetview)



Overpass 2 – Hanson Road Overpass, Wingfield



Overpass 7 – Bolivar Road Overpass, Bolivar



Overpass 8 – Waterloo Corner Road Overpass, Waterloo Corner



Overpass 10 – Port Wakefield Highway Overpass, Waterloo Corner



Overpass 11 – Penfield Road Overpass, Penfield Gardens



Overpass 12 – Heaslip Road Overpass, Penfield Gardens



Overpass 13 – Curtis Road Overpass, Andrews Farm



Overpass 14 – Angle Vale Road Overpass, Angle Vale

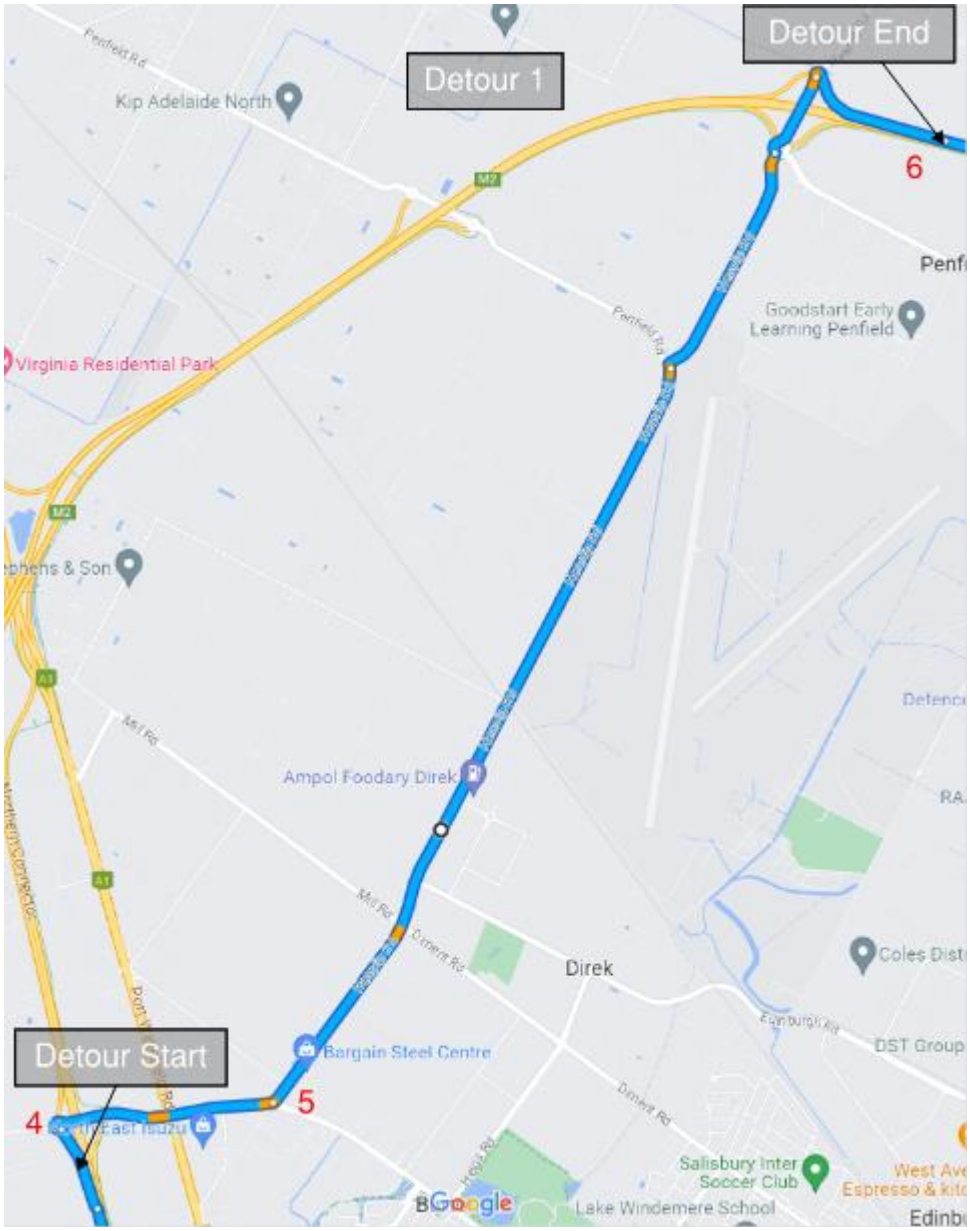


