APPENDIX A

AREA Environmental & Heritage Consultants ABN: 29 616 529 867

- ✓ Environmental impact assessments and approvals: REFs, MW REFs, PEAs
- ✓ Ecology, Aboriginal and historic heritage assessments
- ✓ Biodiversity assessment method (BAM) assessments (BDAR) and offsetting (BSSAR)
- ✓ Commercial landscape architecture and designs for built or natural environments
- ✓ Commercial landscape rehabilitation designs for built or natural environments
- ✓ Expert Witness
- ✓ Plans of Management
- ✓ Aboriginal community engagement
- ✓ Stakeholder and community engagement
- ✓ Peer review / project briefs / budgeting
- ✓ Vegetation Management Plans

ASM Australian Strategic Materials

Australian Strategic Materials, Dubbo Project

Pink-tailed Worm-lizard Monitoring Report

Dubbo Regional LGA NSW

May 2024

AREA - Biodiversity | Heritage | Landscape Design
"The Old Macquarie Brewery" c1876, 72 Brisbane Street, Dubbo, NSW, 2830
w: www.areaenvironmental.com.au
Instagram: areaenvironmental

AREA acknowledge Traditional Owners of the country on which we work

Table of contents

FIGURES

TABLES

1. INTRODUCTION

Pink-tailed Worm-lizard (PTWL) *Aprasia parapulchella* is listed as vulnerable under the Commonwealth *Environment Protection Biodiversity & Conservation Act 1999* (EPBC Act) and the NSW *Biodiversity Conservation Act 2016* (BCA Act).

Roof tile (artificial habitat) monitoring and targeted searches of natural habitat was carried out by Phil Cameron, Tom Carter on 24 April 2024 dates and Dylan Chew on 22 May 2024 from AREA Environmental & Heritage Consultants.

This monitoring program is underpinned and implemented in accordance with the PTWL Plan of Management (OzArk 2016). The Dubbo Project (DP), operated by Australian Strategic Materials continues to oversee PWTL the monitoring program.

Assessment guidelines for detecting the species has changed since the species was first recorded on the property in 2001 (Goldney 2002). Currently the NSW Bionet Atlas Threatened Biodiversity Database Collection recommends survey to occur from September to November (Spring). Monitoring since the species was detected has occurred over many months of the year but mainly March (Autumn) when climatic conditions best suited their detection. Threatened reptiles - Biodiversity Assessment Method survey guide 2022 proposes the following survey methodology for the species:

Method

Habitat surveys consist of diurnal rock searches undertaken by turning over suitably sized rocks in areas of suitable habitat. When turning rocks, ensure careful re-placement to maintain the seal between rock and ground as failure to do this is highly detrimental to species dwelling under rock surfaces.

Turn over a minimum of 200 suitably sized rocks for every 5 ha of suitable habitat (Jones 1999; Osborne et al. 1991). Suitably sized rocks are approximately:

- 300 mm wide and 50 mm deep (Wong et al. 2011)
- 100–150 mm wide, 120–220 mm long, 50–150 mm deep (Jones 1999)

Undertake surveys in the 2 hours after sunrise and 2 hours before sunset on sunny days (<50% cloud cover). This ensures a suitable thermal environment is present for the species to be sheltering under rocks at the time of survey. Cease surveys once temperatures exceed 25°C, as the species will move deeper underground where it is not detectable (Osborne et al. 1991; Jones 1999).

Suitable habitat

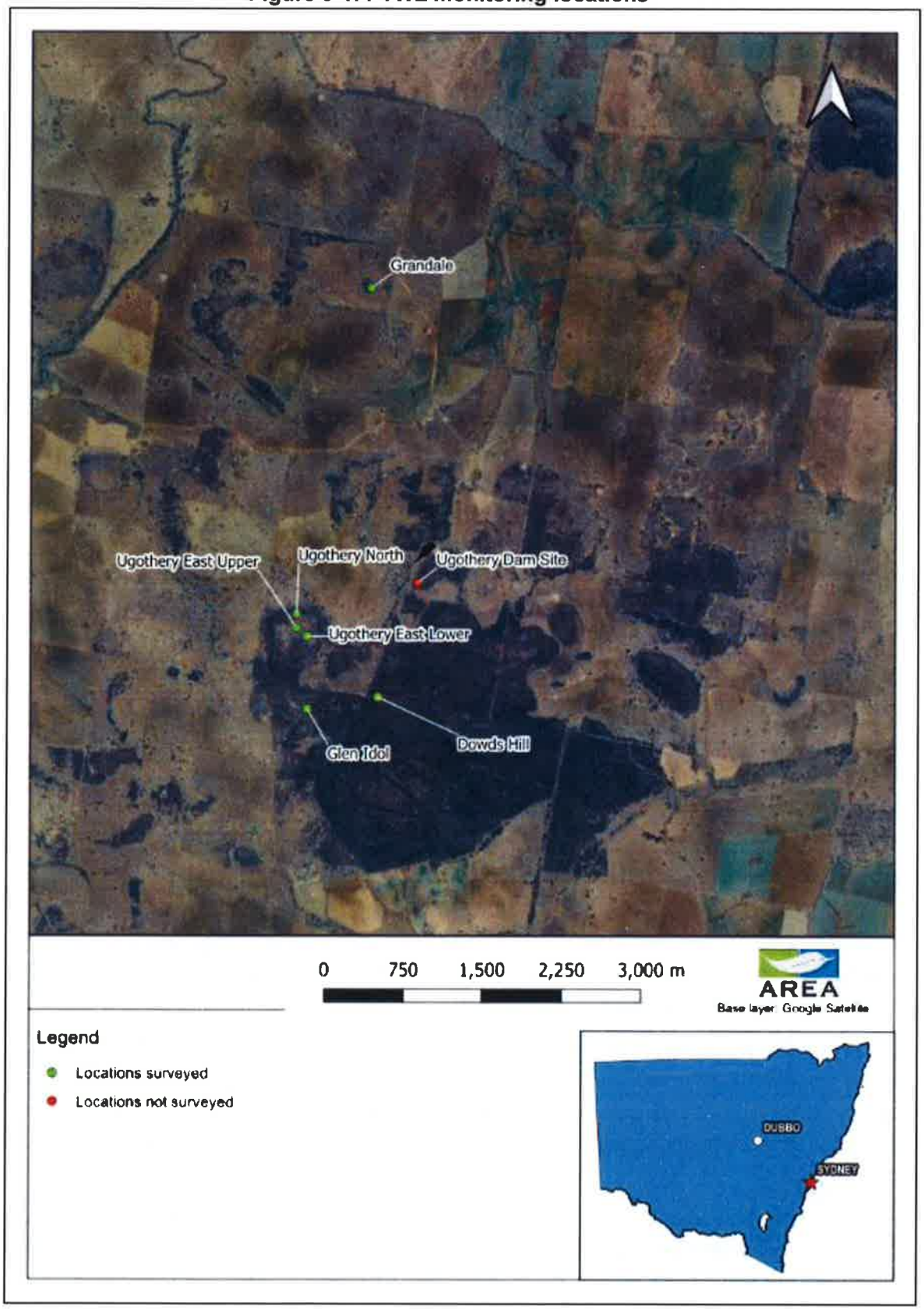
Rocky areas (or within 50 m of rocky areas) located within plant community typed associated with the species in the Threatened Biodiversity Database Collection.

Species polygon

Map the species polygon to the full extent of all suitable habitat on the subject land.

Majority of the 2024 surveys occurred in April and the Grandale site was surveyed in May 2024 when ambient temperatures and preceding rainfall events were suited for their detection. The project usually involves monitoring at seven locations: Glen Idol, Ugothery North, Ugothery East Lower, Ugothery East Upper, Ugothery Dowds Hill, Grandale and Ugothery Dam Site. Figure 0-1 shows the location of the monitoring locations surveyed. Ugothery Dam site was not surveyed in the 2024 monitoring event as this location is deliberately left alone for periodic checking (once every five years) to see if frequency of monitoring / tile disturbance affects detectability of the species.

Figure 0-1: PTWL monitoring locations



2. PTWL MONITORING

1.1 Background

The PTWL (Pink-tailed Worm Lizard) monitoring program assesses the habitat attributes of artificial roofing tiles as a proxy for the species' habitat. The primary objective of this program is to identify the key habitat features present in the artificial habitat (roof tiles), ascertain the frequency of species utilisation of these artificial habitats, and evaluate the feasibility of using this method to monitor PTWL populations. The overarching research question pertains to the viability of employing artificial tiles as ecological land bridges to link otherwise isolated PTWL populations or to expand their occupancy within suitable habitat areas.

Monitoring the PTWL poses challenges due to its cryptic behaviours, as it typically resides within ant burrows. While PTWL can be located year-round by searching beneath rocks, detecting them becomes more challenging during periods of high temperature and low humidity (Osborne et al., 1991). Extreme temperature conditions, whether excessively hot or cold, which are typical Dubbo weather environs, lead the PTWL to retreat below the ground surface within ant burrows beneath rocks. The species' detectability is favoured within ambient temperature ranges between 20 degrees Celsius and 35 degrees Celsius a few days after inundating rainfall (P. Cameron, personal communication, 2017).

Although the species' ecological behaviours remain poorly understood, peak activity is expected to occur in late spring and early summer, characterised by warm yet adequately humid conditions. During this period, the lizards relocate to the upper periphery of ant burrows, allowing them to regulate their body temperature by basking against the warm underside of rocks (Osborne et al., 1991; Jones, 1999). In Dubbo, most positive sightings of the species have been in Autumn but in the same preceding climatic conditions.

The PTWL is generally inactive on the ground surface during the day, and its activity is primarily restricted to moving between sheltering sites during nighttime. Weather conditions, and the natural boom/bust population dynamics of the species plays a role in detection of the PTWL. The species is expected to boom after inundating rains and to bust when dryer, hotter seasons occur (Swan pers comm 2020). Dry and hot conditions are attributed to low detection rates.

Strong winds, rain or overcast skies may also attribute to low detection rates (DSEWPC, 2011). Time of day also has an effect; diurnal surveys are best conducted between 10 am to 4 pm (DSEWPC, 2011) which differs from DECCW guidance where to undertake surveys in the two hours after sunrise and two hours before sunset on sunny days (<50% cloud cover).

Moreover, the observed timeframe during which species identification is attainable remains confined to seasonal convergence spanning from March through to October/November. Given the limitations imposed on detection by these variables, an accurate representation of population density and dispersion emerges when surveys align with favourable climatic

conditions. These conditions involve antecedent[1] saturating rains and moderate temperatures coinciding with the recognised periods of identification. Achieving this synchronicity necessitates a flexible approach in terms of timing, survey frequency, and the count of locations surveyed. This flexibility is imperative to ensure that conducive weather conditions are in place.

Cameron (personal communication, 2022) acknowledges the substantial veracity of the abovementioned points. However, in the context of Toongi, he notes an additional observation. Specifically, the species has been sighted during early mornings in late summer amid severe drought conditions. This occurrence underscores the intricate influence of minute variations in soil and rock temperatures on the species' detectability, potentially outweighing the significance of seasonal considerations.

Cumulatively the PTWL is challenging to detect as there is no reliable detection predictive model and if one was developed it is likely to vary between IBRA subregions (per com Cameron 2024).

1.2 Methods

To ensure the surveys took place under optimal conditions, they occurred on days suitable for their detection. This monitoring program evaluated artificial tile habitats established in 2013. These locations encompass a total of 50 roof tiles distributed across 10 distinct sets. Each set comprises a cluster of four tiles, juxtaposed with a lone tile. This arrangement is designed to discern whether a group of tiles offers a higher likelihood of serving as PTWL habitat compared to individual tiles. The specific configuration of this set-up is illustrated in Plate 2.1.

The surveys occurred on 24 April 2024, between 10am and 2pm, and 22 May 2024, between 2:30pm and 3:30pm. They took place on clear days, after suitable rainfall had occurred and where under tile soil surface temperatures were between 20 degrees Celsius and 32.3 degrees Celsius (a suitable detection range). The survey involved checking under approximately 250 tiles as well as opportunistically under natural rocks at the following locations:

- Ugothery North
- Ugothery East Lower
- Ugothery East Upper
- Ugothery Dowds Hill
- Glen Idol
- Grandale

The remaining site, Ugothery Dam, was not surveyed during the 2024 monitoring event. Data collected for each set consisted of:

- Date and time of assessment
- Ambient air measured with a handheld kestrel weather station
- Soil temperature measured with a handheld laser device
- Number of ant species and burrows present

[1] preceding in time or order; previous or pre-existing

- Other insects (type/abundance)
- Other reptiles (species/abundance)
- General comments
- Photos were also taken where appropriate.

Plate 0-1: Tile set configuration

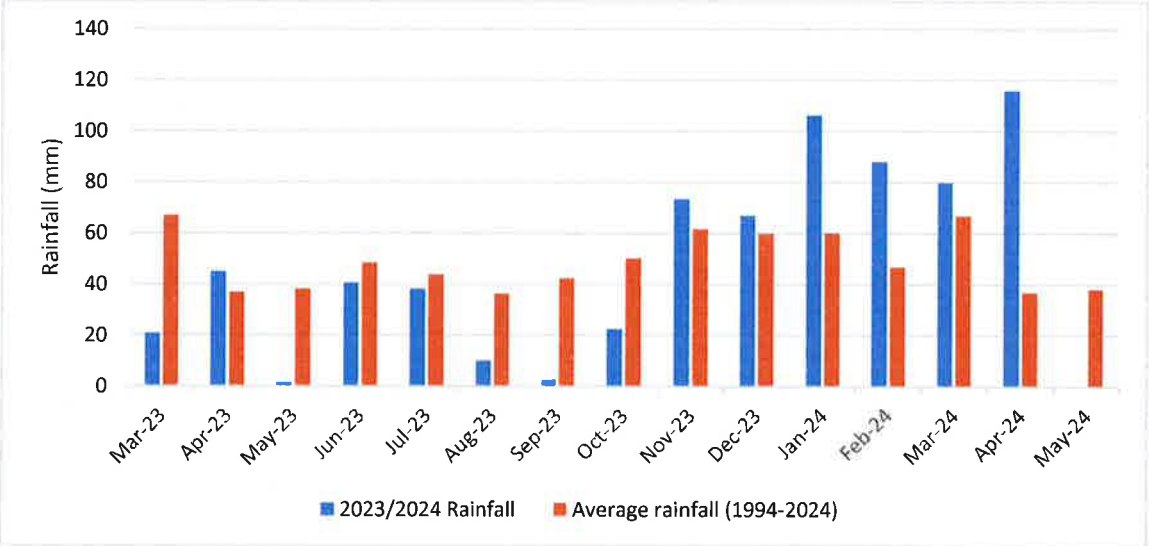
3. WEATHER

1.3 Preceding weather conditions

The closest weather monitoring station as per the Bureau of Meteorology (BoM) website is situated at Dubbo Regional Airport, approximately 25 kilometres to the north of the DP location (Toongi).

Dubbo's average annual rainfall stands at 582.8 millimetres (BoM, 2024) and as of May 2024, Dubbo has experienced 390.4 millimetres (BoM, 2024). Rainfall during April 2024 far surpassed average rainfall with 116 millimetres and while entire data was not available for May at the time of writing this report, it had already surpassed the monthly average. Figure 3.1 illustrates the cumulative rainfall leading up to the survey, comparing these values to historical monthly averages.

Figure 0-2: Dubbo Regional Airport AWS monthly rainfall averages and 2023/2024 rainfall totals (BoM)



In comparison, the previous 'boom' event, documented through monitoring in 2012 and 2013, witnessed a total of 30 PTWLs, occurring beneath naturally formed rocks after years marked by above-average rainfall (577.2 millimetres in 2011 and 608.6 millimetres in 2012). In 2021, the rainfall significantly surpassed the cumulative figures for both 2011 and 2012.

Monthly rainfall statistics from the Dubbo Regional Airport AWS, obtained via the BoM website, are presented in Table 3.1. The inundating rains of 2021 and 2022, following a severe drought period, substantially increased the likelihood of detecting PTWLs (P. Cameron, personal communication).

The total rainfall in April 2024, far surpassed the monthly average of 39.5 millimetres. Two weeks prior to the survey, there was a total of 2.2 millimetres of rain detected at the Dubbo

Regional Airport AWS. At the time this report was written, May also had slightly higher than average rainfall, with a total of 24 millimetres of rain being recorded within two weeks of the survey date.

Table 0-1: Dubbo Regional Airport weather average rainfall (BoM)

Year	Jan (mm)	Feb (mm)	Mar (mm)	Apr (mm)	May (mm)	Jun (mm)	Jul (mm)	Aug (mm)	Sep (mm)	Oct (mm)	Nov (mm)	Dec (mm)	Annual (mm)
1994						4.0	51.0	15.0	8.8	20.0	46.8	20.2	
1995	191.0	7.0		0.6	102.2	13.0	31.2	0.4	52.0	24.4	94.8	58.0	
1996	97.2	30.2	20.6	0.2	74.2								
1997						17.2	23.2	13.8	78.2	30.8	11.4	37.2	
1998	48.0	31.0	10.0	84.4	75.4	82.4	138.0	151.6	111.6	46.4	66.6	5.6	**851.0**
1999	7.4	9.0	142.2	38.6	8.6	36.6	45.0	75.6	40.2	109.2	68.8	77.2	**658.4**
2000	35.0	25.6	173.8	105.8	86.8	18.4	28.4	29.4	11.6	77.4	181.8	35.0	**809.0**
2001	60.2	14.6	77.8	44.8	43.4	59.4	92.0	19.6	31.0	69.0	74.4	25.0	**611.2**
2002	13.2	218.2	27.0	17.4	17.2	14.6	4.0	2.8	42.8	3.0	0.0	21.6	**381.8**
2003	41.2	77.4	18.8	60.0	4.2	52.2	37.0	115.4	8.6	67.0	35.8	26.2	**543.8**
2004	23.6	45.6	13.2	22.0	46.8	44.4	38.2	30.4	10.2	50.6	79.4	65.0	**469.4**
2005	36.0	25.6	15.0	9.6	5.0	91.0	29.4	18.8	81.8	112.0	92.6	15.2	**532.0**
2006	37.4	29.0	24.0	10.8	0.6	35.0	39.2	14.4	9.2	1.2	10.6	17.2	**228.6**
2007	*11.6*	*24.6*	*48.2*	*26.6*	*61.6*	*122.0*	*11.2*	*20.2*	*0.6*	*2.6*	*67.4*	*169.4*	**566.0**
2008	*153.2*	*43.2*	*27.4*	*1.4*	*7.2*	*32.0*	*31.0*	*33.6*	*63.8*	*58.6*	*110.0*	*49.2*	**610.6**
2009	*3.8*	*59.0*	*16.2*	*57.2*	*10.0*	*67.4*	*25.0*	*10.0*	*35.2*	*54.0*	*12.8*	*188.8*	**539.4**
2010	*25.6*		*69.6*	*62.2*	*54.6*	*34.2*	*64.4*	*58.4*	*51.8*	*54.0*	*144.0*	*167.6*	
2011	*8.6*	*37.8*	*49.4*	*28.4*	*60.0*	*11.2*	*8.4*	*59.8*	*81.8*	*55.4*	*101.6*	*74.8*	**577.2**
2012	*98.0*	*118.0*	*125.0*	*1.6*	*85.4*	*41.6*	*44.6*	*9.8*	*31.6*	*9.4*	*38.2*	*5.4*	**608.6**
2013	*63.4*	*27.8*	*80.8*	*0.4*	*27.0*	*126.0*	*23.2*	*5.4*	*83.2*	*5.2*	*3.0*	*47.6*	**493.0**
2014	*49.8*	*50.8*	*142.4*	*57.8*	*26.8*	*57.6*	*55.6*	*15.4*	*15.6*	*11.6*	*11.2*	*77.0*	**571.6**
2015	*130.6*	*31.8*	*8.4*	*81.8*	*47.8*	*72.2*	*60.2*	*39.4*	*6.8*	*46.4*	*66.6*	*59.6*	**651.6**
2016	*122.8*	*3.2*	*16.2*	*25.0*	*55.4*	*151.6*	*105.2*	*50.4*	*157.8*	*56.2*	*34.0*	*138.6*	**916.4**
2017	*14.8*	*1.6*	*223.0*	*9.4*	*5.2*	*9.2*	*3.0*	*20.6*	*5.0*	*84.6*	*34.8*	*54.2*	**465.4**
2018	*28.6*	*2.4*	*4.0*	*6.8*	*13.0*	*18.6*	*1.6*	*36.4*	*6.8*	*90.4*	*68.6*	*34.4*	**311.6**
2019	*64.4*	*18.4*	*46.8*	*0.0*	*23.4*	*10.4*	*6.4*	*6.8*	*11.0*	*1.6*	*19.4*	*2.6*	**211.2**
2020	*36.0*	*81.8*	*145.0*		*28.8*	*32.6*	*82.2*	*39.0*	*47.6*	*60.6*	*12.6*	*120.6*	
2021	*54.0*	*114.4*	*187.2*	*1.8*	*21.0*	*93.8*	*91.8*	*34.0*	*36.8*	*35.4*	*180.8*	*73.4*	**924.4**
2022	*130.0*	*41.0*	*56.4*	*191.2*	*75.8*	*12.8*	*58.6*	*112.2*	*104.8*	*195.8*	*43.8*	*6.4*	**1028.8**
2023	*50.6*	*53.4*	*20.8*	*45*	*1.6*	*40.6*	*38.2*	*10*	*2.6*	*22.6*	*73.4*	*67*	**425.8**
2024	*106.2*	*88.2*	*80*	*116*									

Temperatures two weeks prior to the April surveys, 10 to 23 April 2024, had a minimum temperature of 8.21 degrees Celsius and maximum temperature of 23.64 degrees Celsius. Temperatures two weeks prior to the May surveys, 8 to 21 May 2024, had a minimum temperature of 7.46 degrees Celsius and maximum temperature of 20.18 degrees Celsius.

Figure 0-3 and figure 3-3 depict the minimum and maximum temperatures for April and May 2024.

Figure 0-3: Dubbo Regional Airport maximum and minimum temperatures for April 2024

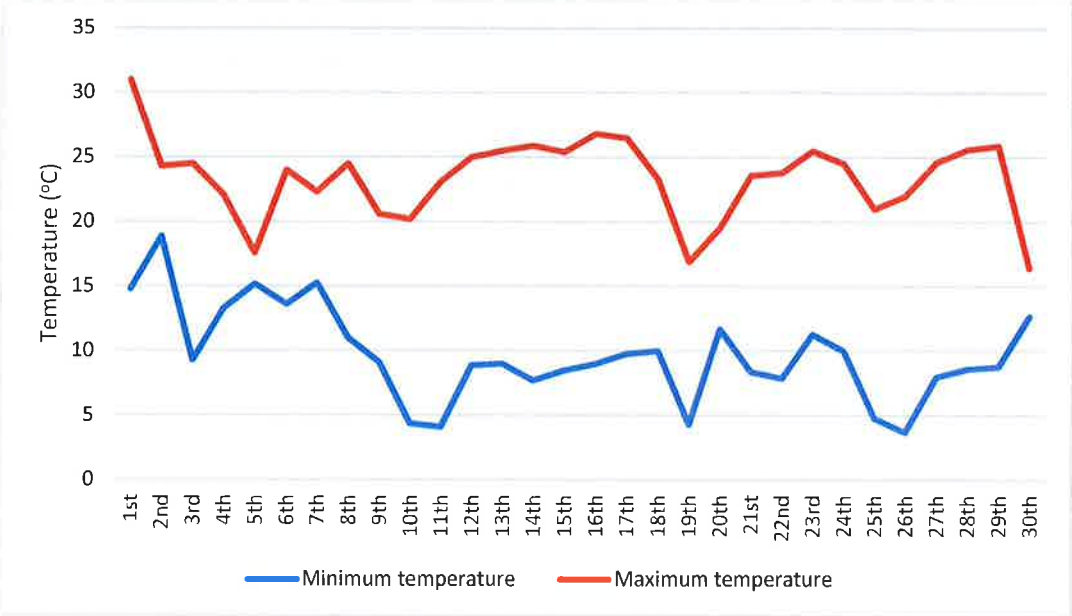
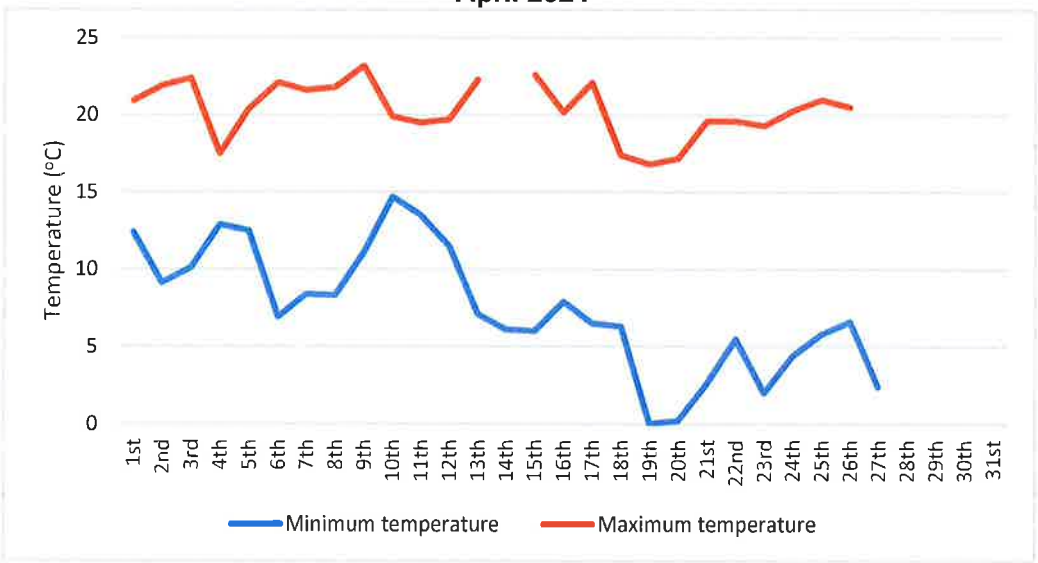


Figure 0-3: Dubbo Regional Airport AWS maximum and minimum temperatures for April 2024



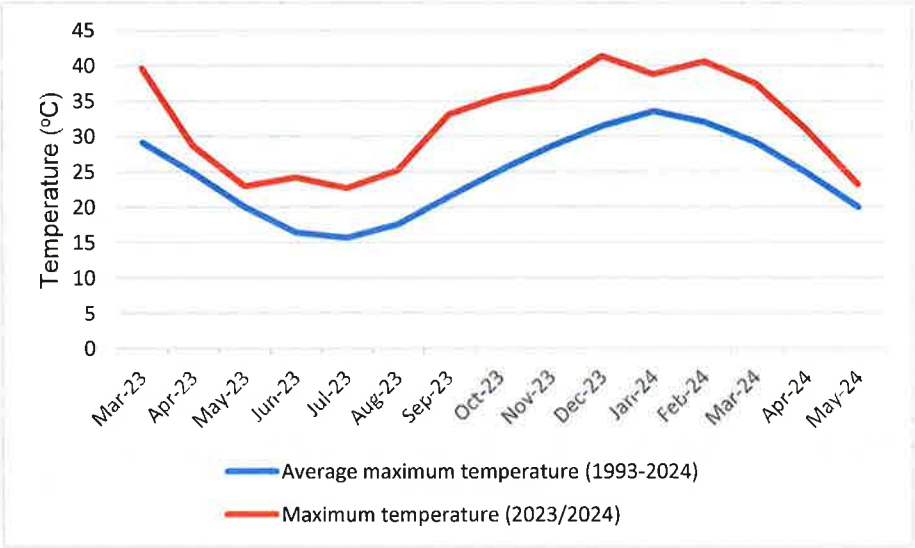
1.4 Weather conditions on day of surveys

For the April survey weather conditions were fine and warm (ambient temperature between 20 to 24 degrees Celsius). The average under tile soil surface temperature on site was 26.85 degrees Celsius. The highest under tile soil surface temperature recorded during

monitoring was 32.3 degrees Celsius at Ugothery Lower East at 1:36pm, and the lowest under tile soil surface temperature recorded on site was 22.6 degrees Celsius at Glen Idol at 10:50am. For the May Survey, weather was clear with no rain occurring and ambient temperature data was averaged to 20 degrees Celsius for every site.

The highest temperature recorded at Dubbo Regional Airport AWS during April 2024 was 31 degrees Celsius, which was higher than the monthly average of 24.8 degrees Celsius. At the time of writing, the highest recorded temperature in May was 23.2 degrees Celsius, slightly higher than the monthly average. The maximum monthly temperatures for 2023/2024 preceding the surveys have also been higher than the historical monthly averages (Figure 0-4).

Figure 0-4: Dubbo Regional Airport AWS 2023/2024 maximum averages & monthly maximum temperature averages.



4. SOIL PARAMETERS

1.5 Soil type and geology

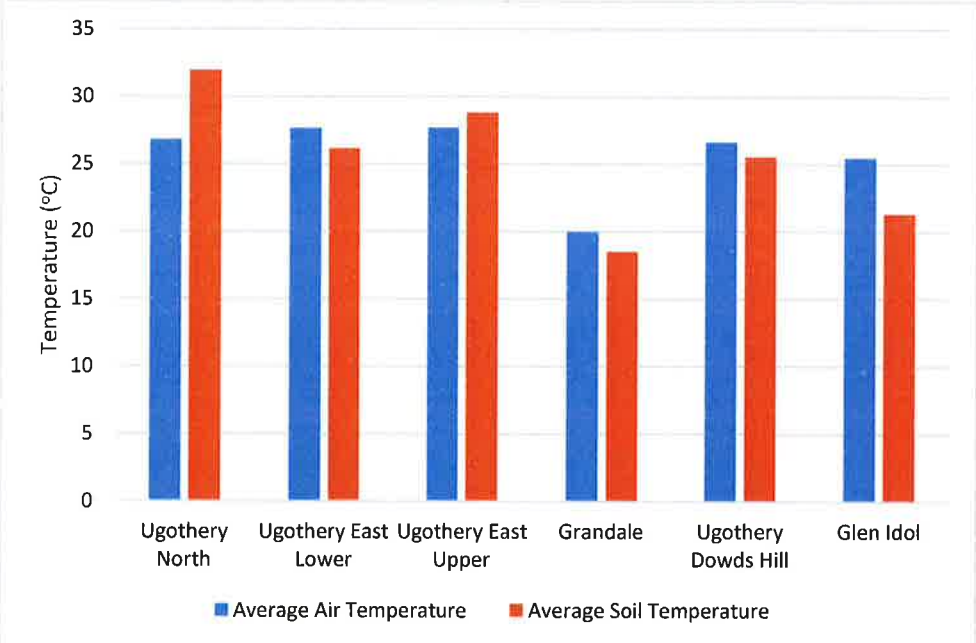
Subsequent data collection within this region did not occur. Pre-existing determinations have been made regarding soil type and underlying geological composition. Further enhancement of soil and geological insights can be achieved by investigating these aspects during forthcoming surveys. This endeavour will contribute to a more comprehensive understanding of the interplay between these factors and the habitat selection patterns of PTWLs.

1.6 Soil temperature

Air temperature was recorded at each tile set as well as soil surface temperature under each set of tiles. The soil temperature ranged from 12.5 degrees Celsius to 44.9 degrees Celsius. The lowest soil temperature occurred when ambient air temperature was 20 degrees Celsius at 2:54 pm at Grandale and the highest soil temperature occurred when ambient air temperature was 27.7 degrees Celsius at 12:32 pm at Ugothery North.

On average most locations during the 2024 surveys recorded ambient air temperature higher than the soil temperature. Soil temperature was mostly in the ideal range (between 20 to 30 degrees Celsius) for the PTWL with an average of 25.38 degrees Celsius. The averages of soil temperature and air ambient temperatures across all monitoring sites surveyed in 2024 are shown below in Figure 0-4.

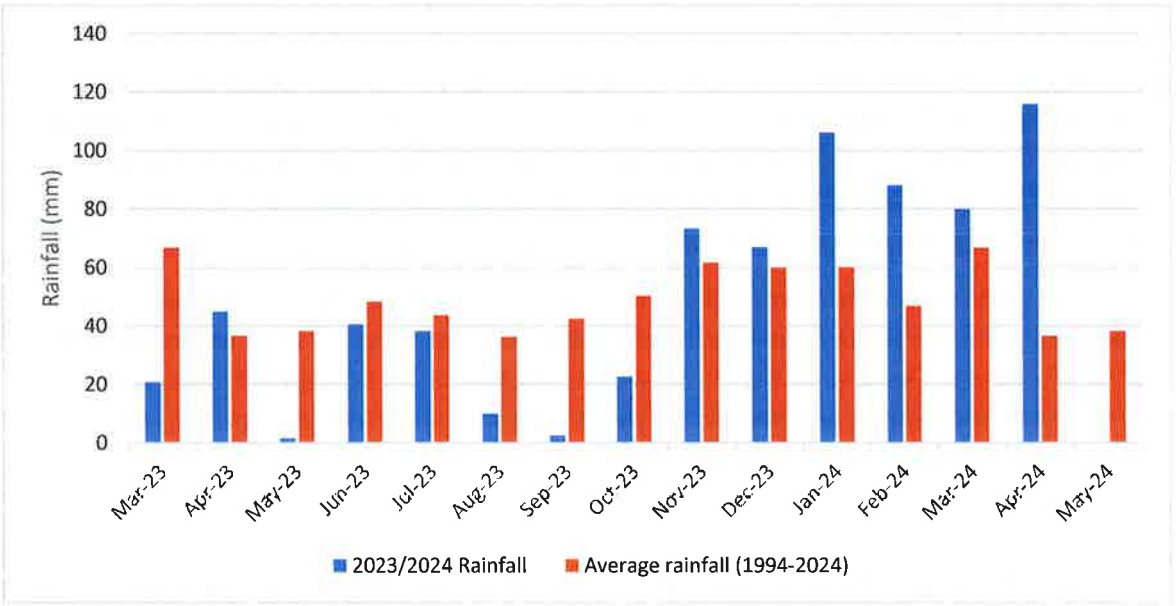
Figure 0-4: Average temperatures of air and soil at sites (Ugothery dam site absent)



1.7 Moisture

A total of 75 sets of tiles, either solitary or group, were found to be moist, leaving 33 sets as dry and 32 sets unrecorded[2]. In the two weeks preceding the April and May surveys, a cumulative rainfall of 2.2 and 24 millimetres were recorded respectively. Notably, April received a total of 116 millimetres, an amount much greater than the average monthly rainfall. Despite this, the ground was overall moist. Monthly rainfall is depicted in Figure 4-2.

Figure 0-5: Rainfall preceding the 2024 survey period



[2] Unrecorded usually reflects the tiles had been disturbed by feral pigs.

5. FLORA

During the 2024 monitoring program above average density and diversity of flora reflecting the favourable last 24 months of weather was observed. Examples of flora density at two of the monitoring sites is shown in Plate 0-2 and Plate 0-3.

Plate 0-2: Ugothery East Lower monitoring site

Plate 0-3: Glen Idol monitoring site

Flora diversity and overall habitat has improved due to livestock removal and fencing of the biodiversity offset area. Natural regeneration was exceptional across grasslands, although several trees on thin skeletal soils died in the severe drought due to severe drought conditions between 2017 until late Summer 2020.

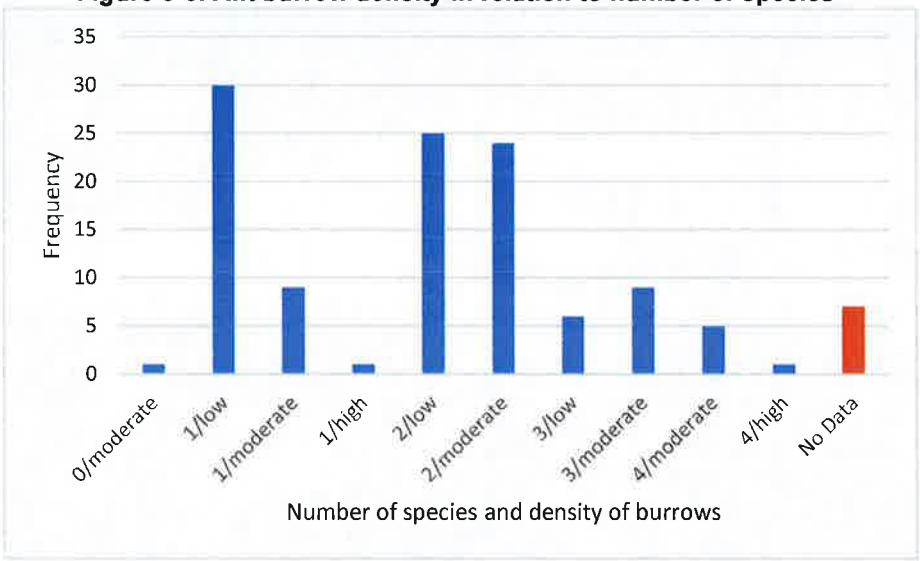
Plate 0-3: Drought affected Callitris and *Allocasuarina sp.* 24 April 2024.

6. FAUNA

1.8 Ants

Ants were assessed by the number of burrows and species. Individual ant or species identification did not occur. Ant burrow density was grouped into three categories. Low = less than five burrows, med = five to eight burrows, high = greater than eight burrows. Figure **0-6** depicts the relationship between ant burrow density and number of ant species. "No data' occurred when feral pigs had recently disturbed the tiles.

Figure 0-6: Ant burrow density in relation to number of species



In 2024, ants were present under 93 per cent of tiles. While down from last year's 97 percent, this is a very high level of occurrence to date. In 2020, 54 per cent of tiles were found with ants and 22 per cent with ant burrows. Ant populations have continued to increase since the cessation of drought. During periods of low rainfall ant numbers were low. Ants were found under 34 per cent of tiles in 2018 (2018 annual rainfall was 311.6 millimetres). Previous years with above average rainfall have seen large increases in populations. In 2016 ants were present under 90 per cent of tiles and 94 per cent in 2014.

The large per cent of occurrence of ants under tiles is an indication of food being readily available for the PTWL. Plate 0-4 displays ant burrows, ant eggs and spider web under a surveyed tile.

Plate 0-4: Ant burrows, ant eggs underneath artificial habitat

1.9 Other invertebrates

Other invertebrates were recorded under 35.8 per cent of the tiles, a decrease from 51 per cent in the 2023 surveys for a similar number of monitoring sites surveyed. Beetles and evidence of beetles were the most common other invertebrate recorded, amongst termites, weevils, crickets, cockroaches, spiders, centipedes, mealworms and millipedes.

1.10 Reptiles and other vertebrates

A notable 19 sets of tiles were disturbed by pigs, mostly yielding no data. This is another increase from six sets in 2023 survey period, and four sets in the 2022 survey period.

Other reptiles or evidence of habitation were found under 11.6 per cent of tile sets, a decrease from 13 per cent in 2023. It seems that in years with higher rainfall, there are less

sightings of reptiles under tiles. This decrease could be the result of the significant amount of pig disturbed sites. See plate 6-2 for an example of a site disturbed by pigs.

Plate 6-2: Site disturbed by pigs at Ugothery East Upper

There were a range of species found under the tiles, including

- *Menetia greyii*, Plate 6-3, commonly known as the common dwarf skink or Grey's skink, is a species of lizard in the family Scincidae. The species is native to mainland Australia and Indonesia.,
- *Underwoodisaurus milii,* Plate 6-4, a species of gecko, a lizard in the family Carphodactylidae. The species is commonly known as the thick-tailed or barking gecko, referring to its distinctive plump tail and sharp, barking defensive call.
- The eastern striped skink (*Ctenotus robustus*) Plate 6-5, a species of skink found in a wide variety of habitats around Australia. They are long-tailed, fast moving skinks that are quite large, growing to a maximum length of about 30 cm (including the tail which can make up around 2/3 of its length) and
- Tiliqua rugosa, most commonly known as the shingleback skink or bobtail lizard, is a short-tailed, slow-moving species of blue-tongued skink (genus Tiliqua) endemic to Australia,

as well as two frog species,

- The desert tree frog (*Litoria rubella*), Plate 6-6, or little red tree frog, a species of tree frog native to Australia, southern New Guinea, and Timor. It is one of Australia's most widely distributed frogs, inhabiting northern Australia, including desert regions and much of temperate eastern Australia. It is one of the few Australian tree frogs to inhabit arid, tropical, and temperate climates
- The common eastern froglet (*Crinia signifera*) Plate 6-7, is a very common, Australian ground-dwelling frog, of the family Myobatrachidae.

Three sets of tiles had reptile burrows and one included an unidentified shed skin. There were no clear indications of reptiles preferring a certain soil temperature or if they prefer single or grouped tiles.

Plate 6-3: *Menetia greyii*

Plate 6-4: *Underwoodisaurus milii*

Plate 6-5: *Ctenotus robustus*

Plate 6-6: *Litoria rubella*

Plate 6-7: *Crinia signifera*

7. ISSUES AND SUGGESTIONS FOR FUTURE MONITORING EFFORTS

1.11 Climate considerations

The DP PTWL Management Plan (OzArk 2016) states the following:

> 'The PTWL appears to mimic the same 'boom and bust' detection rates as seen in many western area species of fauna (P. Cameron, pers. comm.). This observation was supported by Gerry Swan (reptile expert) who also has experience with the species (pers. comm.). In favorable seasons, i.e., not long after inundating repetitive rains, 'many' (in context with the population) PTWL will be recorded with the recommended survey effort (P. Cameron pers. comm). This may be followed by subsequent hotter and dryer seasons when few or no PTWL recorded. Evidence available suggests this pattern follows a ten-year cycle related to approximately 10-year interval high rainfall events (P. Cameron and Gerry Swan pers. comm)'.

The last 'boom' was recorded when targeted surveys were undertaken in 2012 and 2013 by Biosphere Environmental Consultants Pty Ltd (Biosphere) and 30 PTWLs (in total) were found in sites within a five-kilometre radius of the DP impact footprint. All records were associated with natural rock.

Since then, the area has been through a severe hot and dry 'bust' cycle and a severe wet cycle, but few PTWL have been recorded[3]. Rainfall has been well above average since 2020 creating favourable conditions for a 'boom', cycle.

The large rainfall event of 2016 could have inhibited a boom from occurring due to burrow inundation. Since 2020 larger than average annual rainfalls have been occurring. The highest annual rainfall total was recorded in 2022, where a similar annual rainfall total was observed in 2016. Despite the above average rainfall, burrow inundation was not observed in either 2022 or 2023.

The repetitive nature of the current inundating rains may facilitate a boom for the PTWL population. The climate has allowed for native grasses and food (ants) to become abundant. This fits in well with the hypothesised 10-year cycle as the last boom occurred in 2012-2013.

The survey conditions were cooler in 2024 than in 2023, mostly due to the 2024 surveys taking place later in the year. However, the range in soil temperatures were consistent with April surveys ranging from 14.5 degrees Celsius to 44.9 degrees Celsius under tile temperatures, and May surveys ranging from 12.5 degrees Celsius to 25.1 degrees Celsius under tile temperatures.

No 'wet' burrows were detected during the 2024 monitoring period, as the last large rainfall event occurred more than two weeks prior to the survey. A full dataset was not formed but the recommended survey effort for PTWL was reached.

[3] Primarily as monitoring has occurred under roof tiles, not natural rock which are opportunistically checked.

1.12 Artificial habitat considerations

Previous research indicates preferences for artificial reptile habitats can vary among species and different designs. Reptiles exhibit a discerning approach when selecting retreat sites, considering multiple facets of their environment. They make subtle distinctions among available retreat sites based on factors like structural and thermal attributes, the presence of conspecifics or competitors, and the perceived risk of predation (Thierry et al., 2019).