Overpass 15 – Redbanks Road Overpass, Gawler Belt

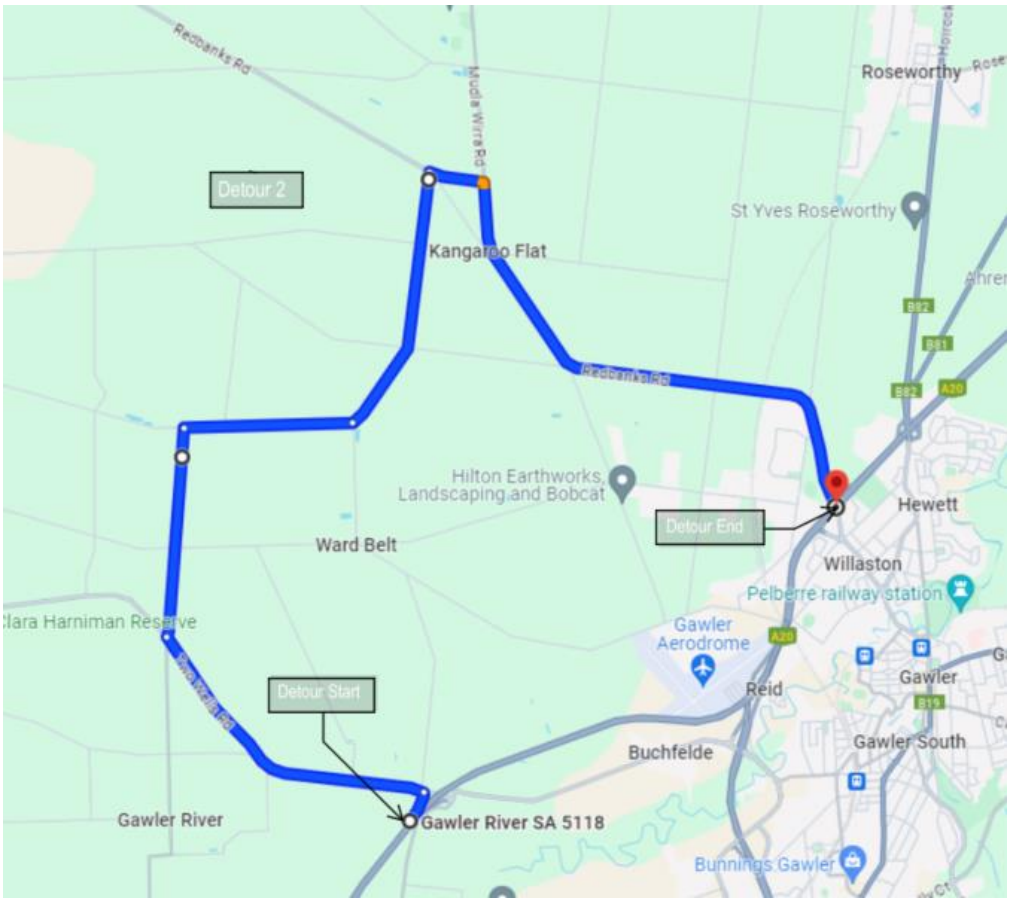


Overpass 16 – Sir Condor Lauke Way Overpass, Nurioopta

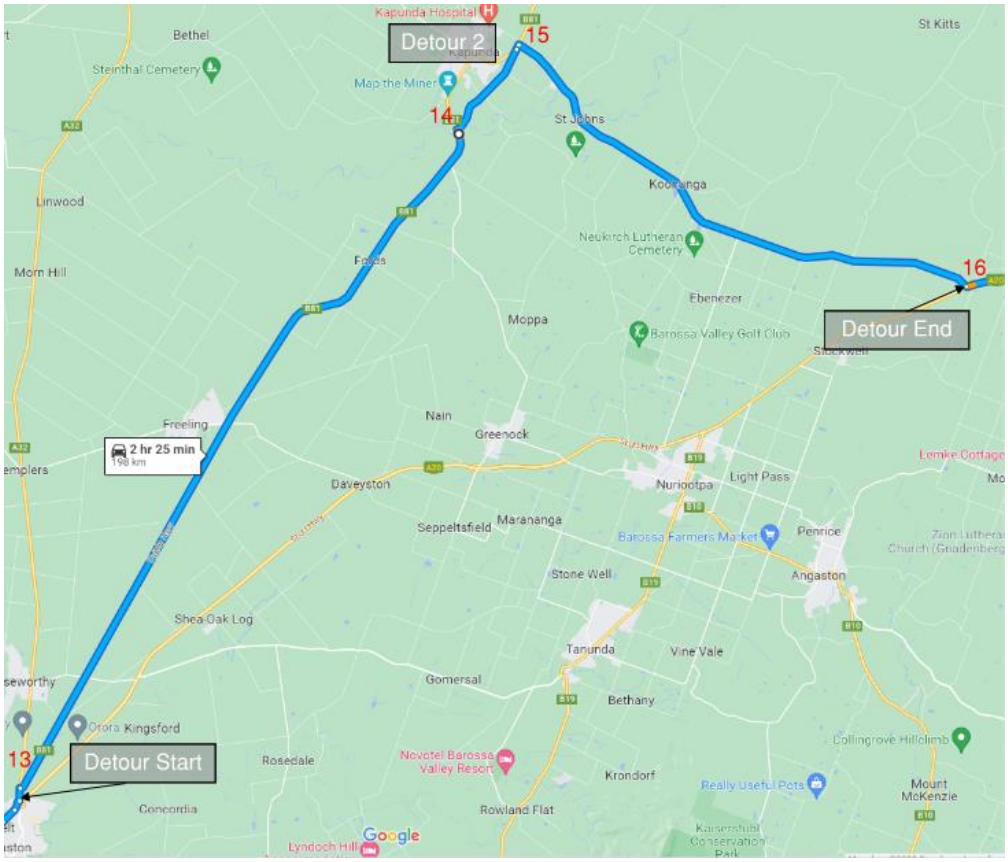
Appendix E – Proposed Alternative Route Options



Detour 1 (Route 2A) – Waterloo Corner Road



Detour 2 (Route 2A) – Two Wells Road



Detour 3 (Route 2A) – Horrocks Highway



Detour 1 (Route 2B) – Port Wakefield Highway / Gawler

Appendix F – Site Entry Points

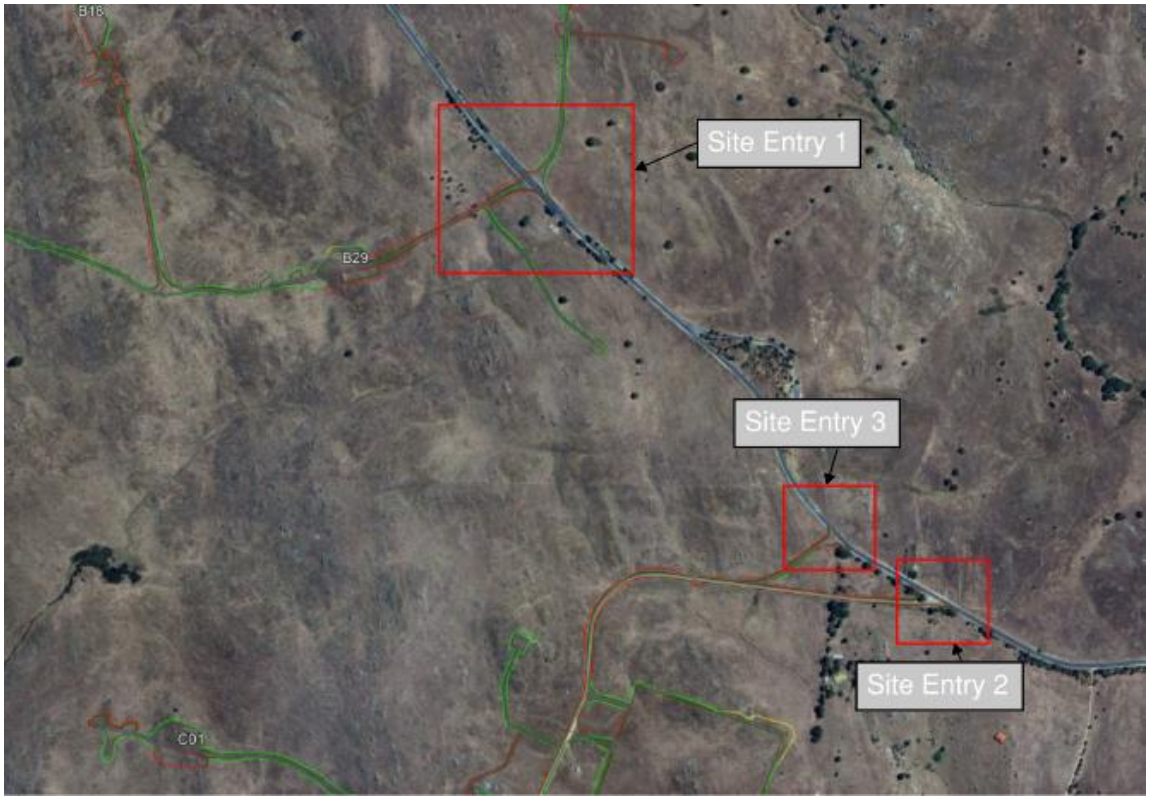


Figure 28: Potential Site Entry Points

Appendix G – List of Identified Bridges and Major Culverts

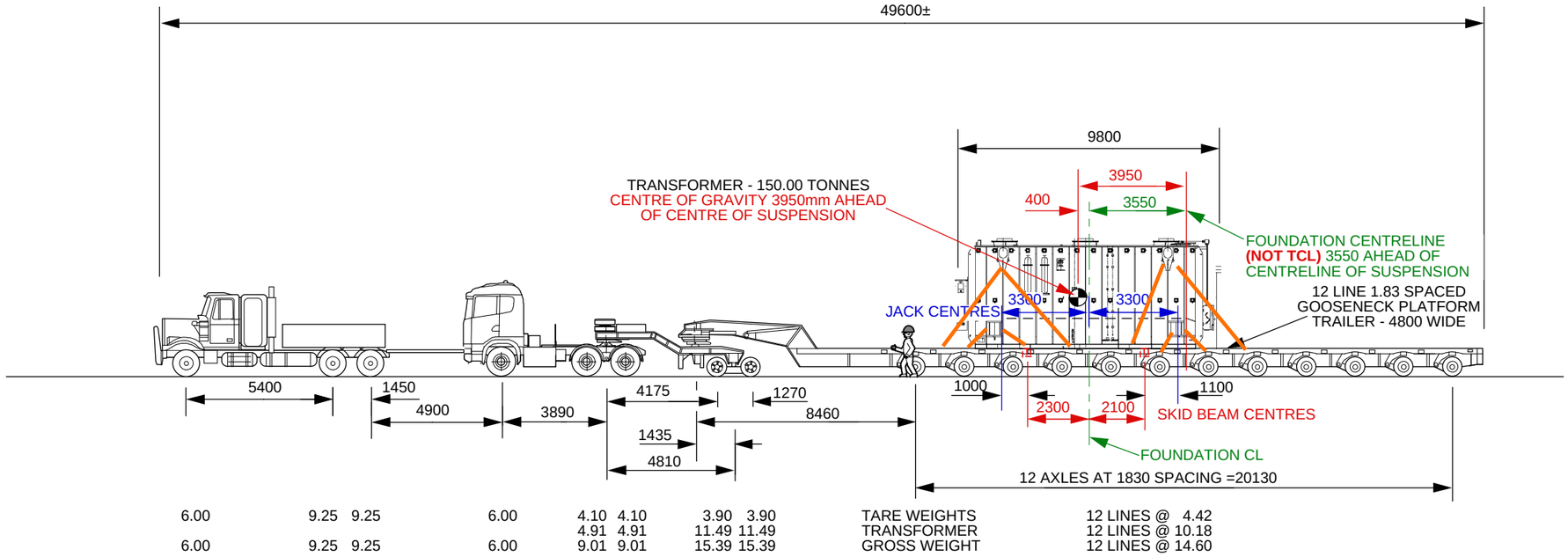
Structure No.	Crossing Description	Location Description	Map Reference Coordinates
Route 1			
1	Para River Bridge	North-Sout Motorway, Dry Creek	-34.79460, 138.57827
2	Little Para River Bridge	North-South Motorway, Salisbury	-34.78337, 138.58258
3	Bridge (Railway)	Northern Expressway, Penfield Gardens	-34.69189, 138.58762
4	Gawler River Bridge	Northern Expressway, Angle Vale	-34.61563, 138.68017
5	Two Wells Road Bridge	Northern Expressway, Gawler River	-34.60969, 138.68668
6	Gawler Bypass Bridge	Northern Expressway, Ward Belt	-34.59948, 138.72612
7	Horrocks Highway Bridge	Sturt Highway, Gawler Belt	-34.57149, 138.74639
8	Old Sturt Highway Bridge	Sturt Highway, Daveyston	-34.46893, 138.88724
9	Adelaide Road Bridge	Sturt Highway, Greenock	-34.46768, 138.91798
10	Major Culvert	Sturt Highway, Truro	-34.40320, 139.15768
11	Wild Dog Creek Bridge	Sturt Highway, Mid Murray	-34.39970, 139.26936
12	Culvert	Halfway House Road, Sandleton	-34.46279, 139.35456
13	Lillecrapp Creek Bridge	Ridley Road, Sedan	-34.58390, 139.28515
14	Pine Hut Creek Bridge	Ridley Road, Sedan	-34.60981, 139.28237
15	Boundary Creek Bridge	Ridley Road, Cambrai	-34.62911, 139.28191
16	Marne River Bridge	Ridley Road, Cambrai	-34.66709, 139.28224
17	Saunders Creek Bridge	Ridley Road, Cambrai	-34.73104, 139.27465
18	Milendella Creek Bridge	Milendella Road, Milendella	-34.80719, 139.20411