The April surveys followed heavy rainfall earlier in the month, which should be favourable conditions for the PTWL. The monthly temperatures of 2023 were considerably higher than those of 2022. Monthly temperatures of 2024, so far, have matched 2023, resulting in more variable soil temperatures under the artificial tiles. This continues to suggest that these tiles might only offer brief periods of habitat suitability for the PTWL. The tiles tend to be less insulated, meaning they heat up and cool down faster compared to natural rock.

Since the introduction of the roof tiles in 2013, two instances of PTWLs being recorded under artificial habitat tiles have been documented. While the species is cryptic in nature, this might indicate these tiles serve as habitats but with very limited periods of suitability.

It can be assumed that, given the option, the PTWL will consistently prefer natural habitats over artificial ones, meaning natural rock might remain irreplaceable. According to the PTWL Plan of Management, prior to the construction of DP's impact footprint, loose surface rocks suitable for PTWL habitats will be gathered and relocated to offset areas. In the interim, the management focus centres on passive translocation and the improvement of habitat quality.

A study by (Milner, 2024) found that 2-3 years post treatment, artificial habitat, in this case house bricks, had colonisation of PTWLs similar to that of natural rock structures. However, in this monitoring effort, the PTWL has failed to colonise the artificial structures provided over a 10-year period. An alternative to artificial habitat, would be to set up plots of natural rocks, similar to the methods of (McDougall, 2016). In their study, the PTWL colonised plots of natural rocks within one year of treatment. (Milner, 2024) suggests that using and flipping rocks during surveys may damage the microenvironment and that if artificial habitats are suitable, then rock flipping should be avoided.

The last observation is exacerbated by in influx of feral pig populations in regional NSW which on site had resulted in tile and natural rock disturbance levels higher than observed in preceding years (Note: the landholder has active feral pig control; the regional population is problematic).

It's likely the roof tiles are unsuitable artificial habitat because:

- they heat up and cool down too quickly
- the act of annual monitoring is damaging the microenvironment
- Feral pigs are having a cumulative impact to damaging the microenvironment

In summary, artificial habitats are not working at this site and other options should be explored.

1.13 Native vegetation habitat

The DP PTWL Management Plan (OzArk 2016) states the following:

'The overarching performance target is to increase the area of occupancy for PTWL by restoring native vegetation, connecting adjoining populations though rehabilitated corridors) and providing natural or artificial rock/tile habitat.

The quality of PTWL habitat in DP was assessed on the EPBC Offset Calculator as:

- *30ha of low condition habitat (quality score = 4/10).*
- *113.6ha of moderate condition habitat (quality score = 7/10).*
- *80.9ha of good condition habitat (quality score = 9/10).*

In practical terms the goal will be to achieve a quality score of 8 or higher in all PTWL Habitat Areas within 5 years'.

Since conception of the PTWL Management Plan in 2016, the region has been through four significant events impacting the quality of habitat within DP:

1. Exclusion of grazing and fencing of the biodiversity offset area (positive)
2. An extreme drought (negative).
3. Reprieve from drought because of well above average rainfalls (positive).
4. Impact from feral pig populations (negative)
5. The act of annual monitoring is damaging the microenvironment (negative)

Habitat re-assessment would be extremely valuable to consider how habitat quality is trending in relation to these significant events.

8. CONCLUSIONS

During the 2024 surveys, no PTWLs were identified, and no evidence of presence was recorded. Opportunistic rock flipping also did not identify any PTWLs. However, a diverse range of reptiles were observed. A total of four lizard species were identified, along with two frog species. The artificial habitat, as a refuge, offers limited windows of suitability for PTWLs. Since the inception of the survey program in 2013, only three instances of PTWLs under tiles have been recorded.

This year's surveys had a further increase in pig disturbance, with 15.8 per cent of the tile sets being impacted. Therefore, ongoing targeted pest control measures should be consistently implemented to mitigate the risk of disruption to sites between survey events.

Numerous converging factors are currently favouring the PTWL. Should a population surge occur, it would provide additional evidence supporting the PTWL's boom-and-bust cycle, which appears linked to high rainfall events recurring at approximately 10-year intervals. Total rainfall in 2024, as of May, has been well above average and the effects of the substantial rainfall events of 2021 and 2022 are still being observed with the recovery of native grasses at the monitoring sites. This recovery has been aided by the exclusion of livestock from the biodiversity offset area and effective land management by the Proponent.

The trend of increasing ant populations also raises the probability of a PTWL population boom due to an increase in food sources. Along with favourable climatic data and a high number of tile sets with retained soil moisture, these factors contribute positively to the potential for a population surge. However, it is yet to be observed. This may suggest that the use of artificial tiles is not an effective option for PTWL management due to their rapid heat up and cool down properties and that natural rocks are a more suitable habitat and annual monitoring of these tiles is affecting their microhabitats.

Given the recent climatic conditions resulting in well above-average rainfall, future surveys under natural rock will yield insights into the impact of such abundant rainfall on PTWL populations. Additionally, these surveys will contribute to the understanding of other reptile populations within the area. Future survey efforts should focus on comparing detection rates of the PTWL beneath natural rock versus under tiles, examining both concurrently, as it is suspected that the detection results under natural rock would yield higher rates in the monitoring area.

9. RECOMMENDATIONS

1. Discontinue annual tile monitoring as it is likely the habitat attribute is unsuitable, and the activity affects microclimate for PTWL.
2. Continued targeted surveys for PTWL in the biodiversity offset area are strongly recommended, but not under tiles, they would be in under natural rock in areas they were detected in 2016 which have not since been disturbed.
3. Surveys under natural rock would follow the latest NSW BioNet database collection guidance.
4. Start collecting and moving natural rock form the deposit area and use them to seed vacant grasslands adjoining to the north.

References

(DSEWPC) Department of Sustainability, Environment, Water, Population and Communities. (2011). Survey Guidelines for Australia's threatened reptiles. Australian Government

Bureo of Meteorology. (2022). Climate Statistics for Dubbo Regional Airport.

AREA (2018) *Pink-tailed Worm-lizard monitoring report* Advanced Regional Environmental Assessments (AREA) Dubbo

Biosphere Environmental Consultants P/L. (2013). *Plan of Management for Pink-tailed Worm-lizard Aprasia parapulchella: Dubbo Project , Dubbo NSW.* Dubbo: Biosphere.

Jones, S. (1999). Conservation biology of the pink- tailed worm lizard (Aprasia parapulchella). Unpublished PhD thesis, Applied Ecology Research Group, University of Canberra.

Osborne, W. S., & McKergow, F. V. (1993). *Distribution, population density and habitat of the Pink-tailed Legless Lizard Aprasia parapulchella in Canberra Nature Park ACT pp14-23.* Canberra: ACT Government.

Osborne, W., Lintermans, M., & Williams, K. D. (1991). *Distribution and conservation status of the endangered pink-tailed legless lizard (Aprasia parapulchella).* Canberra: ACT Parks and Conservation Service Research Report 5.

OzArk EHM. (2013). *Clearing Procedure: Pink-tailed Worm-lizard.* Dubbo, NSW: OzArk

OzArk (2016). Dubbo Project Pink-tailed Worm-lizard Management Plan Dubbo, NSW: OzArk

EHM. OzArk EHM. (2016). *Pink-tailed Worm-lizard survey letter {June 16}.* Dubbo NSW.

Robertson, P., & Heard, G. (2008). *Report on field-surveys for the Pink-tailed Worm-lizard (Aprasia parapulchella) in the Bendigo region, central Victoria: Distribution, habitat associations and population attributes.* Hurstbridge, Victoria: Wildlife Profiles Pty Ltd.

RW Corkery. (2016). *Dubbo Project Biodiversity Management Plan*: Alkane Zirconia Ltd.

Tongway, D. J., & Hindley, N. L. (2004). *Landscape Function Analysis: Procedures for monitoring and assessing landscapes.* Canberra, Australia: CSIRO.

Thierry, A., Lettink, M., Besson, A., and Cree, A. (2009) Herpetological Review *Thermal properties of artificial refuges and their implications for retreat-site selection in lizards*

White, A. W. (2012). *Surveys for the Pink-tailed Worm-lizard Aprasia parapulchella. Dubbo Project . Prepared for Alkane Resources Pty Ltd.*

White, A. W. (2013). *Surveys for the Pink-tailed Worm-lizard Aprasia parapulchella. Dubbo Project . March 2013. Prepared for Alkane Resources Pty Ltd.*

Appendix A – Field Data

See following page.

Field Data

	Tile No	GDAz55 Easting	GDAz55 Northing	Time	Air Temp	Soil Temp	Soil Moisture	Ant Nests / Burrows Present?	Ants present?	Other insects (Type / abundance)	Other reptiles (Sp / abundance)	comment
Ugothery North	1	652845	6407800	11:56	25.2	25.6	Dry	Y	Y	No	No	
Ugothery North	1ABCD			11:56	25.2	19	Moist	Y	Y	No	No	
Ugothery North	2	652837	6407796	11:59	28	19	Moist	Y	Y	No	No	
Ugothery North	2ABCD			11:59	28	19	Moist	Y	Y	Beetles including Pill Beetles. Slaters	No	
Ugothery North	3	652829	6407792	12:16	25.8	30.7	Moist	Y	Y	No	No	
Ugothery North	3ABCD			12:16	25.8	32.7	Moist	Y	Y	Spider Webs	No	
Ugothery North	4	652816	6407792	12:03	27.6	29.1	Dry	Y	Y	No	No	
Ugothery North	4ABCD			12:03	27.6	40.8	Moist	Y	Y	No	Reptile Burrows	
Ugothery North	5	652809	6407780	12:06	26.6	37.7	Moist to Dry	Y	Y	No	No	
Ugothery North	5ABCD			12:06	26.6	41.2	Dry	Y	Y	No	No	
Ugothery North	6	652823	6407772	12:18	26.9	22.5	Moist	Y	Y	No	1 *Underwoodisaurus milii*	
Ugothery North	6ABCD			13:18	26.9	32.2	Moist	Y	Y	No	No	
Ugothery North	7	652830	6407773	12:22	26.3	32	Moist	Y	Y	No	No	
Ugothery North	7ABCD			12:22	26.3	29.9	Moist	Y	Y	No	No	
Ugothery North	8	652845	6407770	12:27	25.4	41	Dry	Y	Y	No	No	

Ugothery North	8ABCD			12:27	25.4	34.8	Moist	Y	Y	No	Reptile Burrows. Skink Skin	
Ugothery North	9	652845	6407778	12:30	28.6	35.3	Dry	Y	Y	No	No	
Ugothery North	9ABCD			12:30	28.6	38	Dry	Y	Y	1 termite	No	
Ugothery North	10	652833	6407776	12:32	27.7	44.9	Dry	Y	Y	No	No	
Ugothery North	10ABCD			12:32	27.7	33.4	Dry	Y	Y	Beetles.	No	
Ugothery East Lower	1	652929	6407563	1:30	25.2	28.5	Dry	Y	Y	No	No	Disturbed by Pigs
Ugothery East Lower	1ABCD			1:30	25.2	24.9	Dry	Y	Y	Crickets	No	Disturbed by Pigs
Ugothery East Lower	2	652912	6407571	1:32	27	38.5	Dry	Y	Y	No	*Crinia* Frog Sp.Unknown.	Disturbed by Pigs
Ugothery East Lower	2ABCD			1:32	27	31.9	Moist	Y	Y	No	No	Disturbed by Pigs
Ugothery East Lower	3	652905	6407583	1:36	32.3	20.9	Moist	N	N	Beetle. Spider	No	Disturbed by Pigs
Ugothery East Lower	3ABCD			1:36	32.3	N/A	N/A	N/A	N/A	2 sp Beetle. Weevil. Cockroach.	No	No data. Disturbed by Pigs
Ugothery East Lower	4	652915	6407589	1:37	29.8	22.2	Moist	Y	Y	Cricket. Weevil.Spider.Centipede.	No	
Ugothery East Lower	4ABCD			1:37	29.8	21.7	Moist	N/A	N/A	No	No	No data. Disturbed by Pigs
Ugothery East Lower	5	652929	6407583	1:40	27.5	26.4		Y	Y	Weevil	No	No data. Disturbed by Pigs
Ugothery East Lower	5ABCD			1:40	27.5	N/A	N/A	N/A	N/A	N/A	1 *Menetia greyii*	
Ugothery East Lower	6	652928	6407574	1:43	25.8	27.3	Moist	Y	Y	Weevil	No	
Ugothery East Lower	6ABCD			1:43	25.8	26.2	Moist	Y	Y	No	No	

Ugothery East Lower	7	652935	6407562	1:45	26.8	33.9	Dry	Y	Y	No	No	
Ugothery East Lower	7ABCD			1:45	26.8	22.8	Moist	Y	Y	No	1 *Menetia greyii*	
Ugothery East Lower	8	652946	6407541	1:48	29.4	26	Dry	Y	Y	No	1 *Litoria rubella*	
Ugothery East Lower	8ABCD			1:48	29.4	24.9	Moist	Y	Y	No	No	
Ugothery East Lower	9	652947	6407575	1::51	25.3	28.1	Moist	Y	Y	No	No	
Ugothery East Lower	9ABCD			1:51	25.3	24.9	Moist	Y	Y	No	No	
Ugothery East Lower	10	652943	6407585	1:53	27.3	22.3	Dry to moist	N	N	Weevil	No	
Ugothery East Lower	10ABCD			1:53	27.3	19.3	Dry to Moist	Y	Y	1 sp termite 2.sp. bug 1 sp. Weevil	No	
Ugothery East Upper	1	652836	6407637	12:45	27.5	33.7	Moist	Y	Y	No	No	
Ugothery East Upper	1ABCD			12:45	27.5	36.9	Moist	Y	Y	No	No	
Ugothery East Upper	2	652841	6407649	12:48	26.1	32.2	Moist	Y	Y	No	No	Disturbed by Pigs
Ugothery East Upper	2ABCD			12:48	26.1	38.6	Moist	Y	Y	No	No	
Ugothery East Upper	3	652835	6407657	12:50	26.2	26.7	Moist	N/A	N/A	No	No	Disturbed by Pigs. No Data.
Ugothery East Upper	3ABCD			12:50	26.2	25.2	Moist	Y	Y	No	No	
Ugothery East Upper	4	652846	6407659	12:54	24.6	22.4	Moist	Y	Y	Weevil. Spider	Reptile Burrow	
Ugothery East Upper	4ABCD			12:54	24.6	24.7	Moist	Y	Y	Cocoon	No	
Ugothery East Upper	5	652841	6407664	12:57	29.4	21.2	Moist	Y	Y	No	No	

Ugothery East Upper	5ABCD			12:57	29.4	29.7	Dry	Y	Y	Beetle	No	
Ugothery East Upper	6	652818	6407649	1:01	28.3	31.4	Dry	Y	Y	No	No	
Ugothery East Upper	6ABCD			1:01	28.3	33	Dry	Y	Y	No	No	
Ugothery East Upper	7	652811	6407639	1:03	28.4	31.6	Dry	Y	Y	No	No	
Ugothery East Upper	7ABCD			1:03	28.4	28.7	Dry	Y	Y	No	No	Disturbed by Pigs
Ugothery East Upper	8	652811	6407663	1:05	28	27.1	Moist	Y	Y	No	No	
Ugothery East Upper	8ABCD			1:05	28	24.4	Moist	Y	Y	No	No	Disturbed by Pigs
Ugothery East Upper	9	652819	6407665	1:07	28.8	N/A	N/A	N/A	N/A	No	No	Disturbed by Pigs. No Data.
Ugothery East Upper	9ABCD			1:07	28.8	26.8	Moist	Y	Y	No	No	Disturbed by Pigs
Ugothery East Upper	10	652803	6407676	1:08	29.7	N/A	N/a	N/A	N/A	No	No	Disturbed by Pigs. No Data.
Ugothery East Upper	10ABCD			1:08	29.7	24.5	Moist	Y	Y	No	No	
Grandale	1	653547	6410880	2:40	20	25.1	moist	Y	Y	mealworm	No	
Grandale	1ABCD			2:40	20	23.2	moist	Y	Y	pill bug	No	
Grandale	2	653541	6410870	2:43	20	13.2	moist	Y	Y	pill bug	Three striped skin (Ctenotus robustus)	
Grandale	2ABCD			2:43	20	13.3	moist	Y	Y	pill bug	No	
Grandale	3	653549	6410852	2:47	20	20.5	moist	Y	Y	No	No	
Grandale	3ABCD			2:47	20	23.2	moist	Y	Y	pill bug, spider, millipede, x1 other insect	No	

Grandale	4	653541	6410831	na	na	na	na	na	na	na	na	
Grandale	4ABCD			na	na	na	na	na	na	na	na	
Grandale	5	653537	6410851	2:52	20	23.2	moist	Y	Y	beetle	No	
Grandale	5ABCD			2:52	20	12.6	moist	Y	Y	beetle	No	Disturbed
Grandale	6	653525	6410856	2:54	20	12.5	moist	Y	Y	beetle	No	
Grandale	6ABCD			2:54	20	13.3	moist	Y	Y	beetle	No	one tile flipped by pigs
Grandale	7	653518	6410846	2:57	20	23.7	dry	Y	N	No	No	
Grandale	7ABCD			2:57	20	22.6	moist	Y	Y	No	No	four tiles scattered by pigs
Grandale	8	653507	6410862	3:01	20	18.5	moist	Y	Y	No	No	
Grandale	8ABCD			3:01	20	19.3	moist	Y	Y	No	x2 three striped skink (one juvenile and one adult)	all tiles flipped by pigs
Grandale	9	653499	6410870	3:04	20	17.4	moist	Y	Y	No	No	
Grandale	9ABCD			3:04	20	14.4	moist	Y	Y	No	No	
Grandale	10	653504	6410848	3:06	20	18.2	moist	Y	Y	No	No	
Grandale	10ABCD			3:06	20	19	moist	Y	Y	No	No	
Ugothery Dowds Hill	1	653525	6406962	2:23	27	22.2	Dry	Y	Y	No	No	
Ugothery Dowds Hill	1ABCD			2:23	27	28.2	Dry	Y	Y	No	No	
Ugothery Dowds Hill	2	653544	6406972	2:26	26.6	22.5	Dry	Y	Y	No	No	

Ugothery Dowds Hill	2ABCD			2:26	26.6	25	Dry	Y	Y	No	No	
Ugothery Dowds Hill	3	653561	6406985	2:27	26.2	29.2	Dry	Y	Y	No	No	
Ugothery Dowds Hill	3ABCD			2:27	26.2	26.4	Dry	Y	Y	No	No	
Ugothery Dowds Hill	4	653575	6406991	2:29	25.7	30.2	Dry	Y	Y	No	No	
Ugothery Dowds Hill	4ABCD			2:29	25.7	29.6	Dry	Y	Y	Beetle. Weevil.	No	
Ugothery Dowds Hill	5	653589	6406998	2:31	25.3	23.4	Dry	Y	Y	1 sp. Termite low density. Beetle Shells	No	
Ugothery Dowds Hill	5ABCD			2:31	25.3	27.8	Dry	Y	Y	Beetle Shells	No	
Ugothery Dowds Hill	6	653603	6407004	2:32	28.5	22.9	Dry	Y	Y	Weevil	No	
Ugothery Dowds Hill	6ABCD			2:32	28.5	24.9	Dry	Y	Y	1 sp. termite low density. Beetle.	1 *Ctenotus robusta*	
Ugothery Dowds Hill	7	653618	6407007	2:34	27.9	21.4	Moist	Y	Y	Beetle	No	
Ugothery Dowds Hill	7ABCD			2:34	27.9	22.6	Dry	Y	Y	1 sp. termite low density	No	
Ugothery Dowds Hill	8	653633	6407009	2:36	26.4	25.5	Moist	Y	Y	1 sp. termite moderate density	No	
Ugothery Dowds Hill	8ABCD			2:36	26.4	25.2	Moist	Y	Y	3 sp. Beetle. Cricket. Termites	No	
Ugothery Dowds Hill	9	653646	6407011	2:38	26.9	24.8	Moist	Y	Y	Cricket. Beetle. Cockroach.	No	
Ugothery Dowds Hill	9ABCD			2:38	26.9	28.7	Moist	Y	Y	2 sp. termite moderate density. Cricket. Beetles	No	
Ugothery Dowds Hill	10	653660	6407011	2:40	25.9	26.8	Dry	Y	Y	No	No	
Ugothery Dowds Hill	10ABCD			2:40	25.9	23.4	Moist	Y	Y	No	1 *Underwoodisaurus milli*	

Glen Idol	1	652877	6406944	10:42	23.5	19.1	Moist	Y	Y	No	No	Diggings underneath
Glen Idol	1ABCD			10:42	23.5	23.9	moist	Y	Y	Beetle	No	
Glen Idol	2	652903	6406954	10:47	27.5	26.2	Moist	Y	Y	No	No	
Glen Idol	2ABCD			10:47	27.5	18.4	Moist	Y	Y	Beetle Remnants	No	
Glen Idol	3	652896	6406929	10:50	22.6	N/A	Moist	Y	Y	No	No	
Glen Idol	3ABCD			10:50	22.6	24.4	N/A	Y	Y	No	No	
Glen Idol	4	652888	6406885	10:54	27.3	18.4	Moist	Y	Y	No	*Menetia greyii*	
Glen Idol	4ABCD			10:54	27.3	19.3	Moist	Y	Y	Huntsman Spider	No	
Glen Idol	5	652909	6406873	10:59	25.7	17.9	Moist	Y	Y	No	No	
Glen Idol	5ABCD			10:59	25.7	21.4	Moist	Y	Y	Beetle Shells	No	
Glen Idol	6	652923	6406847	11:01	25.5	20	Moist	Y	Y	Beetle Shells	No	
Glen Idol	6ABCD			11:01	25.5	25.6	Moist	Y	Y	Weevil. Beetle Shells.	No	
Glen Idol	7	652946	6406871	11:09	26	N/A	N/A	Y	Y	No	No	
Glen Idol	7ABCD			11:09	26	14.5	Moist	Y	Y	No	No	
Glen Idol	8	652961	6406896	11:13	24.2	22.1	Moist	Y	Y	No	No	
Glen Idol	8ABCD			11:13	24.2	27.2	Moist	Y	Y	Centipede	No	
Glen Idol	9	652953	6406846	11:05	26.5	27	Moist	Y	Y	No	*Litoria rubella* and Shingled Skink	