Route 2A			
19	Waterloo Corner Bridge	Waterloo Corner Road, Waterloo Corner	-34.73287, 138.57677
20	Heaslip Road Railway Crossing	Heaslip Road, Waterloo Corner	-34.71075, 138.60437
21	Heaslip Road Bridge	Heaslip Road, Penfield Gardens	-34.67912, 138.62338
22	Thiele Highway Bridge	Thiele Highway, Fords	-34.39513, 138.88438
23	Light River Bridge	Thiele Highway, Kapunda	-34.36481, 138.91114
24	Allen Creek Bridge	Truro Road, Kapunda	-34.34121, 138.94150
25	Light River Bridge	Truro Road, Kapunda	-34.35477, 138.95415
Route 2B			
26	Saunders Creek Bridge	Ridley Road, Cambrai	-34.73104, 139.27465
27	Port Wakefield Road Culvert	Port Wakefield Road, Riverlea Park	-34.65255, 138.54145
28	Gawler River Bridge	Port Wakefield Road, Virginia	-34.63954, 138.53124
29	Port Wakefield Highway Culvert	Port Wakefield Road, Two Wells	-34.63392, 138.52826
30	Port Wakefield Highway Bridge	Port Wakefield Road, Two Wells	-34.62056, 138.52115
31	Salt Creek Bridge	Port Wakefield Road, Two Wells	-34.60430, 138.51578
Route 3			
32	Large Culvert	Ridley Road, Punthari	-34.82378, 139.31012
Transformer Transportation Route			
33	Swanport Bridge	South Eastern Freeway, A1	-35.147405, 139.309009
34	Rocky Gully Creek Bridge	Mannum Road	-35.108027, 139.255796
35	Reedy Creek Bridge	Mannum Road	-34.937980, 139.228347
36	Large Culvert	Mannum Road	-34.912469, 139.270112
37	Large Culvert	Randell Road	-34.893432, 139.255351
38	Large Culvert	Randell Road	-34.856969, 139.171486

Note: Prior to construction, a detailed survey should be conducted to verify the location and condition of these structures. Minor culverts were excluded from the identification process. Load limits of the bridge structures has been considered sufficient for 59.5 tonnes OSOM loads according to NHVR Route Planner.