Glen Idol	9ABCD			11:05	26.5	19.3	Moist	Y	Y	No	*Ctenotus robusta*	
Glen Idol	10	652998	6406853	11:17	25.9	17.4	Moist	Y	Y	No	No	
Glen Idol	10ABCD			11:17	25.9	21.2	Moist	Y	Y	No	No	
Ugothery Dam Site	1	653894	6407990		na	na						
Ugothery Dam Site	1ABCD				na	na						
Ugothery Dam Site	2	653931	6408018		na	na						
Ugothery Dam Site	2ABCD				na	na						
Ugothery Dam Site	3	653963	6408042		na	na						
Ugothery Dam Site	3ABCD				na	na						
Ugothery Dam Site	4	653964	6408060		na	na						
Ugothery Dam Site	4ABCD				na	na						
Ugothery Dam Site	5	654014	6408118		na	na						
Ugothery Dam Site	5ABCD				na	na						
Ugothery Dam Site	6	653997	6408121		na	na						
Ugothery Dam Site	6ABCD				na	na						
Ugothery Dam Site	7	653998	6408134		na	na						
Ugothery Dam Site	7ABCD				na	na						

Ugothery Dam Site	8	654014	6408123		na	na						
Ugothery Dam Site	8ABCD				na	na						
Ugothery Dam Site	9	654030	6408142		na	na						
Ugothery Dam Site	9ABCD				na	na						
Ugothery Dam Site	10	654035	6408158		na	na						
Ugothery Dam Site	10ABCD				na	na						

AREA Environmental & Heritage Consultants ABN: 29 616 529 867

- ✓ Environmental impact assessments and approvals: REFs, MW REFs, PEAs
- ✓ Ecology, Aboriginal and historic heritage assessments
- ✓ Biodiversity assessment method (BAM) assessments (BDAR) and offsetting (BSAR)
- ✓ Plans of Management
- ✓ Aboriginal community engagement
- ✓ Stakeholder and community engagement
- ✓ Peer review / project briefs / budgeting assistance / expert witness
- ✓ Commercial external landscape designs for built or natural environments
- ✓ Vegetation Management Plans
- ✓ Stakeholder and community engagement

Biodiversity Offset Area
Analogue vegetation plot monitoring-Dubbo Project

Dubbo Regional Local Government Area
Report to Australian Strategic Materials
August 2024

Australian Strategic Materials

AREA Environmental & Heritage Consultants
"The Old Macquarie Brewery" c1876, 72 Brisbane Street Dubbo NSW 2830
phil@areaenv.com.au

AREA acknowledges Traditional Owners of the country on which we work

EXECUTIVE SUMMARY

AREA Environmental & Heritage Consultants (AREA) were commissioned by Australian Strategic Materials Ltd (the proponent) to undertake annual monitoring of five established analogue vegetation monitoring points for their Dubbo Project (formerly known as Dubbo Zirconia Project), near Toongi, New South Wales (NSW). The Dubbo Project was approved as SSD-5251 by the NSW Planning Assessment Commission (PAC) on 28 May 2015, assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act). Annual monitoring of five analogue plots is required under the Biodiversity Management Plan. This year, plot 3 was surveyed on 23 April 2024 and plots 1, 2, 4, 5 were surveyed on 23 July 2024.

Prior to 2019, vegetation monitoring was conducted using the now defunct BioBanking Assessment Method. Since that time, monitoring has used the current assessment framework outlined by the NSW government, the Biodiversity Assessment Method (BAM 2020). Data prior to 2019 has been excluded from this monitoring report due to inconsistencies with the data collection method, preventing comparisons to be made.

Plot data collected during 2024 was measured against their associated plant community type (PCT) benchmarks for an average rainfall year (default benchmark) and wet rainfall year where applicable. Plots 1 and 2 were assessed against benchmarks for PCT267 *White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion,* plot 3 against PCT201 *Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion*, plot 4 against PCT76 *Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions* and plot 5 against *PCT270 White Box - Tumbledown Red Gum - Long-leaved Box shrub/grass woodland on fine-grained sediments of the upper Macquarie River gorge, NSW central western slopes.*

Like last year, all plots showed one or more attributes below the 25 percent benchmark scores. However, all sites had increases overall in benchmark scores in the 25-75% range and >75% range, indicating an improvement across all plots. The vegetation integrity (VI) scores reflect the results from the composition, structure and function scores, with all plots increasing in VI compared to last year's results. Most notably, plot 3 is equal with its highest VI score, and plots 1 and 5 increased to their highest recorded VI score since the implementation of BAM in 2019.

Document Controls

Proponent	Australian Strategic Materials Ltd (ASM)
Client	ASM
Quote number	TBA
Project No / Purchase Order No	TBA
Document Description	Biodiversity Offset Area Monitoring Points 2024
Clients Representative Managing this Document	Mike Sutherland
AREA Person(s) Managing this Document	Phil Cameron
Cover image	Starting point of Plot 1 July 2024

DOCUMENT STATUS: DRAFT		
DRAFT: Series V1.X AREA internal edits	**Date**	**Action**
V1.0	30/07/2024	For internal edit
V1.1	07/08/2024	Reviewed
V1.2	08/08/2024	For internal edit
DRAFT Series V2.X Client / AREA internal edits	**Date**	**Action**
V2.0		AREA to Client
FINAL (Draft approved by client)	**Date**	**Action**
V3.0		AREA to Client

Prepared for ASM Australian Strategic Materials	Mike Sutherland General Manager NSW Australian Strategic Materials Ltd 88-90 Macquarie Street, Dubbo NSW 2830 Office: 6882 2866 Fax: 6882 9282 Mobile: 0427 691 733
Prepared by AREA Environmental & Heritage Consultants	Dylan Chew Environmental Consultant AREA Environmental Consultants & Communication Pty Ltd 'Old Macquarie Brewery' c1876, 72 Brisbane Street Dubbo, NSW 2830 M 0435 334 008 E dylan@areaenv.com.au ABN:29 616 529 867

TABLE OF CONTENTS

FIGURES

TABLES

Terms and acronyms used in this document

Acronym	Definition
AREA	AREA Environmental & Heritage Consultants
BAM	Biodiversity assessment method
BOA	Biodiversity Offset Area
BOM	Bureau of Meteorology
DBH	Diameter at breast height
GPS	Global positioning system
HTW	High threat exotic weed
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
NSW	New South Wales
PCT	Plant Community Types
Project site	The project boundary, project offset area, and monitoring plots
VI	Vegetation Integrity
VIS	Vegetation Information System

1 Introduction

1.1 Background and locality

AREA Environmental & Heritage Consultants (AREA) were commissioned by Australian Strategic Materials Ltd (the proponent) to undertake annual monitoring of five established analogue vegetation monitoring points for their Dubbo Project (formerly the Dubbo Zirconia Project), in Toongi, New South Wales (NSW). The Dubbo Project was approved as an SSD-5251 by the NSW Planning Assessment Commission (PAC) on 28 May 2015, assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act). Annual monitoring of five analogue plots is required by the Biodiversity Management Plan, in this case three plots in the Dubbo Project Biodiversity Offset Area (BOA) and two local plots on public land (Figure 1-1).

Prior to 2019, vegetation monitoring was conducted using the now defunct BioBanking Assessment Method. Since that time, monitoring has used the current assessment framework outlined by the NSW government, the Biodiversity Assessment Method (BAM 2020). The BAM, as it pertains to vegetation assessment plots, is described in section 2.1. Data collected prior to 2019 has been excluded from this monitoring report due to inconsistencies with the data collection method, preventing comparisons to be made.

Figure 1-2 to Figure 1-6 show the location and local context of the Biodiversity Offset Area. The project site, defined as the project boundary, project offset area, and monitoring plots, is in Toongi, approximately 25 kilometres south of Dubbo, NSW. It falls under the Dubbo Regional Council local government area (LGA) and occurs on the border of two Interim Biogeographic Regionalisation's for Australia (IBRA Regions), being *NSW South Western Slopes* and *Brigalow Belt South*. Its primary situation is in IBRA region *NSW South Western Slopes*. There are four different PCTs associated with the monitoring plots, outlined in Table 1-1. Historically the land has been used for agricultural purposes, and the surrounding land is mainly grazed and ploughed for agriculture.

The topography is relatively flat, ranging from approximately 280 – 420 metres above sea level. No named waterways occur within the Biodiversity Offset Area (BOA). However, within 1500 metres, Wambangalang Creek occurs to the north west, Paddys Creek occurs to the south west, Cockabroo Creek occurs to the south east, where a small section lies within the project boundary. These are all third or higher Strahler Order waterways. Numerous unnamed first, second and third Strahler Order waterways are mapped within the BOA.

Figure 1-1: Vegetation plot location

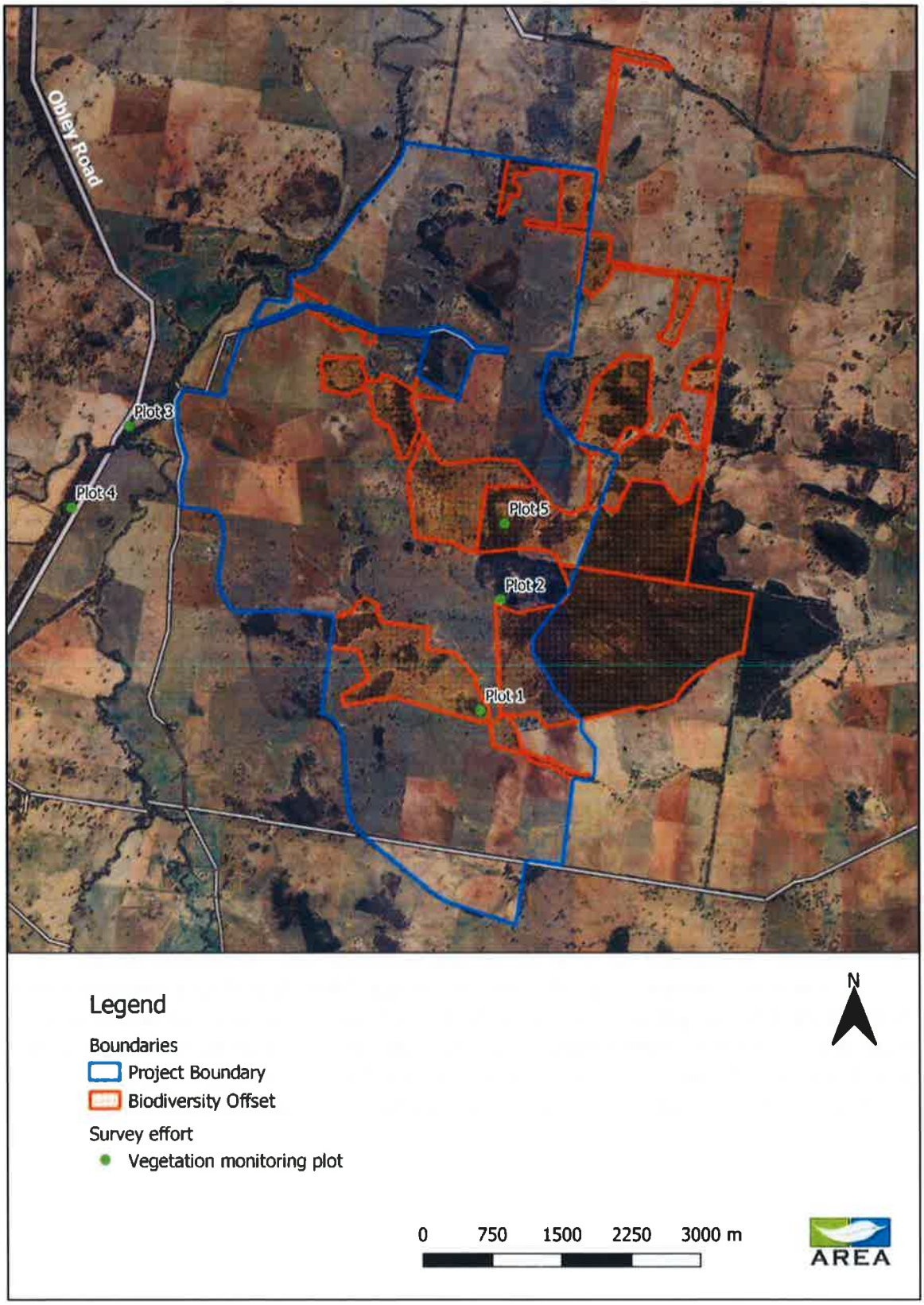


Figure 1-2: Project Site Location

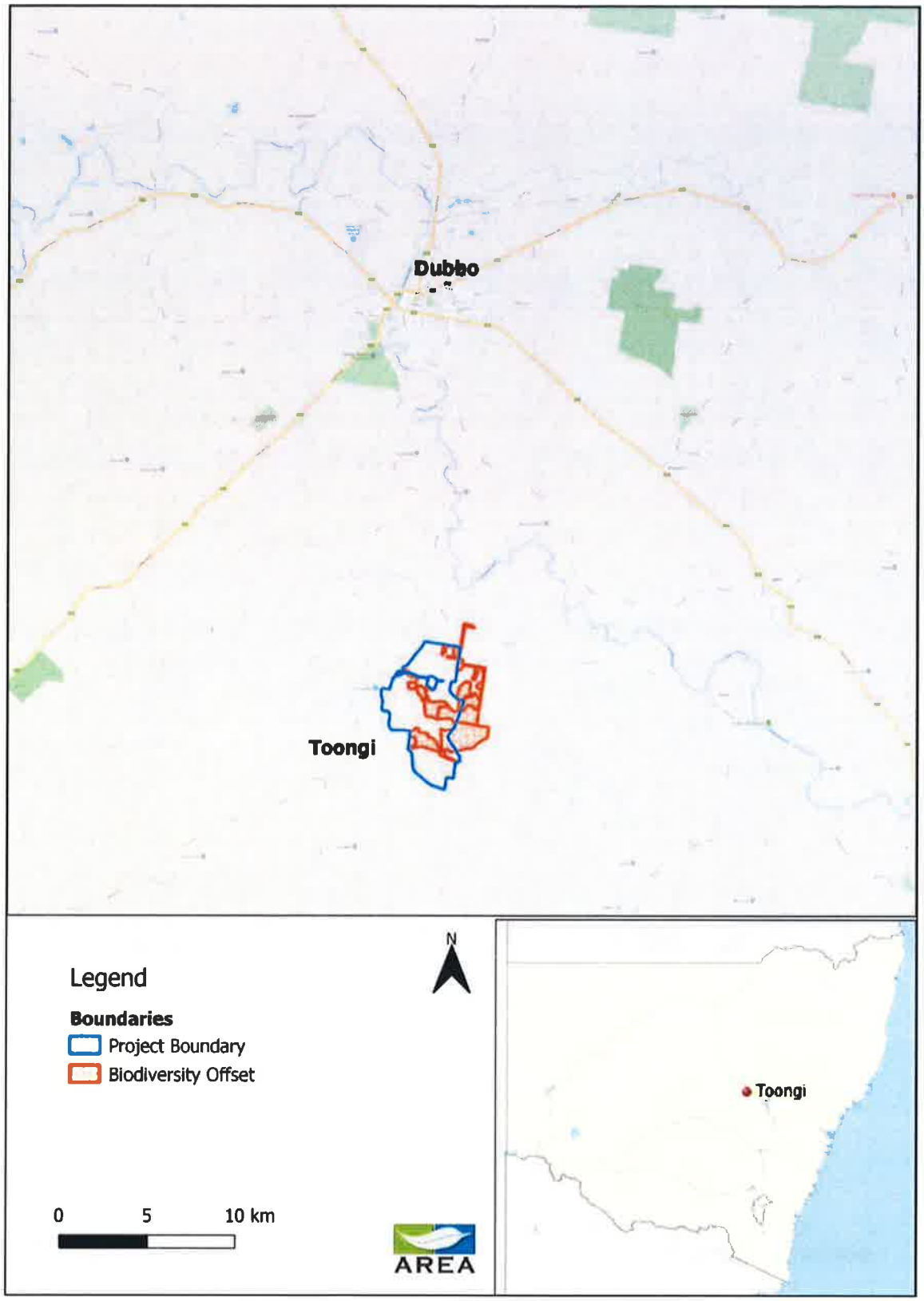


Figure 1-3: Biodiversity Offset Area (Aerial)

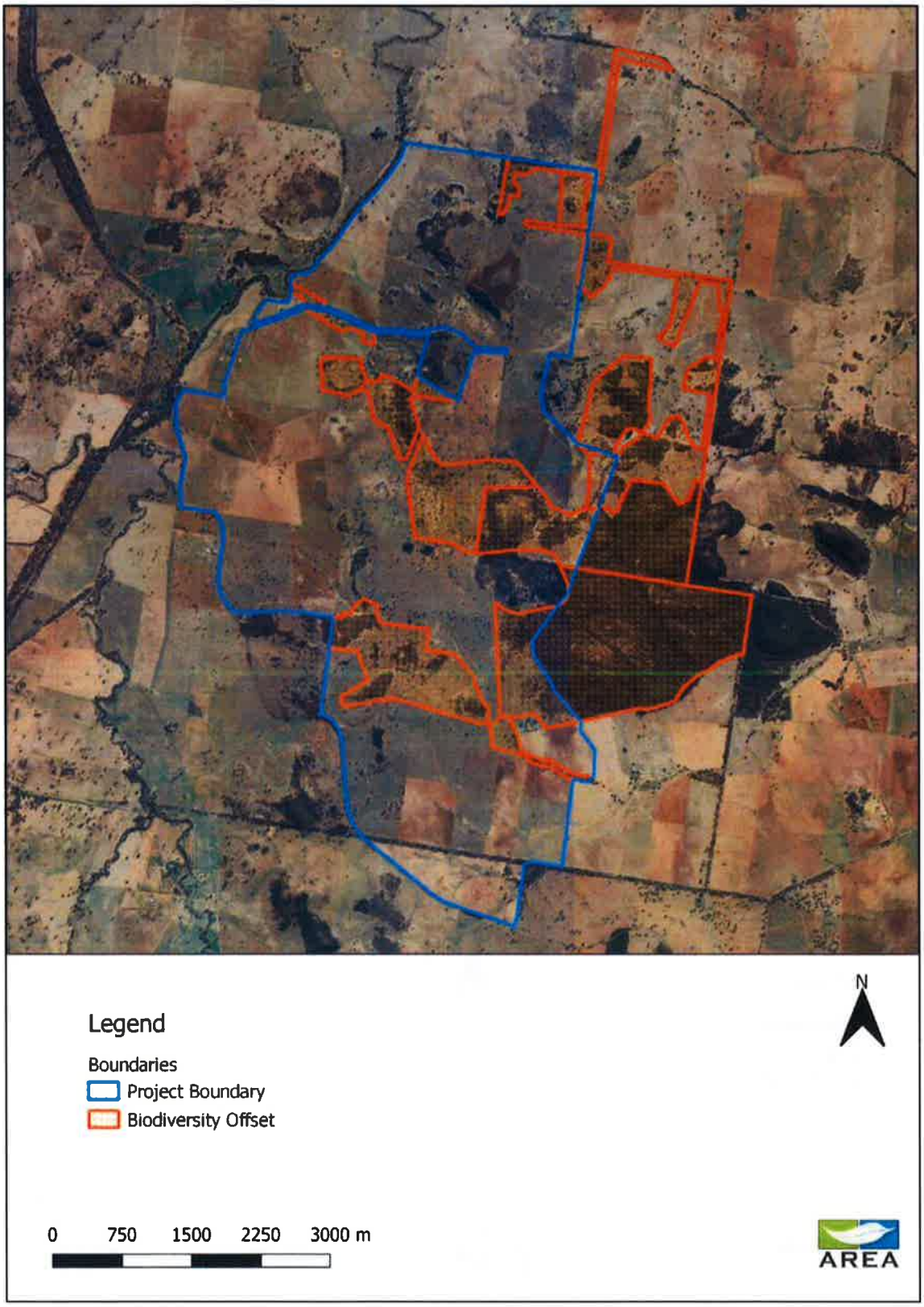


Figure 1-4: Biodiversity Offset Area (Topographic)

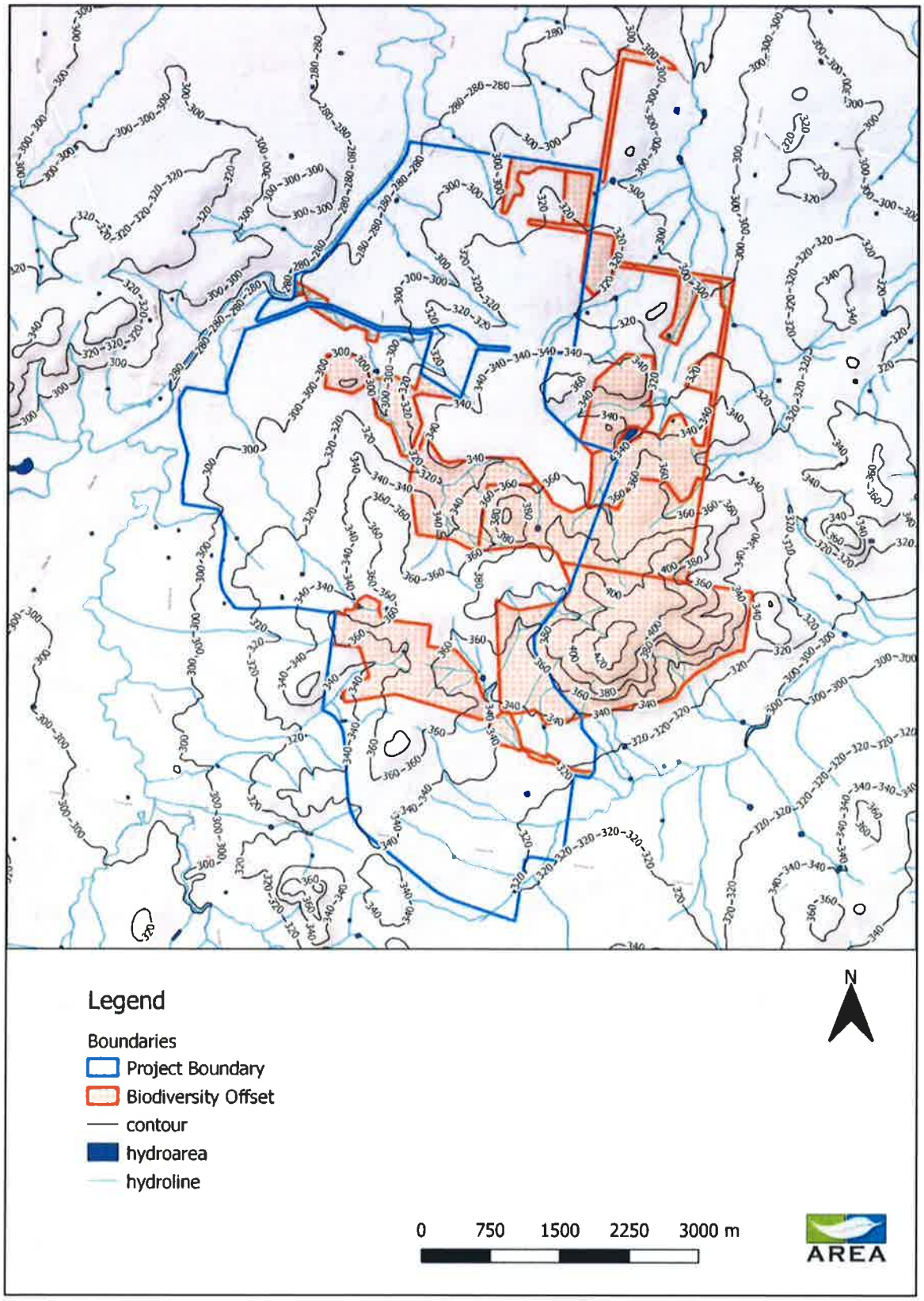


Figure 1-5: Biodiversity Offset Area (Lots and DPs)

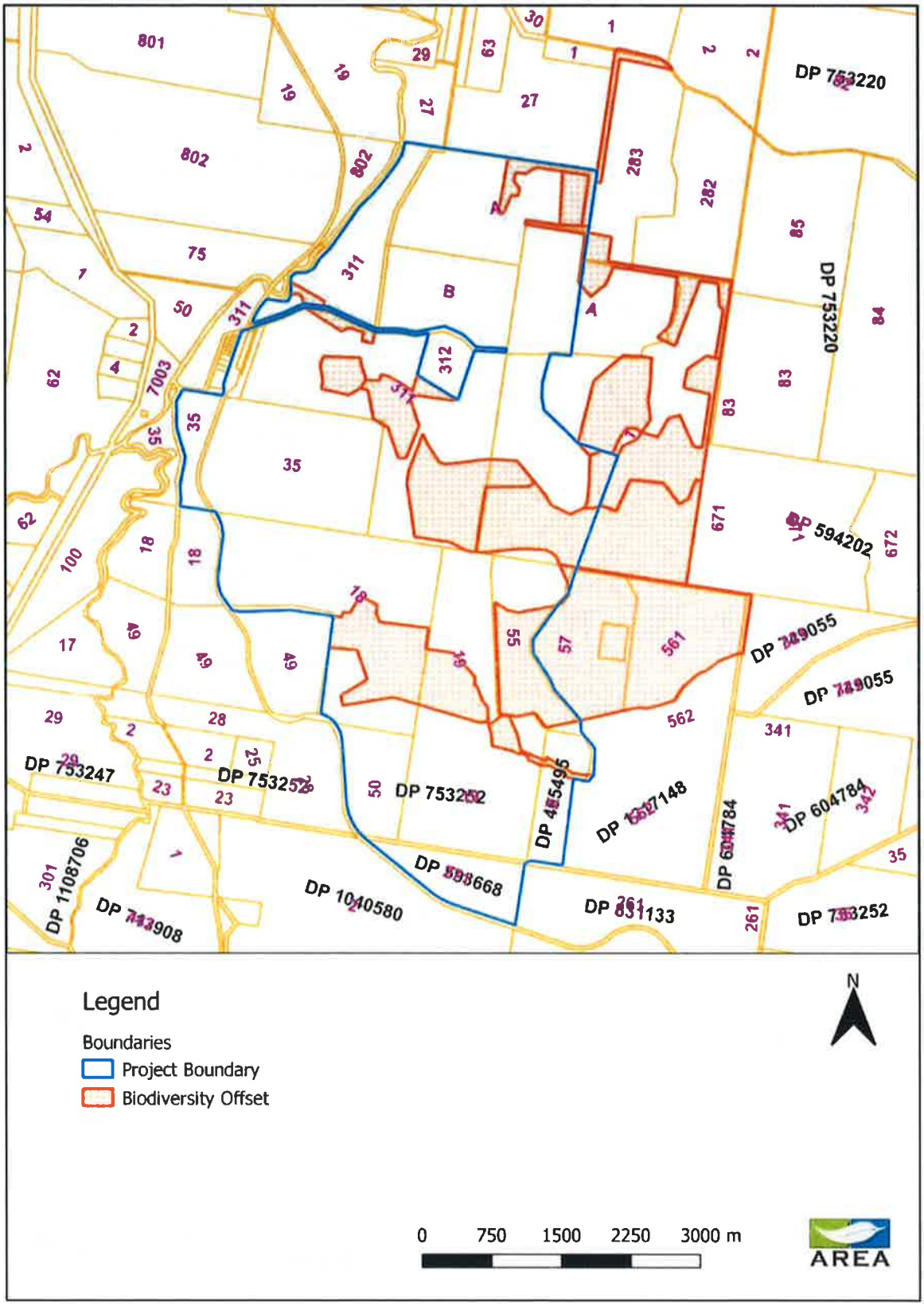


Figure 1-6: Waterways

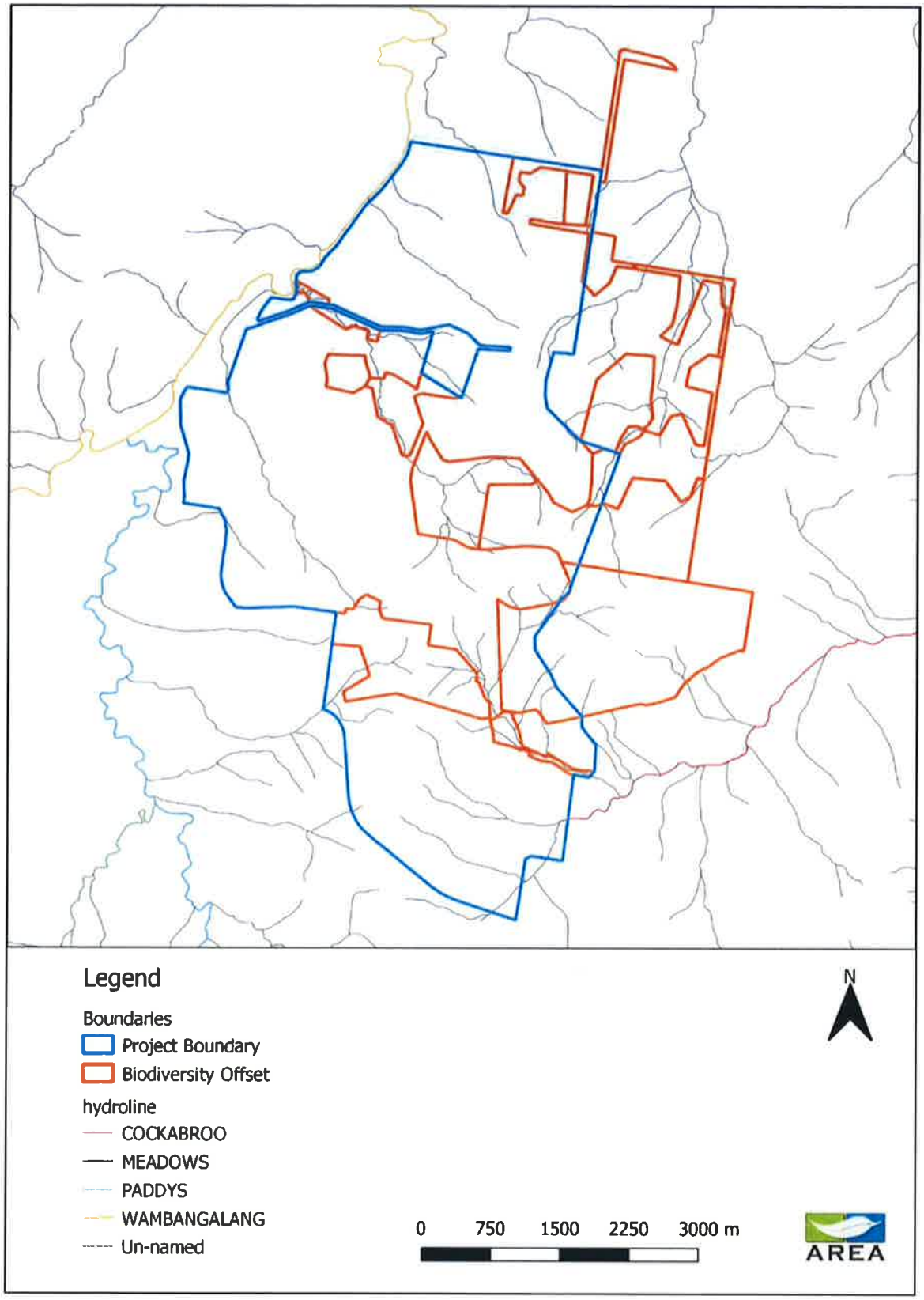


Table 1-1: Plant Community Types

Plot ID	Current classification (BAM 2020)
1	PCT 267 - *White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion*
2	PCT 267 - *White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion*
3	PCT 201 -*Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion*
4	PCT 76 - *Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions*
5	PCT 270 - *White Box - Tumbledown Red Gum - Long-leaved Box shrub/grass woodland on fine-grained sediments of the upper Macquarie River gorge, NSW central western slopes*

2 Methods

2.1 Plot location and surveys

The five analogue monitoring plots were surveyed in two efforts, plot 3 on 23 April 2024, and plots 1, 2, 4, and 5 on 23 July 2024. Previously, plots were not permanently marked, but a combination of rock cairns, GPS coordinates and photos are used to locate start and end points of each plot. This year, start and end points were marked with wooden stakes where possible. The GPS coordinates were recorded at each plot's start point and are recorded in Table 2-1. Monitoring and preparation of this monitoring report was carried out by appropriately qualified and experienced staff (Table 2-2).

Table 2-1: Monitoring plots coordinates in GDA z55

Plot ID	Easting (GDA94 Zone 55)	Northing (GDA94 Zone 55)
1	652434	6405473
2	652672	6406658
3	648685	6408581
4	648038	6407726
5	652722	6407474

Table 2-2: Summary of AREA project teams' qualifications

Name	Position	CV Details	Role in this project
Phil Cameron	Managing Director	• BSc. Major in Biology. Macquarie University • Ass Dip App Sci. University of Queensland • Dip Landscape Design (in-prep) • Cert III (Captive vertebrate management) • Certified Environmental Practitioner (EIANZ) and practicing member • NSW OEH BioBanking and Bio-certification Assessor: accreditation number 0117 • NSW Biodiversity Assessment Method Accredited Assessor (BAAS17082) • AHCPCM201- Recognising grasses • Practicing member of the NSW Ecological Consulting Association	• Project Management • Fieldwork
Addy Watson	Manager/ Senior Consultant	• Grad. Dip. Captive Vertebrate Management, Charles Sturt University • Grad. Cert. Social Impact, University of NSW • B. Env. Sc. University of New England. • NSW Biodiversity Assessment Method Accredited Assessor (BAAS19066) • Diploma Project Management • NSW Biodiversity Assessment Method • Lean Six Sigma Certificate (Sydney Uni) • WHS White Card • Apply First Aid. Certificate number: 07328	• Fieldwork • Report editing
Dave Sturman	Manager/ Senior Consultant	• B. Env. Sc. Land and Water Specialisation Charles Sturt University • Cert III (Horticulture) • White card – general construction induction card. • RMS-worker on foot training.	• Report editing

Name	Position	CV Details	Role in this project
		• Senior First Aid • Chainsaw operator ticket • Confined Space worker and atmospheric monitoring. • Risk assessment training. • AHCPM201-Recognising grasses • NSW Biodiversity Assessment Method Accredited Assessor (BAAS22015)	
Gabrielle Green	Environmental Consultant	• B. Env. Sc. University of New England • AHCPCM201 – Recognising grasses • WHS White Card - general construction induction card (CGI1667253SEQ01) • RMS-worker on foot training • First Aid Certificate (Cert No. 6995717) • WIRES volunteer	• Report editing
Dylan Chew	Environmental Consultant	• Bachelor of Environmental Science and Management (Hons) (Conservation), University of Newcastle • Certificate III Information and Digital Technology • WHS White card	• Field work • Report writing
Thomas Carter	Environmental Consultant/ Heritage Consultant	• Master of Environmental Science Charles Sturt University • Honours Bachelor of Science Ecology and Environmental Science University of Adelaide • Bachelor of Arts (History) University of Adelaide	• Fieldwork

2.2 Biodiversity Assessment Method

The BAM 2020 provides a system for measuring vegetation which is more transparent, repeatable, and objective. The method uses a nested plot design to collect data for three different components of the defined plot and generates scores that reflect its overall quality. A summary of the data collection method is provided below.

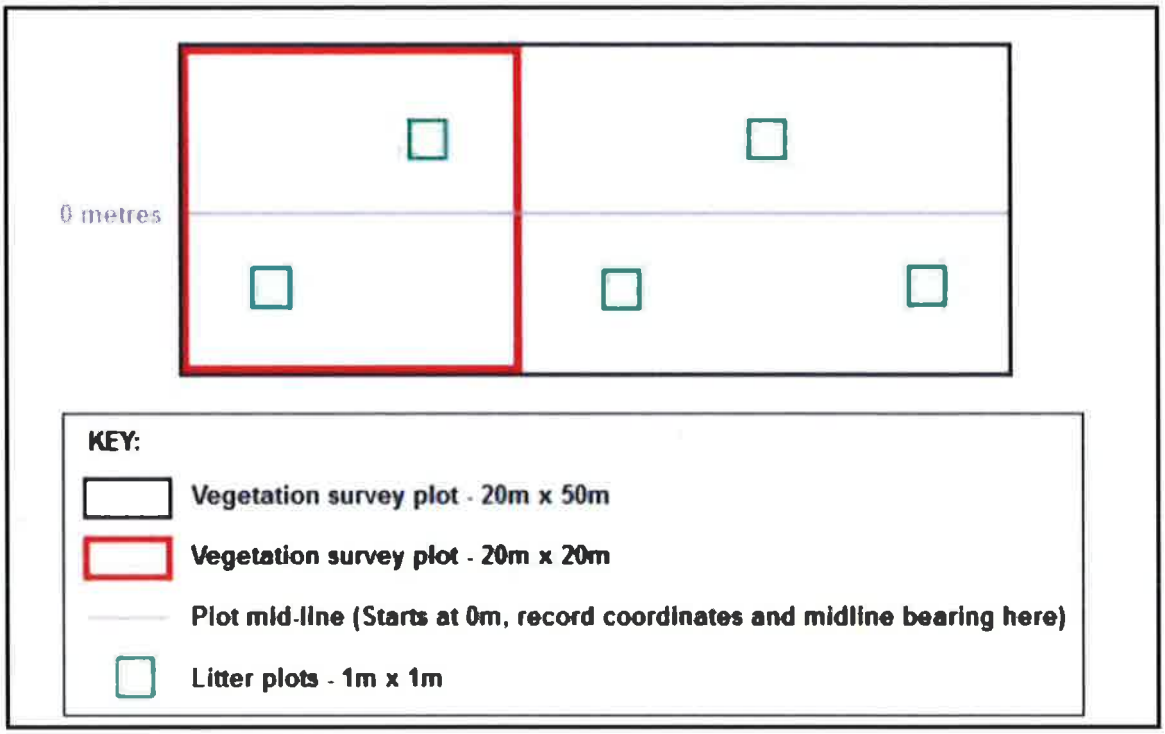
2.2.1 Nested plot design

- One 400 square metre plot (standard 20 x 20 metre) was used to assess the composition (species richness) and structure (percent cover).
- One 1000 square metre (standard 20 x 50 metre) plot was used to assess the function attributes: number of large trees, stem size class, tree regeneration and length of logs.

Five one square metre sub-plots were used to assess ground cover (leaf litter and other optional groundcover components) for the plot, see

- Figure 2-1

Figure 2-1: Nested plot layout



2.2.2 Composition

Composition attributes refers to the number of native species within each growth form group recorded within the survey plot.

- Assessment of composition was based on the number of native plant species (richness) observed and recorded by the assessor within each 20 x 20 metre plot for each growth form group shown in *Table 2* of BAM (2020)
- To determine growth, the native species by growth form query tool was used
- The survey data recorded by the assessor for composition within each 20 x 20 metre condition plots was:
    - The growth form group to which each native species has been allocated.
    - Scientific name for native and exotic species within each growth form group.
    - Whether each species is native, exotic or high threat exotic.
    - The composition of each growth form group was assessed by counting the number of different native plant species recorded within each growth form group, within each of the 20 x 20 metre condition plots.

2.2.3 Structure

Structure attributes relate to the foliage cover of each native species in each growth form group within the plot.

- Structure is the assessment of foliage cover estimates for each growth form group within the 20 x 20 metre plot boundaries. Foliage cover for a growth form group is the percentage of cover of all living plant material of all individuals of the species present for that group. This includes leaves, twigs, branchlets and branches as well as canopy overhanging the plot even if the stem is outside the plot.

- An estimate of the foliage cover for each native and exotic species present within the 20 x 20 metre plot was recorded.
- The structure of each growth form group for the 20 x 20 metre plot was recorded as the sum of the individual foliage cover estimates of all native plant species recorded within each growth form group, within each plot.
- Each non-native (exotic) plant species was assigned a foliage cover estimate and either classified as exotic (E) or high threat weed (HTW).

2.2.4 Function

Function is the assessment of large trees, tree stem size, tree regeneration, fallen logs and leaf litter. Only native species are recorded for these attributes.

- Tree stem size classes were measured at 1.3 metres above ground height, referred to as 'diameter at breast height over bark' or DBH.
    - Tree stem size classes are:<5, 5–9, 10–19, 20–29, 30–49, 50–79, and more than 80 centimetres DBH, and include all species in the tree growth form group.
    - Regeneration was based on the presence or absence of living trees with stems less than five centimetres DBH.
    - Only living trees contributed to counts for determination of presence. For a multi-stemmed tree, only the largest living stem is included in the count for determining the presence or absence of stems within each size class.
    - The number of large trees is a count of all living stems with a DBH equal to or greater than the large tree benchmark DBH size for that PCT or vegetation class.
        - For a multi-stemmed tree, at least one living stem equal to or greater than the large tree benchmark DBH size, to count as a large tree, was used.
    - Stem size classes were based on the presence or absence of living tree stems within size classes that fall between regenerating stems (less than five centimetres DBH), and the large tree benchmark DBH size(s).
- The length of fallen logs is the total length in metres of all woody material greater than 10 centimetres in diameter, that is dead and entirely, or in part, on the ground within the 20 x 50 metre plot. Where logs extend outside of the plot, only the length of fallen log that is contained within the plot was recorded.
- Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 x 1 metre plots evenly, placed along the central transect of each plot,
    - Litter cover includes all dead and detached plant debris, including leaves, seeds, twigs, branchlets and branches (less than 10 centimetres in diameter).
    - Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants.
    - Plant material that is not detached was assessed as growth form foliage cover, regardless of whether it appears alive or dead.
- The number of trees with hollows was determined by counting trees with hollows that are visible from the ground in the 20 x 50 metre plot. The number of trees with hollows included native species allocated to the shrub growth form group. It included both living and dead trees.

- A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance width is at least 5 centimetres; (c) the hollow appears to have depth (i.e., solid wood cannot be seen beyond the entrance); and (d) the hollow is at least one metre above the ground.

3 Limitations

Not all and plant species can be fully accounted for within any given study area. The presence of threatened species is not static it changes over time, often in response to longer term natural forces which can at any time be dramatically influenced by human-made disturbance or weather. There were no seasonal or climatic conditions limiting the assessment being complete to the necessary requirements.

4 Results

4.1 Rainfall

Rainfall data was retrieved from historic data recorded at Dubbo Airport Weather Station (AWS), located approximately 25 kilometres north of the project site (Bureau of Meteorology[1]). The 2024 monitoring surveys were conducted two years after a period of above-average rainfall, with it on track to be another year of high rainfall. The Dubbo average is 589.6 millimetres, and as of July 2024, the yearly rainfall measure is 530.2 millilitres (Table 4-1).

In relation to the plots, rainfall total of the previous 12 months was used when considering whether benchmarks for an "average" or "wet" year were used for its associated PCT, as per NSW VIS database (BioNet Vegetation Classification). Total rainfall was higher than the upper limit of an "average" year for PCT 76 (annual rainfall >593 millilitres). Therefore plot 4 was measured against "wet" year benchmarks and all other plots were compared to "average" rainfall benchmarks.