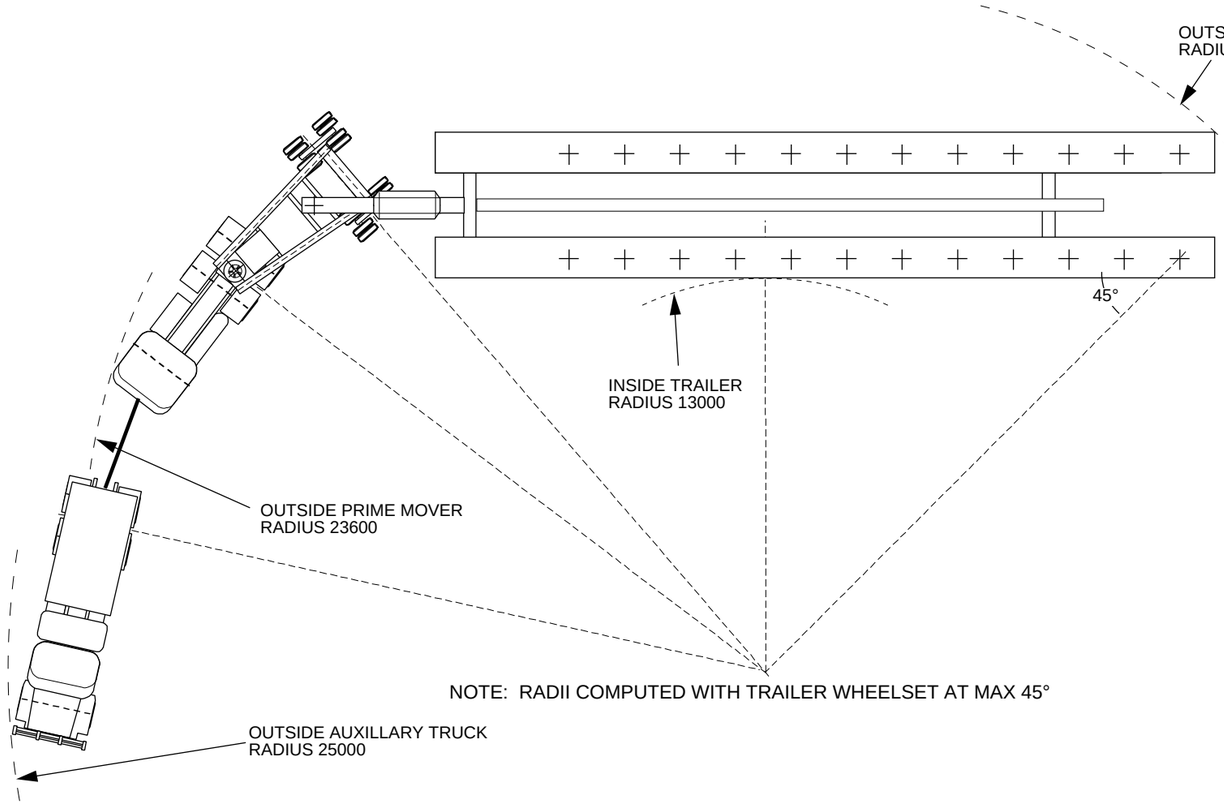
Appendix H – Transformer Transport Vehicle Details

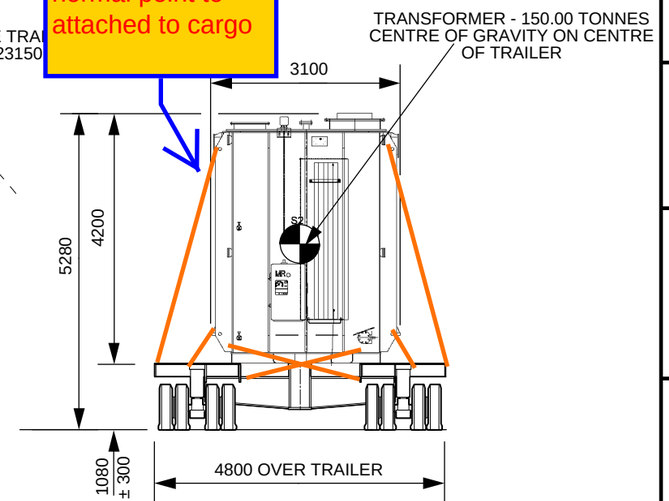
Plans shown overleaf

HEAVY LIFT AND TRANSPORT ENGINEERING AND PLANNING



lashing min 18 chains at 9t each 18 chain at 9t is 162t of lashing we show the normal point to attached to cargo