Table 4-1: Monthly rainfall averages from 2015 – 2024

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2015	130.6	31.8	8.4	81.8	47.8	72.2	60.2	39.4	6.8	46.4	66.6	59.6	651.6
2016	122.8	3.2	16.2	25.0	55.4	151.6	105.2	50.4	157.8	56.2	34.0	138.6	916.4
2017	14.8	1.6	223.0	9.4	5.2	9.2	3.0	20.6	5.0	84.6	34.8	54.2	465.4
2018	28.6	2.4	4.0	6.8	13.0	18.6	1.6	36.4	6.8	90.4	68.6	34.4	311.6
2019	64.4	18.4	46.8	0.0	23.4	10.4	6.4	6.8	11.0	1.6	19.4	2.6	211.2
2020	36.0	81.8	145.0	N/A	28.8	32.6	82.2	39.0	47.6	60.6	12.6	120.6	N/A
2021	54.0	114.4	187.2	1.8	21.0	93.8	91.8	34.0	36.8	35.4	180.8	73.4	924.4
2022	130.0	41.0	56.4	191.2	75.8	12.8	58.6	112.2	104.8	195.8	43.8	6.4	1028.8
2023	0.6	53.4	20.8	45.0	1.6	40.6	38.2	10.0	2.6	22.6	73.4	67.0	425.8
2024	106.2	88.2	80.0	116.0	45.6	45.8	48.4						

4.2 Plot data

Plot data measured attributes against the plant community type (PCT) benchmarks from the NSW VIS database, for an "average" (default benchmark) or "wet" rainfall year. These benchmarks are recorded in Table 4-2 to Table 4-6 below, where green shading indicates 75 percent or greater of benchmark (good), blue shading indicates between 25 percent and 75 percent of benchmark (average) and red shading indicates less than 25 percent of the benchmark (poor) value has been recorded.

[1]http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=065070

Table 4-2: PCT 267 default benchmarks for plot 1 and plot 2

PCT267 - White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion					
Class/IBRA: Western Slopes Grassy Woodlands / NSW South Western Slopes					
Attribute	Benchmark value	25% benchmark	75% benchmark	Plot 1	Plot 2
Tree Richness	3	0.75	2.25	2	2
Shrub Richness	3	0.75	2.25	1	1
Grass and Grass Like Richness	8	2	6	9	10
Forb Richness	10	2.5	7.5	14	18
Fern Richness	1	0.25	0.75	1	1
Other Richness	1	0.25	0.75	1	0
Tree Cover	19	4.75	14.25	18	10.1
Shrub Cover	1	0.25	0.75	0.1	0.1
Grass and Grass Like Cover	32	8	24	46.5	19.8
Forb Cover	6	1.5	4.5	2.1	14.6
Fern Cover	0	0	0	0.1	0.2
Other Cover	0	0	0	0.2	0
Total length of fallen logs	41	10.25	30.75	31	24
Litter Cover	55	13.75	41.25	24	29.4
Number of Large Trees (>50dbh)	4	1	3	0	0

Key:
green = 75 percent or greater of benchmark (good),
blue = between 25 percent and 75 percent of benchmark (average)
red = indicates less than 25 percent of the benchmark (poor).

Table 4-3: PCT 201 default benchmarks for plot 3

PCT201 - Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion				
Class/IBRA: Western Slopes Grassy Woodlands / NSW South Western Slopes				
Attribute	Benchmark value	25% benchmark	75% benchmark	Plot 3
Tree Richness	3	0.75	2.25	1
Shrub Richness	3	0.75	2.25	1
Grass and Grass Like Richness	8	2	6	16
Forb Richness	10	2.5	7.5	15
Fern Richness	1	0.25	0.75	1
Other Richness	1	0.25	0.75	1
Tree Cover	19	4.75	14.25	15
Shrub Cover	1	0.25	0.75	0.3
Grass and Grass Like Cover	32	8	24	33.9
Forb Cover	6	1.5	4.5	66.5
Fern Cover	0	0	0	0.1
Other Cover	0	0	0	2
Total length of fallen logs	41	10.25	30.75	26
Litter Cover	55	13.75	41.25	27
Number of Large Trees (>50dbh)	4	1	3	3

Key:
green = 75 percent or greater of benchmark (good),
blue = between 25 percent and 75 percent of benchmark (average)
red = indicates less than 25 percent of the benchmark (poor).

Table 4-4: PCT 76 default benchmarks for plot 4

PCT76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions Class/IBRA: Floodplain Transition Woodlands / NSW South Western Slopes				
Attribute	Benchmark value	25% benchmark	75% benchmark	Plot 4
Tree Richness	3	0.75	2.25	1
Shrub Richness	4	1	3	5
Grass and Grass Like Richness	6	1.5	4.5	6
Forb Richness	10	2.5	7.5	14
Fern Richness	1	0.25	0.75	0
Other Richness	1	0.25	0.75	0
Tree Cover	31	7.75	23.25	28
Shrub Cover	2	0.5	1.5	0.6
Grass and Grass Like Cover	23	5.75	17.25	45.4
Forb Cover	5	1.25	3.75	3
Fern Cover	0	0	0	0
Other Cover	0	0	0	0
Total length of fallen logs	49	12.25	36.75	15
Litter Cover	65	16.25	48.75	31.6
Number of Large Trees (>50dbh)	3	0.75	2.25	2

Key:
green = 75 percent or greater of benchmark (good),
blue = between 25 percent and 75 percent of benchmark (average)
red = indicates less than 25 percent of the benchmark (poor).

Table 4-5: PCT 76 wet rainfall year (>593 mm) benchmarks for plot 4

PCT76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions Class/IBRA: Floodplain Transition Woodlands / NSW South Western Slopes				
Attribute	Benchmark value	25% benchmark	75% benchmark	Plot 4
Tree Richness	3	0.75	2.25	1
Shrub Richness	5	1.25	3.75	5
Grass and Grass Like Richness	7	1.75	5.25	6
Forb Richness	11	2.75	8.25	14
Fern Richness	1	0.25	0.75	0
Other Richness	1	0.25	0.75	0
Tree Cover	38	9.5	28.5	28
Shrub Cover	2	0.5	1.5	0.6
Grass and Grass Like Cover	35	8.75	26.25	45.4
Forb Cover	6	1.5	4.5	3
Fern Cover	0	0	0	0
Other Cover	0	0	0	0
Total length of fallen logs	49	12.25	36.75	15
Litter Cover	65	16.25	48.75	31.6
Number of Large Trees (>50dbh)	3	0.75	2.25	2

Key:
green = 75 percent or greater of benchmark (good),
blue = between 25 percent and 75 percent of benchmark (average)
red = indicates less than 25 percent of the benchmark (poor).

Table 4-6: PCT270 default benchmark for plot 5

PCT270 - White Box - Tumbledown Red Gum - Long-leaved Box shrub/grass woodland on fine-grained sediments of the upper Macquarie River gorge, NSW central western slopes Class/IBRA: Western Slopes Dry Sclerophyll Forests / NSW South Western Slopes				
Attribute	Benchmark value	25% benchmark	75% benchmark	Plot 5
Tree Richness	5	1.25	3.75	4
Shrub Richness	9	2.25	6.75	1
Grass and Grass Like Richness	6	1.5	4.50	9
Forb Richness	8	2	6	19
Fern Richness	1	0.25	0.75	0
Other Richness	1	0.25	0.75	0
Tree Cover	60	15	45	20.1
Shrub Cover	10	2.5	7.5	0.3
Grass and Grass Like Cover	15	3.75	11.25	32.2
Forb Cover	4	1	3	3.6
Fern Cover	0	0	0	0
Other Cover	0	0	0	0
Total length of fallen logs	67	16.75	50.25	12.5
Litter Cover	66	16.5	49.50	26.4
Number of Large Trees (>50dbh)	1	0.25	0.75	0

Key:
green = 75 percent or greater of benchmark (good),
blue = between 25 percent and 75 percent of benchmark (average)
red = indicates less than 25 percent of the benchmark (poor).

Like last year, all plots showed one or more attributes below the 25 percent benchmark scores. However, all sites had increases overall in benchmark scores in the 25-75% range and >75% range, indicating an improvement across all plots. There were some notable differences:

Plot 1:

- Plot one had a forb cover decrease of 46.4%, possibly due to a reduction of *glycine spp.*
- No large trees, however, tree stem size classes have increased from last year, indicating progress towards this benchmark

Plot 2:

- A miscalculation in last year's grass foliage cover was presented as 41.4% but was actually 24%.
- Plot two had a similar, >75% benchmark, score for grass species richness, however its foliage cover decreased into the 25-75% benchmark, due to a decrease in foliage cover across all species

Plot 3:

- Plot three had a shrub cover decrease of 19.7%, due to a reduction of *Myoporum debile / Eremophila debilis*
- No scores less than the <25% benchmark

Plot 4:

- Plot four had a tree cover increase of 13%, due to increase in *Eucalyptus microcarpa*.
- Plot four had a decrease in grass cover by 25.9% and litter cover by 20.5%. Also, the only plot to be compared wet benchmarks.

Plot 5:

- Plot five forb richness increased by 14 *spp.*, tree cover increased by 8.1% and litter cover increased by 14.4%
- While no large trees are present, a significant increase in regrowth and smaller DBH classes is improvements on previous years and progress towards achieving the large DBH benchmark

4.3 Photographic record

Photographs were taken at the start and end points of each vegetation plot, along with photos of each of the plot square placements (Table 4-7). Photos of the start point, for each plot, for each year, are compiled in Table 4-8 as another record of plot progress.

Table 4-7: Plot photographs January 2023

2024 monitoring
PLOT 1
Midline start

Midline end

Groundcover quadrats


2024 monitoring

PLOT 2

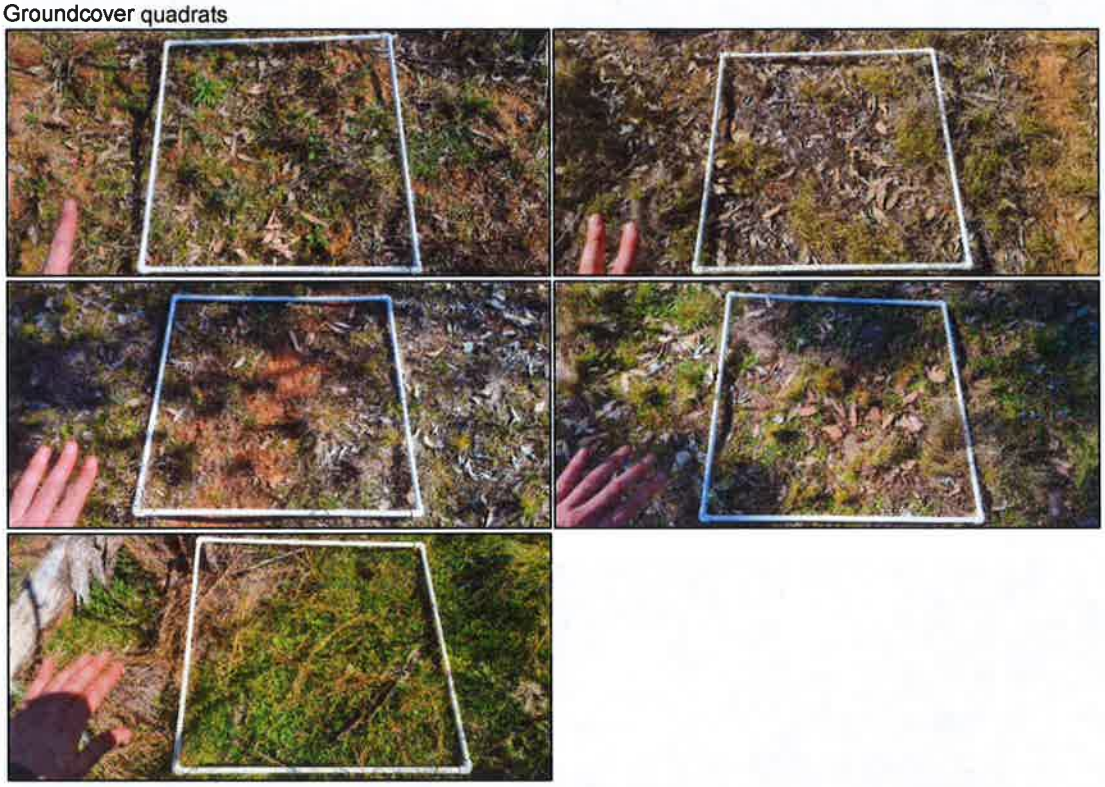
Midline start

Midline end

The tree shown in the midline end is deceased.

2024 monitoring

Groundcover quadrats

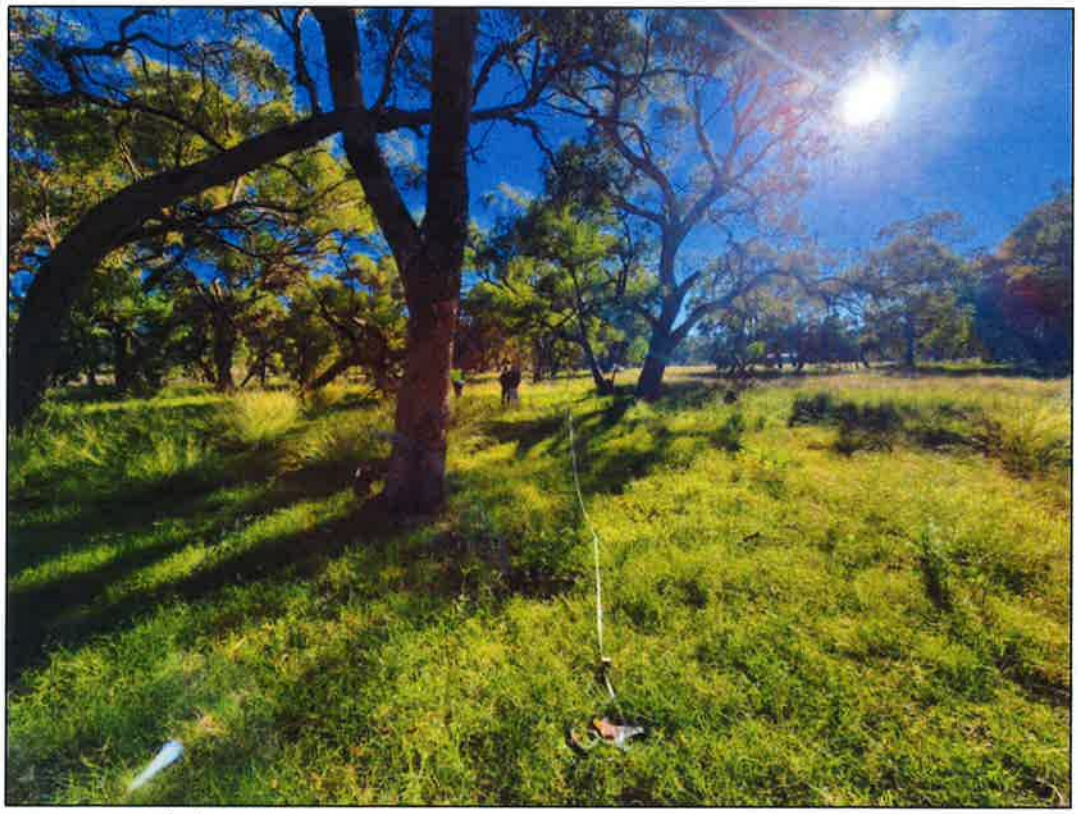


PLOT 3

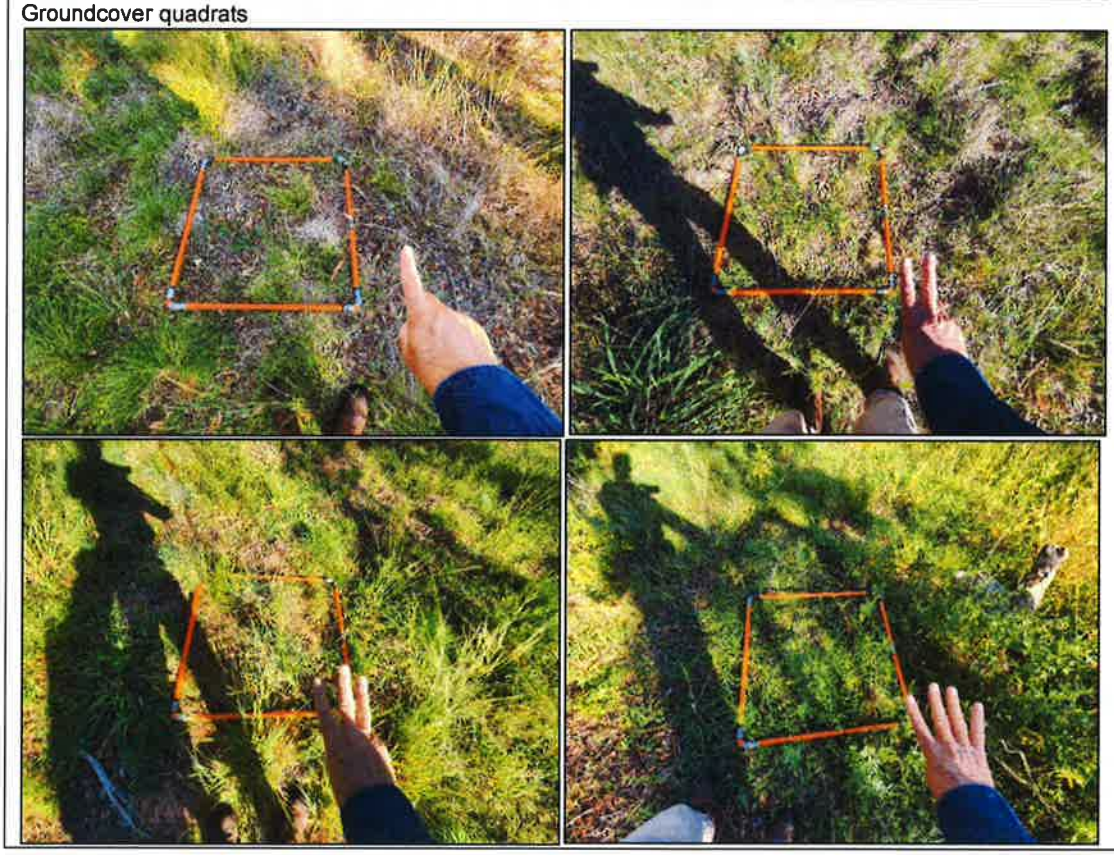
Midline start

2024 monitoring

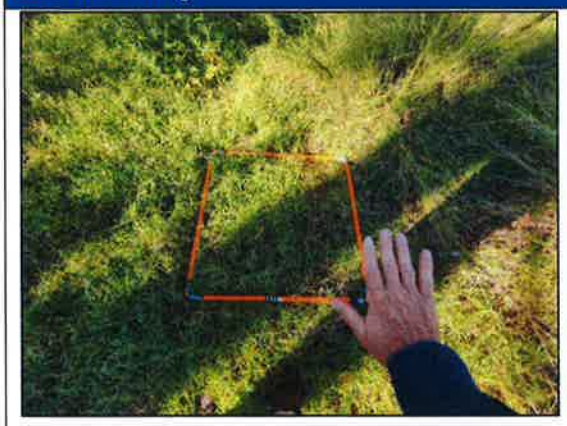
Midline end



Groundcover quadrats



2024 monitoring



PLOT 4

Midline start

Midline end

Groundcover quadrats

2024 monitoring

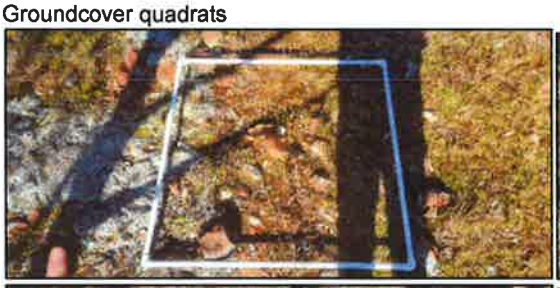
PLOT 5

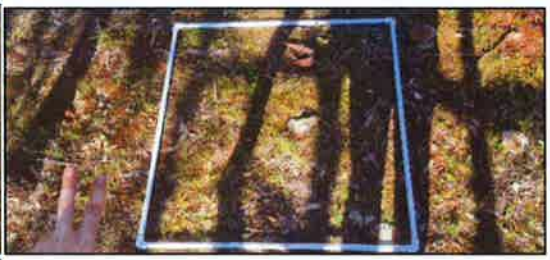
Midline start

Midline end

2024 monitoring

Groundcover quadrats





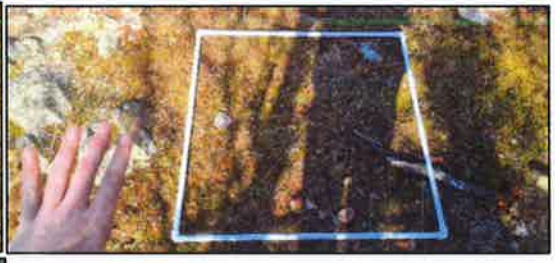


Table 4-8: Photo point comparison

PLOT 1		
From Biodiversity Management Plan (2015)	Monitoring September 2019	Monitoring September 2020
		
Monitoring June 2022	Monitoring January 2023	Monitoring July 2024
		

PLOT 2

From Biodiversity Management Plan (2016)	Monitoring September 2019	Monitoring September 2020
		
Monitoring June 2022	**Monitoring January 2023**	**Monitoring July 2024**
No midline start recorded for 2021		

PLOT 3

Biodiversity Management Plan (2016)

Monitoring September 2019

Monitoring September 2020

Monitoring June 2022

Monitoring January 2023

Monitoring July 2024

PLOT 4

Biodiversity Management Plan (2016)	Monitoring September 2019	Monitoring September 2020
		
Monitoring June 2022	**Monitoring January 2023**	**Monitoring July 2024**
		

PLOT 5

Biodiversity Management Plan (2016)	Monitoring September 2019	Monitoring September 2020
		
Monitoring June 2022	**Monitoring January 2023**	**Monitoring July 2024**
		

4.4 2024 BAM calculations

Data for composition, structure, and function are entered into the BAM calculator (BAMC), where scores for each component are generated and an overall Vegetation Integrity (VI) score is calculated, presented in Table 4-9. BAMC is periodically updated which may change the results if the same data is processed later.

Table 4-9: BAM results July 2024 monitoring effort

Plot number	PCT	Composition score	Structure score	Function score	Vegetation integrity score
1	267	89.8	90.9	54.3	76.3
2	267	86	74.8	54.5	70.5
3	201	83.3	96.8	65.7	80.9
4	76	83.3	94.7	44.8	70.7
5	270	63.1	40.1	31.3	43

4.5 Comparison of BAM calculations

The data collected under BAM 2020 for previous monitoring events has been compiled in comparison tables to demonstrate the overall change in condition for plots 1 – 5 (Table 4-10 to Table 4-13).

The composition scores increased across all plots from 2023 to 2024 and was also the highest score recorded for plots 1, 3, and 4 since the implementation of BAM in 2019 (Table 4-10). There was a general increase in forbs species richness across all plots, reversing the trend from previous years scores.

Table 4-10: Composition score

Plot number	2019	2020	June 2022	January 2023	July 2024
1	73.6	65.7	81.5	70.2	89.9
2	75.8	79	87.4	78.1	86
3	67.6	76.7	74.7	75.6	83.3
4	74.1	62.7	50.5	62.4	83.3
5	41.8	64	65.6	57.1	63.1

Structure scores varied with some minor changes in plots 1, 2, and 3, however, there were notable increases in plot 4 and 5 (Table 4-11). The increase in the structure score at plot four is the result of an increase in foliage cover of tree species. It seems that higher tree and grass cover contributes to a high total structure score for PCT76, supported by data from previous years. For plot 5, while the trend of its grass and forb cover decreasing is consistent, its increase in tree cover improves its overall structure score. Also observed at the site was a high number of regenerating saplings.

Table 4-11: Structure score

Plot number	2019	2020	June 2022	January 2023	July 2024
1	50.3	43.7	98.2	95.4	90.9
2	55.3	66.2	81.7	73.1	74.8
3	98.2	89.5	89.4	94.8	96.8
4	96.5	73.5	95.2	74.4	94.7
5	20.6	21.5	24.3	27.2	40.1

Function scores remained relatively unchanged, except for the increase in plot 3 and the decrease in plot 4 (Table 4-12). There was an increase of fallen logs and litter cover at plot 3, improving its overall function score. A reduction in litter cover and the removal of two larger trees at plot 4 could be credited to its decline. The plot has a history of being slashed (or similar), as it occurs on private property outside of the BOA.

Table 4-12: Function score

Plot number	2019	2020	June 2022	January 2023	July 2024
1	55.8	46.9	48.4	50.4	54.3
2	79.3	61.3	80.8	57.1	54.5
3	72.2	58.7	79.4	52.9	65.7
4	70.6	67.3	71.9	54.7	44.8
5	54.3	32.1	38.2	30.9	31.3

The VI scores reflect the results from the composition, structure and function scores, with all plots increasing in VI compared to last year's results (Table 4-13). Most notably, plot 3 is equal with its highest VI score, and plots 1 and 5 increased to their highest recorded VI score since the implementation of BAM in 2019.

Table 4-13: Vegetation integrity score

Plot number	2019	2020	June 2022	January 2023	July 2024
1	59.1	51.3	72.9	69.7	76.3
2	69.3	68.4	83.2	68.8	70.5
3	78.3	73.9	80.9	72.4	80.9
4	79.6	67.7	70.2	63.3	70.7
5	36	35.3	39.4	36.3	43

4.6 Invasive and exotic species

There was evidence of feral pigs (*Sus scofra*) presence at plot 2 and nearby plot 5, in the form of diggings. This remains consistent with observations from last year. Compared to last year, the species richness varied, however foliage cover increased at all plots except plot 2 (Table 4-14). This year, all plots had varying degrees of exotic species richness and foliage cover, with plot 4 having the highest at 44.1% foliage cover, due to a high coverage of *Lolium perenne* and *Hordeum leporinum*.

Table 4-14: Exotic species richness and foliage cover per plot, from 2023 and 2024

Plot Number	Exotic species richness		Exotic species foliage cover (%)	
	2023	2024	2023	2024
Plot 1	13	7	8.4	21
Plot 2	9	9	7.5	6.2
Plot 3	13	9	8.6	24.2
Plot 4	5	13	5.4	44.1
Plot 5	1	7	0.1	5.6

A total of 26 exotic plant species were observed, including high threat weeds (HTW). Compared to last year, the species list is quite different, with only six species observed in both 2023 and 2024. Three HTWs were recorded, which was the same richness count as last year but different species. Plot 3 had a 5.1% foliage cover of HTW and plot 2 had a 0.1% foliage cover. Observed exotic species are recorded in Table 4-15 and HTW species in Table 4-16.

Table 4-15: Exotic species recorded in the July 2024 survey

Scientific name	Common name
Anagallis arvensis	Scarlet pimpernel
Arctotheca calendula	Cape weed
Asphodelus fistulosus	Onion weed
Cyperus rotundus	Cyperus nut grass
Echium plantagineum	Pattersons curse
Erigeron bonariensis	Hairy fleabane
Exotic grass sp.	N/A
Galium aparine	Cleavers
Hordeum leporinum	Barley grass
Hypochaeris radicata	Flat weed
Lactuca serriola	Prickly lettuce
Lolium perenne	Rye grass
Lolium sp.	N/A
Marrubium vulgare	White horehound
Medicago spp	Clover
Modiola caroliniana	Red flowering mallow
Solanum nigrum	Blackberry Nightshade
Sonchus oleraceus	Sow thistle
Sysimbrium irio	London rocket
Trifolium arvense	Hares foot clover
Verbascum virgatum	Twiggy mullein
Weed sp juvenile	N/A

Table 4-16: High Threat exotics recorded in the January 2023 survey

Scientific name	Common name
Bidens spp	Farmers friends
Heliotropium amplexicaule	Blue heliotrope
Paspalum dilatatum	Paspalum

5 Conclusions

This document addressed monitoring actions in the approved Biodiversity Management Plan shown on Table 5-1.

Table 5-1: Project comments against Development Conditions of Consent

Location	Monitoring action	Frequency	Comment
Control Site and Analogue Sites 1 to 5	BioMetric Vegetation Condition Benchmark	Annual	Monitoring completed – July 2024

Vegetation integrity scores increased at all plots but most notably, plot 1 and plot 5 recorded their highest VI scores since the implementation of monitoring under the BAM system in 2019. Plot 5 has had historically low scores across all components of the BAM but improvements in composition and structure this year have seen its VI increase to the highest score since BAM monitoring started. This is mainly due to its increase in tree foliage cover, and with a high abundance of regenerating saplings present within the plot, its VI should continue to improve.

Exotic plant species have no identifiable trend with their increase in richness across all plots. It was thought that last years observed increase in exotic plant species richness was due to above average rainfall, in the year leading up to the monitoring, and lower composition scores. However, during this year's monitoring, composition scores increased, rainfall total was in line with the average, or above in the case of plot 4, for the region and exotic plant species richness and foliage cover still increased.

6 Reference sources

BoM. (2022). *Climate Statistics for Australian Locations: Dubbo Airport AWS* . Retrieved from http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=065070

Cunningham, G.G. (1992) Plants of Western New South Wales. Inkata Press, Sydney.

Department of Planning, Industry and Environment. (2020). Biodiversity Assesssment Methodology. Sydney: NSW Government.

Department of Planning and Environment. (2022). BioNet Vegetation Classification. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/about-bionet-vegetation-classification

Royal Botanic Gardens and Domain Trust, Sydney (online). (2023). PlantNET (The NSW Plant Information Network System). Retrieved from PlantNET (The NSW Plant Information Network System): http://plantnet.rbgsyd.nsw.gov.au

Richardson, F.J., Richardson R.G. and Shepherd, R.C.H. (2016) Weeds of the south-east – An identification guide for Australia. 3rd Ed. R.G. and F.J. Richardson, Meredith, Victoria

7 Appendix A - 2024 BAM Plot sheets

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of **Date** 23/7/24 **Survey name** Dubbo Project **Plot identifier** Plot # 1

Recorders Addy Watson, Dylan Chan **IBRA region** **Veg zone ID**

[1]Datum **Coordinate system** ☐ Projected ☐ Geographic **MGA zone** **[1]X coordinate** 652 434 **[1]Y coordinate** 6405473

Location description descriptive notes to locate site without grid reference

[1] Plot dimensions For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m **[1] Orientation of midline from 0 m point** Magnetic 112° **Photo #**

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (**richness**) in each growth form group (not individual plants within each growth form)	Trees (TG)	2	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	18	80 + cm	Count: —
	Shrubs (SG)	1		Shrubs (SG)	0.1	50 – 79 cm	Count (best practice): —
	Grasses etc. (GG)	9		Grasses etc. (GG)	46.5	30 – 49 cm	Count (best practice): 14
	Forbs (FG)	14		Forbs (FG)	2.1	20 – 29 cm	Count (best practice): 17
	Ferns (EG)	1		Ferns (EG)	0.1	10 – 19 cm	Count (best practice): 5
	Other (OG)	1		Other (OG)	0.2	5 – 9 cm	Count (best practice): —
						[4]Tree regeneration <5 cm	Tick: ✓
			Total high threat weed cover		—	[5]Length of fallen logs	Tally space: Total: 31 m
						[6]Hollow bearing trees	Tick: —

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	12	28	43	18	19	1	1	1	1	3	0	0	0	0	1	28	28	20	43	21
Average of the 5 subplots	24					1.4					0.2					27.4				

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8]Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) EEC Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=slight, 2=moderate, 3=severe

Brief site description or other notes

Cypress pine

Casuarina

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot: **Survey name** **Plot identifier** **Recorders**

Date 23 07 24 Dubbo Project Cypress Pine AL JC

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund -ance	Voucher
TG	Callitris glaucophylla	N	15	15	
TG	Brachychiton populneus	N	3	2	
GG	Austrostipa scabra	N	10	1000	
GG	Microlaena stipoides	N	25	1000	
—	Trifolium sp Clover	E	10	1000	
EG	Cheilanthes sieberi	N	0.1	50	
—	Sonchus oleraceus Sow thistle	E	0.1	100	
—	Arctotheca calendula Cape weed		0.5	500	
FG	Dichondra repens Kidney weed	N	0.3	500	
FG	Sida corrugata	N	0.1	10	
FG	Erodium crinitum		0.1	10	
GG	Aristida ramosa	N	5	1000	
OG	Glycine tabacina	N	0.2	200	
EG	Tricoryne elatior Yellow Star	N	0.1	5	
GG	Panicum effusum Hairy panic	N	0.2	100	
—	Hypochaeris radicata Flat weed	E	10	1000	
FG	Ajuga australis Australian bugle	N	0.1	5	
FG	Daucus glochidiatus Australian carrot	N	0.1	500	
GG	Eragrostis gracilis 'Bellevue'	N	5	1000	
—	Lysimachia arvensis Scarlet pimpernel	E	0.1	50	
—	Medicago sp	E	0.2	1000	
GG	Panicum decompositum	N	1	500	
FG	Arthropodium minus (rosette only) vanilla lily	N	0.1	100	
IG	Bulbine sp	N	0.1	5	
GG	Rytidosperma sp	N	0.1	20	
FG	Einadia nutans	N	0.1	5	
TG	Hyalosolyle laevis	N	0.2	20	
FG	Villadia cunicularis	N	0.1	5	
GG	Sporobolus creber	N	0.1	5	
GG	Eragrostis leptostachya	N	0.1	20	
FG	Vittadinia dissecta Early Nancy	N	0.1	20	
IG	No degradation G/L	N	0.5	500	
—	Lolium sp	E	0.1	100	
FG	Plantago cunninghamiana Sage weed	N	0.1	5	
SG	Dodonaea viscosa	N	0.1	1	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Sheet 1/2

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of **Date** 23/7/24 **Survey name** Dubbo Project **Plot identifier** Plot #2

Recorders **IBRA region** **Veg zone ID**

[1]Datum **Coordinate system** ☐ Projected ☐ Geographic **MGA zone** **[1]X coordinate** 652672 **[1]Y coordinate** 6406658

Location description descriptive notes to locate site without grid reference

[1]Plot dimensions For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m **[1]Orientation of midline from 0 m point** Magnetic 176° **Photo #**

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)	2	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	10.1	80 + cm	Count: —
	Shrubs (SG)	1		Shrubs (SG)	0.1	50 – 79 cm	Count (best practice): tick; If large tree benchmark size ≥80 cm: count: —
	Grasses etc. (GG)	10		Grasses etc. (GG)	10.8	30 – 49 cm	Count (best practice): tick; If large tree benchmark size 50-80 cm: count: one
	Forbs (FG)	18		Forbs (FG)	11.6	20 – 29 cm	Count (best practice): tick; If large tree benchmark size 30-50 cm: count: one
	Ferns (EG)	1		Ferns (EG)	0.2	10 – 19 cm	Count (best practice): tick; If large tree benchmark size 20-30 cm: count: three
	Other (OG)	0		Other (OG)	0	5 – 9 cm	Count (best practice): tick; If large tree benchmark size 10-20 cm: count: two
						[4]Tree regeneration <5 cm	Tick: ✓
			Total high threat weed cover		0.1	[5]Length of fallen logs	Total: 24 m
						[6]Hollow bearing trees	Tick: one

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	39	34	16	26	12	19	1	24	1	0	9	0	3	4	0	0	0	6	0	0
Average of the 5 subplots	29.4					9					3.2					0				

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8]Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) EEC Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

White box large >80cm DBH dead tree
Evidence of pigs digging
lots of hollows

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Sheet 1/2

400 m² floristics plot: **Survey name** **Plot identifier** **Recorders**

Date 23 07 24 Dubbo Project 2 AW DC

White Box

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
TG	Eucalyptus albens		N	10	12	
TG	Callitris glaucophylla		N	0.1	2	
GG	Aristida ramosa		N	10	1000	
GG	Eragrostis macra		N	2	200	
FG	Cymbonotus lawsonianus	Bears ears	N	0.1	25	
FG	Arthropodium minus	Small vanilla lily	N	1	200+	
FG	Wahlenbergia sp		N	0.1	50	
–	Hypochaeris radicata		E	0.5	200	
FG	Goodenia pinnatifida		N	0.1	100	
GG	Panicum sp		N	3	1000	
FG	Rumex brownii		N	0.1	5	
FG	Daucus glochidiatus	Aust carrot	N	0.1	100	
FG	Wurmbea dioica	Early nancy	N	0.1	200	
FG	Convolvulus		N	10	1000'	
LG	Cheilanthes sieberi		N	0.2	100+	
	Glycine clandestina		N	0.1	20	
FG	Dichondra repens		N	2	1000	
–	Asteraceae sp		–	3	100'	
FG	Hydrocotyle laxiflora		N	0.2	200	
GG	Austrostipa scabra		N	0.3	200'	
FG	Gonocarpus elatus		N	0.1	50	
SG	Sclerolaena diacantha		N	0.1	1	
FG	Lepidium sp		N	0.1	5	
GG	Eragrostis sp		N	2	1000	
FG	Sida corrugata		N	0.1	5	
FG	Vittadinia cuneata		N	0.1	5	
GG	Juncus sp (Rushes)		N	0.1	20	
–	Aristida calycina	Grass	E	0.1	50	
FG	Erodium crinitum		N	0.1	25	
–	Echium plantagineum		E	0.1	15	
–	Weed sp - juvenile		E	0.1	100	
GG	Lomandra filiformis		N	0.1	1	
GG	Bracteantha bracteata		N	0.1	10	
FG	Euphorbia dallachyana		N	0.1	5	
–	Trifolium arvense	Hares foot clover	E	0.1	10	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Sheet 2/2

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of **Date** 25/11/24 **Survey name** Dubbo Project **Plot identifier** Plot #2 Watboo

Recorders Addy Watson, Dylan Chu **IBRA region** **Veg zone ID**

[1]Datum **Coordinate system** ☐ Projected ☐ Geographic **MGA zone** **[1]X coordinate** 682672 **[1]Y coordinate** 6410668

Location description descriptive notes to locate site without grid reference

[1]Plot dimensions For composition & structure: 20 m x 20 m; For function (1000m²): 20 m x 50 m **[1]Orientation of midline from 0 m point** Magnetic 176° **Photo #**

Datum: AGD66 WGS84 GDA94 GDA2020 or Other (specify) **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW) 55 (Central NSW or 54 (Western NSW) **X/Y coordinate** Long/Lat (for Projected coordinate system) Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)	2	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	10.1	80 + cm	
	Shrubs (SG)	1		Shrubs (SG)	0.1	50 – 79 cm	
	Grasses etc (GG)	10		Grasses etc (GG)	19.8	30 – 49 cm	1
	Forbs (FG)	18		Forbs (FG)	11.6	20 – 29 cm	1
	Ferns (EG)	1		Ferns (EG)	2.2	10 – 19 cm	3
	Other (OG)	0		Other (OG)	0	5 – 9 cm	2
						[4]Tree regeneration <5 cm	✓
			Total high threat weed cover		0.1	[5]Length of fallen logs	24
						[6]Hollow bearing trees	1

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots				

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8]Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) **EEC** Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity 0=no evidence 1=slight 2=moderate 3=severe Age R=recent (<3yrs) NR=not recent (3-10yrs) O=old (>10yrs)

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Sheet 2/2

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 23 7 24	Dubbo Project	Plot #2 Whitebox	AW DC

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
CG	Panicum effusum	N	0.1	50	
FG	Calotis cuneifolia	N	0.1	1	
–	Solanum nigra	E	0.1	1	
CG	Elymus scaber	N	0.1	10	
FG	Xerochrysum viscosum	N	0.1	1	
–	Erigeron bonariensis	E	0.1	5	
–	Heliotropium amplexicaule	E	0.1	5	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers 1-8 on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of	**Date** 25/4/24	**Survey name**	Dubbo Project ASM Monitoring April 2024	**Plot identifier**	Fuzzy Box 3
Recorders	PJC, Tom C	**IBRA region**		**Veg zone ID**	
[1]Datum	**Coordinate system** □ Projected □ Geographic	**MGA zone**	**[1]X coordinate** 648 685	**[1]Y coordinate**	6402581
Location description	descriptive notes to locate site without grid reference				
[1]Plot dimensions	For composition & structure (400m²) 20 m x 20 m ✓ For function (1000m²) 20 m x 50 m ✓	**[1]Orientation of midline from 0 m point**	Magnetic 200°	**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation Integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2]foliage cover of native plant species by growth form group	Trees (TG)	15	80 + cm	Count 1
	Shrubs (SG)	1		Shrubs (SG)	0.3	50 – 79 cm	Count (tick if applicable) If large tree benchmark size ≥50 cm count ‖
	Grasses etc. (GG)	16		Grasses etc. (GG)	33.9	30 – 49 cm	Count (tick if applicable) If large tree benchmark size ≥30 cm count ‖‖
	Forbs (FG)	15		Forbs (FG)	66.5	20 – 29 cm	Count (tick if applicable) If large tree benchmark size ≥20 cm count 1
	Ferns (EG)	1		Ferns (EG)	0.1	10 – 19 cm	Count (tick if applicable) –
	Other (OG)	1		Other (OG)	2	5 – 9 cm	Count (tick if applicable) –
						[4]Tree regeneration <5 cm	Tick –
	invasive sp.	8	Total high threat weed cover		5.1	[5]Length of fallen logs	Tally space – Total 26
						[6]Hollow bearing trees	Tick ‖ eleven

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	25	30	15	40	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	27					0					0					0				

These attributes require consideration of site observations and may be completed after field work

Vegetation class		**[8]Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type	Alluvium	Landform element	Creek Flat	Landform pattern	Plain	Microrelief	+ or 5cm
Lithology	Basalt	Soil surface texture	Soft	Soil colour	Dark brown	Soil depth	Deep
Slope	Flat	Aspect	–	Site drainage	Good	Distance to nearest water and type	50m, 3rd Order

Disturbance	Severity code	Age code
Clearing (inc. logging)	–	–
Cultivation (inc. pasture)	–	–
Soil erosion	–	–
Firewood / CWD removal	2	R
Grazing (id. native/stock)	–	–
Fire damage	–	–
Storm damage	1	R
Weediness	1	R
Other	–	–

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
– m	– m	– m	15 m	15 m	12 m	– m	– m	0.1 m	2 m	0.3 m	0.1 m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe   Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

FG 43 Cymbonotus preissianus N 0.1 25

HH Verbascum virgatum

400 m² floristics plot: **Survey name** **Plot identifier** **Recorders**

Date 23 4 24

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover %	Abund -ance	Voucher
TG	Eucalyptus Conica					
GG	Aristida Ramosa					
FG	Hydrocotyle laxiflora			15		
OG	Glycine Clandestina			2	80	
FG	Einadia nutans			2		
GG	Chloris truncata			0.1	1	
GG	Juncus Sp. 1			0.1	5	
EG	Chrysocephalum sieberi			0.1	5	
FG	Calotis lappulacea			5		
GG	Cynodon dactylon			10	200	
–	Asphodelus fistulosus	onion weed		2	50	*
–	Cyperus sp.			15	60	
FG	Commelina diffusa	scurvy weed		15	60	
FG	Senna barclayana	Peppered Senna		1	0.1	
–	Rubus parvus			2	2.0	*
FG	Dichondra repens			20	80	
FG	Oxalis sp.			0.1	5	
–	Oxalis dilatata			0.1	2	*
GG	Microlaena stipoides			1	15	
FG	Salvia verbenaceus			3	5	
FG	Diamella racemosa			0.1	3	
GG	Paspalidium constrictum			0.1	1	
GG	Bothriochloa macra			1	15	
GG	Cirsium vulgare			15		
GG	Panicum effusum			0.5	5	
GG	Sporobolus elongatus			0.5	5	
GG	Austrostipa nodosa			2	20	
–	Medicago sp.			0.1	1	
FG	Chrysocephalum sp.			3	12	
GG	Austrostipa scabra			2	20	
–	Marrubium vulgare			3		
–	Exotic grass sp.				1	
FG	Sida corrugata			1	15	
–	Red Flowering Herb			1	15	
FG	Wahlenbergia sp.			0.1	15	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

GG Digeniculata 0.5 2

FG Vittadinia cuneata 1 10

Sheet 1 of 2

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of **Date** 23/7/24 **Survey name** Dubbo Project **Plot identifier** Plot #4

Recorders Addy Walker, Dylan Chant **IBRA region** **Veg zone ID**

[1]Datum **Coordinate system** ☐ Projected ☐ Geographic **MGA zone** **[1]X coordinate** 648038 **[1]Y coordinate** 6407726