TRAILER CROSS SECTION
SCALE - 1:100

REFERENCE DRAWINGS

NOTES

1) IT IS ASSUMED THAT THE HAUL WILL BE UNDERTAKEN WITH COMPETENT AND EXPERIENCED HAUL SUPERVISORS/ PILOTS/ASSISTANTS AS APPROPRIATE FOR THE TYPE OF HAUL, OPERATING EQUIPMENT IN GOOD CONDITION, WITHIN ITS DESIGN CAPABILITIES, AND TAKING INTO ACCOUNT THE ROAD/TRAFFIC /WEATHER CONDITIONS AT THE TIME. IT IS ALSO ASSUMED THAT THE LOAD BEING TRANPORTED AND ANY BEAMS OR SUPPORT FRAMEWORK HAVE BEEN DESIGNED TO BE ABLE TO BE TRANSPORTED IN THE MANNER PROPOSED, AND THAT THE METHOD OF SECURING THE LOAD IS CAPABLE OF WITHSTANDING THE FORCES GENERATED DURING TRANSPORTATION.

L & A TALBOT SERVICES LTD. CANNOT BE HELD RESPONSIBLE FOR OPERATOR ERROR, INCLUDING ALL THE ABOVE, AND ESPECIALLY, BUT NOT LIMITED TO, EXCESSIVE SPEED FOR THE CONDITIONS AT THAT POINT IN TIME.

REV No.		BY	DATES
A	ISSUED FOR COMMENT	LT	29/03/22

SCALES		
1:100 1:200	DESIGN: - B LAY	MAR 22
	DRAWN: - L.D.T	MAR 22
	CHECK: -	-

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L & A Talbot Services Ltd

PROJECT
INSTALL 150 TONNE
225 MVA TRANSFORMER
AT RYE PARK WINDFARM SUBSTATION

TITLE
PROPOSED TRANSPORT CONFIGURATION #2

DRAWING No.	REV
2666/D3/102	**A**

Claris CAD 2.0v3

Appendix I – Transformer Route Images



Location – National Highway A8



Railway Underpass – National Highway A8



Railway Underpass - National Highway A8



Swanport Bridge – National Highway A8



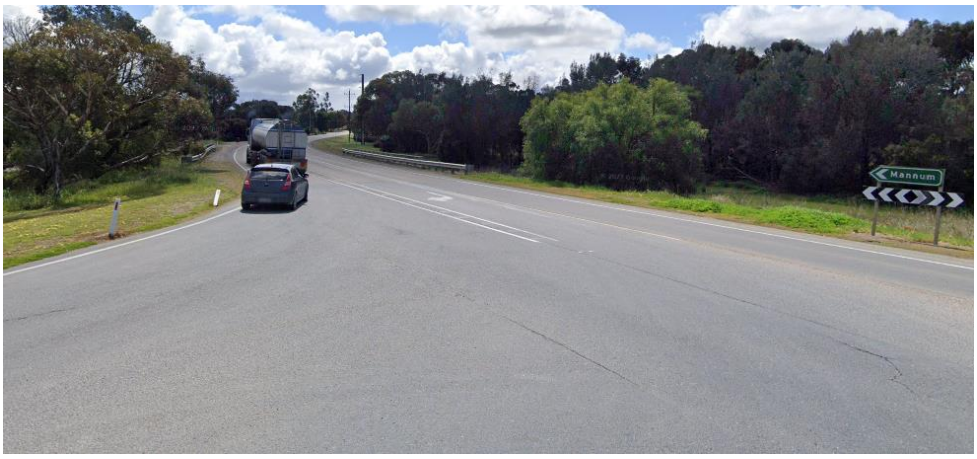
Overpass – Murray Bridge Overpasses



Location – Hindmarsh Road near Murray Bridge



Location – Maurice Road to Cypress Terrace Intersection



Location – Cypress Terrace to Mannum Road Intersection



Location – Mannum Road on Reedy Creek Bridge



Location – Mannum Road to Randell Road Intersection

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