Location description descriptive notes to locate site without grid reference

[1] Plot dimensions For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m **[1] Orientation of midline from 0 m point** Magnetic: 32° **Photo #**

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify) **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW) **X/Y coordinate**: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure (400 m² plot)**		Sum values (%) (may sum to >100%)	**Function (1000 m² plot)** [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	28	80 + cm	Count: one
	Shrubs (SG)	5		Shrubs (SG)	0.6	50 – 79 cm	Count (best practice)/tick If large tree benchmark size ≥50 cm: count: 0 / 2
	Grasses etc (GG)	6		Grasses etc (GG)	45.4	30 – 49 cm	Count (best practice)/tick If large tree benchmark size ≥ 30 cm: count: 0 / 2
	Forbs (FG)	4		Forbs (FG)	3	20 – 29 cm	Count (best practice)/tick If large tree benchmark size ≥ 20 cm: count: –
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	Count (best practice)/tick –
	Other (OG)	6		Other (OG)	0	5 – 9 cm	Count (best practice)/tick –
			Total high threat weed cover	%		[4]Tree regeneration <5 cm	Tick –
						[5] Length of fallen logs	Tally space: Total: 15 m
						[6] Hollow bearing trees	Tick: 4 trees

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)				Bare ground cover (%)				Cryptogam cover (%)				Rock cover (%)			
Subplot score (% in each)	10	22	44	9	75	0	5	1	5	7	0	0	0	1	0	0	0	0	0	0
Average of the 5 subplots	31.6				2.2				0.2				0			

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8]Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) EEC Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Reg 1.5m into the plot
Grey box

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Sheet 1/2

400 m² floristics plot: **Survey name** **Plot identifier** **Recorders**

Date 23 07 24 Dubbo Project 4 Nat JC

Grey Box

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
TG	Eucalyptus microcarpa		N	28	2	
GG	Austrostipa verticillata		N	35	1000	
GG	Austrostipa nodosa		N	5	1000	
GG	Rytidosperma sp.		N	5	500	
—	Hordeum (glaucum?)	Barley Grass	E	10	1000	
—	Lolium sp	Rye grass	E	30	1000	
—	Galium aparine	Cleavers	E	2	20	
FG	Sida corrugata		N	0.1	25	
FG	Goodenia pinnatifolia		N	0.5	100	
FG	Calotis sp			0.1	5	
FG	Galium sp		E	0.2	100	
FG	Wahlenbergia sp		N	0.1	100	
FG	Einadia nutans		N	1	15	
SG	Schoenus sp		N	0.1	10	
—	[illegible]		E	0.2	100	
TG	Callitris monoxyla		N	0.1	100	
GG	Eriochloa pseudoacrotricha	Early spring grass	N	0.2	25	
TG	Acacia [illegible]		N	0.1	100	
SG	[illegible]	Stackhousia	N	0.2	2	
FG	Dichondra sp.	Kidney weed	N	0.1	100	
GG	[illegible]		N	0.1	25	
—	Medicago sp		E	0.5	200	
—	Sysimbrium sp.		E	0.1	10	
FG	Calotis hispidula	Hairy burr daisy	N	0.1	10	
—	Malva parviflora	marshmallow	E	0.5	20	
—	[illegible]	Paterson's curse	E	0.1	10	
—	Sisymbrium sp.	London rocket	E	0.1	5	
FG	Erodium crinitum		N	0.1	5	
FG	Xerochrysum bracteatum	Golden Everlasting	N	0.1	10	
SG	Schoenus clandestinus		N	0.1	5	
SG	Schoenus apogon	Black root-sedge	N	0.1	10	
SG	Schoenus brevifolius	Grey bog-sedge	N	0.1	5	
FG	Einadia polygonoides		N	0.2	5	
—	Lactuca serriola	Prickly lettuce	E	0.1	5	
—	Arctotheca calendula	Cape weed	E	0.1	5	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Sheet 2 of 2

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of **Date** 25/7/24 **Survey name** Dubbo Project **Plot identifier** Plot #1 4 Corner box

Recorders Addy Watson, Dylan Chew **IBRA region** **Veg zone ID**

[1]Datum **Coordinate system** ☐ Projected ☐ Geographic **MGA zone** **[1]X coordinate** 648036 **[1]Y coordinate** 6467126

Location description descriptive notes to locate site without grid reference

[1]Plot dimensions For composition & structure (0.04ha) 20m x 20m; For function (0.1ha) 20m x 50m **[1]Orientation of midline from 0 m point** Magnetic 32° **Photo #**

Datum: AGD66 WGS84 GDA94 GDA2020 or Other (specify) **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW) 55 (Central NSW or 54 (Western NSW) **X/Y coordinate** Long/Lat (for Projected coordinate system) Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of **[2] foliage cover** of native plant species by growth form group	Trees (TG)	28	80 + cm	Count 1
	Shrubs (SG)	5		Shrubs (SG)	0.6	50 – 79 cm	Count best practice site 1
	Grasses etc. (GG)	6		Grasses etc. (GG)	45.4	30 – 49 cm	Count best practice site 1
	Forbs (FG)	4		Forbs (FG)	3	20 – 29 cm	Count best practice site –
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	–
	Other (OG)	0		Other (OG)	0	5 – 9 cm	–
			Total high threat weed cover			[4]Tree regeneration <5 cm	Tick –
						[5]Length of fallen logs	Tally score 15
						[6]Hollow bearing trees	Tick 2

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots				

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8]Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) **EEC** Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood, CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=slight, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom

Sheet 2/2

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 23 7 24	Dubbo Project	4 Grey box	Aw Dc

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
FG	Eremophila debris	N	0.2	5	
GG	Dianella revoluta	N	0.1	5	
–	Marrubium vulgare	E	0.2	5	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*. Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

page 1 of 2

Numbers 1-8 on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date** 23/7/24	**Survey name** Dubbo Project	**Plot identifier**	Plot #5
Recorders	Addy Watson, Dylan Cheen	**IBRA region**		**Veg zone ID**	
[1]**Datum**	**Coordinate system** ☐ Projected ☐ Geographic	**MGA zone**	[1]**X coordinate** 652 722	[1]**Y coordinate**	6410 1474

Location description Descriptive notes to locate site without grid reference

[1] **Plot dimensions** For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m

[1] **Orientation of midline from 0 m point** Magnetic 129° | **Photo #**

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify) MGA Zone (for Projected coordinate system only) 56 (Coastal NSW), 55 (Central NSW) or 54 (Western NSW) X/Y coordinate Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (**richness**) in each growth form group (not individual plants within each growth form)	Trees (TG)	4	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	20.1	80 + cm	—
	Shrubs (SG)	1		Shrubs (SG)	0.5	50 – 79 cm	—
	Grasses etc. (GG)	9		Grasses etc. (GG)	32.2	30 – 49 cm	—
	Forbs (FG)	17		Forbs (FG)	3.6	20 – 29 cm	—
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	14
	Other (OG)	0		Other (OG)	0	5 – 9 cm	40
						[4]Tree regeneration <5 cm	✓
			Total high threat weed cover		—	[5] Length of fallen logs	12.5
						[6] Hollow bearing trees	two

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	12	22	79	8	11	5	4	1	3	6	47	12	3	36	14	26	3	1	7	51
Average of the 5 subplots	26.4					3.4					22.4					17.6				

These attributes require consideration of site observations and may be completed after field work

Vegetation class | [8] **Large tree benchmark size** | 20/ 30/ 50/ 80 DBH | Confidence H/ M/ L

Plant community type (PCT) | **EEC** Tick | Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

Dwyer's Red Gum Community, reasonably high regen

reasonably high moss & cryptogam cov

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom

Sheet 1/2

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 23 07 24	Dubbo Project	5 Dwyers Red Gum	AW / DC.

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N. HTW or non-HTW	[2] Foliage cover	Abund -ance	Voucher
TG	Eucalyptus dwyeri		N	10	30	
SG	Hibbertia obtusifolia		N	0.3	10	
TG	Callitris glaucophylla		N	5	~15	
TG	Casuarina cristata		N	5	~15	
FG	Cheilanthes sieberi		N	1	1000	
GG	Aristida ramosa		N	30	1000	
FG	Portulaca oleracea	Purslane	N	0.1	20	
FG	Swainsona sp		N	0.1	100	
FG	Gonocarpus elatus		N	0.5	500	
GG	Panicum effusum		N	1	100	
FG	Daucus glochidiatus	Aust carrot	N	0.1	200	
TG	Villadinia cunicida		N	0.5	5	
FG	Bulbine sp		N	0.1	100	
FG	Wahlenbergia	Early Nancy	N	0.1	5	
FG	Drosera sp	Sundew	N	0.1	200	
FG	Goodenia pinnatifida		N	0.1	5	
–	Hypochaeris radicata			5	1000	
FG	Erodium crinitum		N	0.1	10	
FG	Euphorbia drummondii		N	0.1	5	
–	weed sp- juvenile		E	0.1	20	
–	Sporobolus creber		N	0.1	5	
–	Medicago sp		–	0.1	500	
GG	Eragrostis sp			0.1	20	
–	Trifolium arvense	(hare's foot)	–	0.1	20	
GG	Themeda dicholoma		N	0.1	10	
FG	Dichondra repens		N	0.1	50	
GG	Eriochloa pseudoacrotricha		N	0.2	100	
TG	Brachychiton populneus		N	0.1	1	
–	Solanum nigra			0.1	2	
FG	Oxalis perennans		N	0.1	50	
FG	Stypandra glauca		N	0.1	1	
GG	Austrostipa scabra		N	0.5	100	
GG	Danthonia racemosa		N	0.1	1	
–	Arctotheca calendula	Cape weed		0.1	1	
FG	Crassula colorata	Dove orop	N	0.1	200	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0 5% cover represents an area of approximately *1 4 x 1 4 m, and 1% = 2.0 x 2 0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	23/1/24	**Survey name**	Dubbo project		**Plot identifier**	Plot #5	Degrees not sure
Recorders	Addy Watson, Dylan Chew			**IBRA region**			**Veg zone ID**		
[1]Datum		**Coordinate system**	☐ Projected ☐ Geographic	**MGA zone**	**[1]X coordinate**	652722	**[1]Y coordinate**	6407474	

Location description descriptive notes to locate site without grid reference

[1] Plot dimensions For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m

[1] Orientation of midline from 0 m point Magnetic ° 189°

Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation Integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure (400 m² plot)**		Sum values (%) (may sum to >100%)	**Function (1000 m² plot)**	**[3] Tree stem size class (DBH)**	**If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted**
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	4	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	20.1		80 + cm	Count –
	Shrubs (SG)	1		Shrubs (SG)	0.7		50 – 79 cm	Count (best practice)/tick if [3]large tree benchmark size ≥50 cm: count –
	Grasses etc. (GG)	9		Grasses etc. (GG)	32.2		30 – 49 cm	Count (best practice)/tick if [3]large tree benchmark size ≥ 30 cm: count –
	Forbs (FG)	19		Forbs (FG)	3.6		20 – 29 cm	Count (best practice)/tick if [3]large tree benchmark size ≥ 20 cm: count –
	Ferns (EG)	0		Ferns (EG)	0		10 – 19 cm	Count (best practice)/tick 14
	Other (OG)	0		Other (OG)	0		5 – 9 cm	Count (best practice)/tick 40
							[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		– %		[5]Length of fallen logs	Tally space – Total 12.5 m
							[6]Hollow bearing trees	Tick 2

Vegetation integrity - function cont. (five 1 m²) plots)	[7] Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	a b c d e	a b c d e	a b c d e	a b c d e
Average of the 5 subplots				

These attributes require consideration of site observations and may be completed after field work

Vegetation class **[8] Large tree benchmark size** 20/ 30/ 50/ 80 DBH Confidence H/ M/ L

Plant community type (PCT) EEC Tick Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type	Landform element	Landform pattern	Microrelief
Lithology	Soil surface texture	Soil colour	Soil depth
Slope	Aspect	Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Sheet 2/2

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 23 7 24	Dubbo Project	5 Burgers red gum	AJ DC

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
FG	Convolvulus sp	N	0.1	5	
Gla	Austrostipa nodosa	N	0.1	10	
FG	Calotis lappulacea	N	0.1	5	
	weed sp- juvenile	E	0.1	5	
FG	Arthropodium minis	N	0.1	100	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, .. 100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 .. 100, 200, 300 ..., 1000, 2000, 3000 .... (as integer values).

APPENDIX B

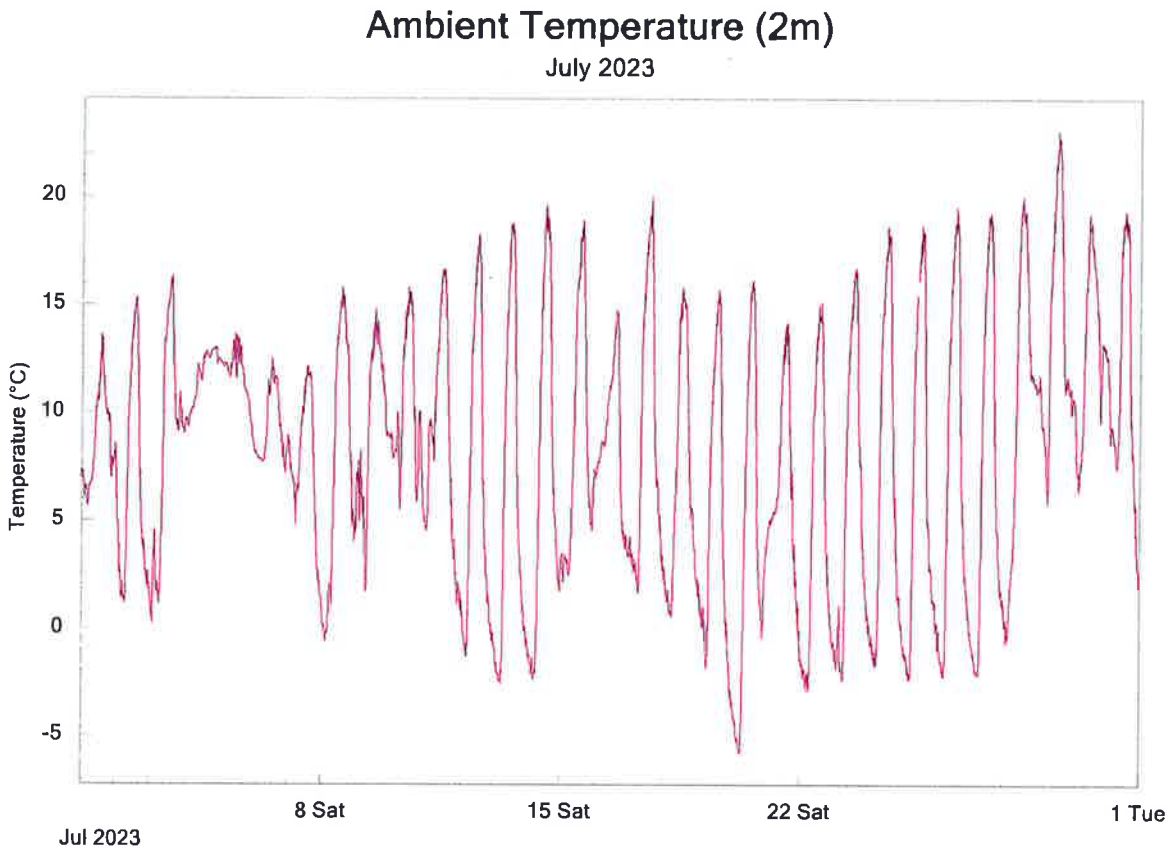


Figure 5: Ambient Temperature for July 2023

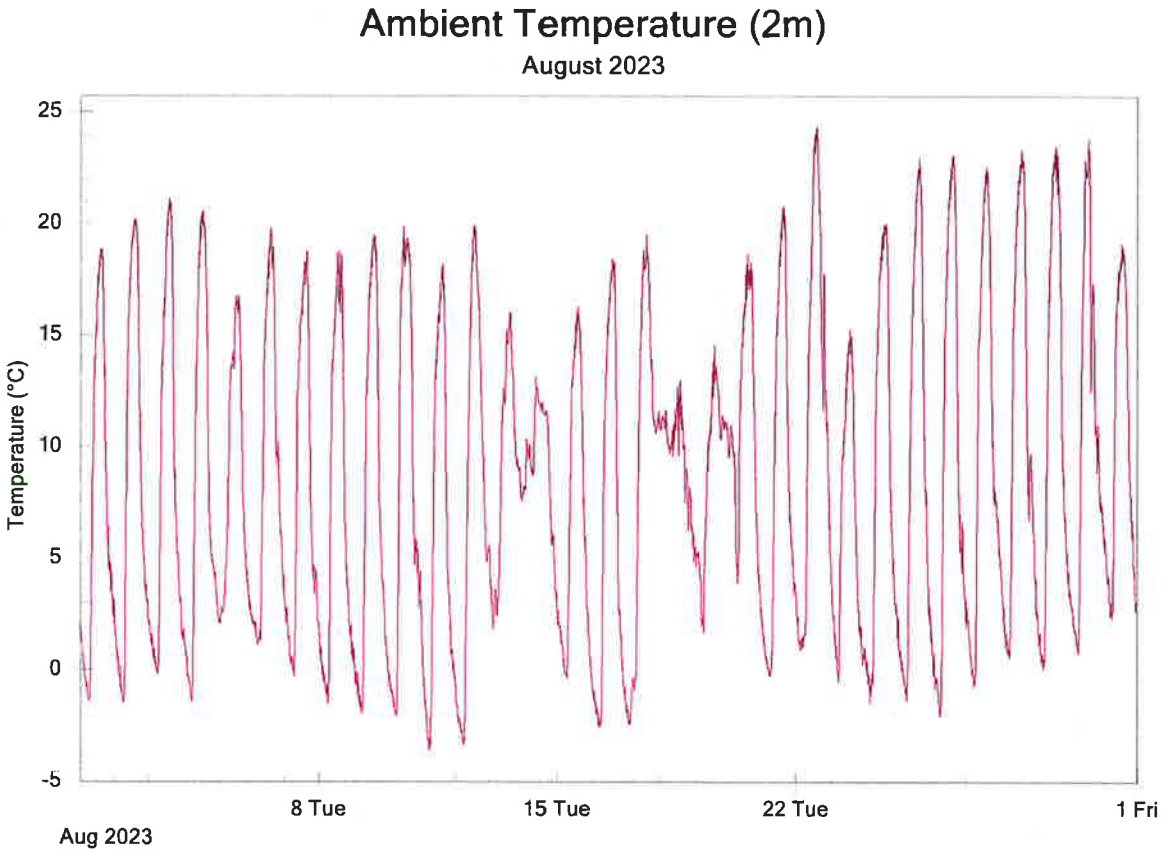


Figure 5: Ambient Temperature for August 2023

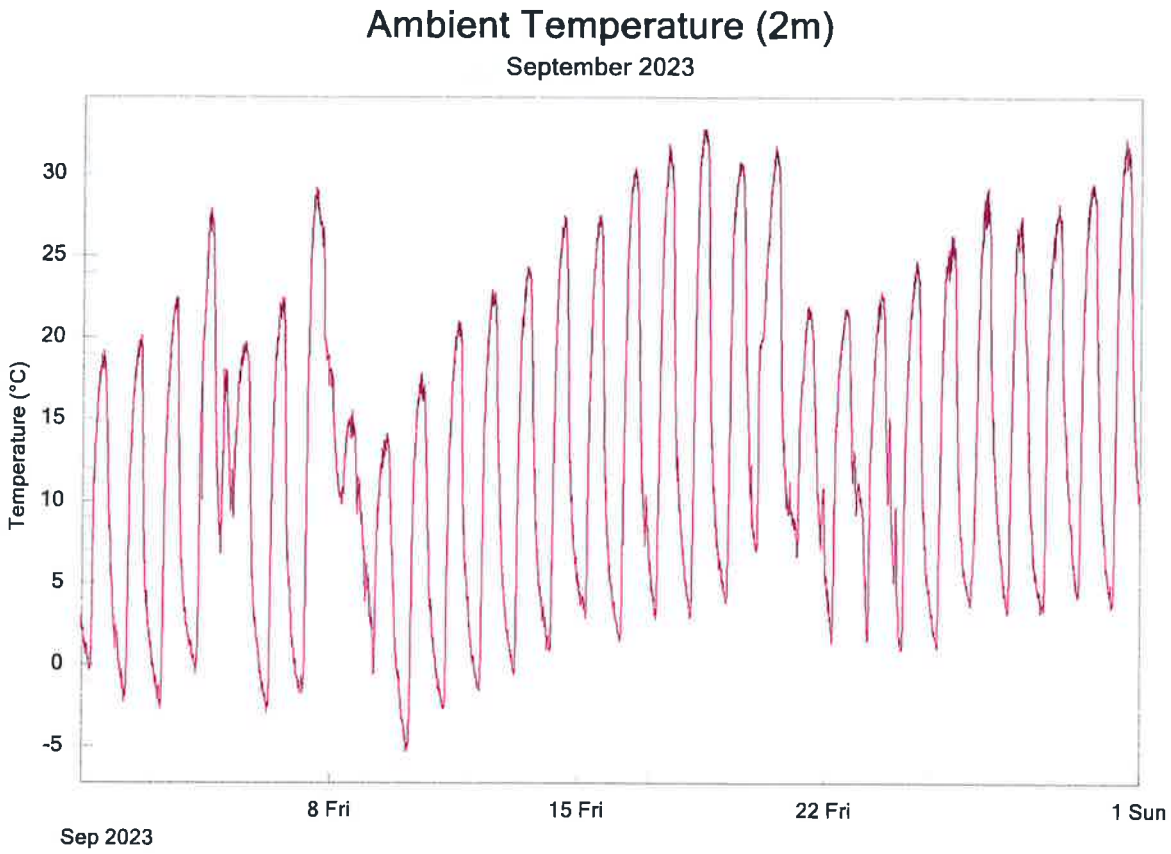


Figure 5: Ambient Temperature for September 2023

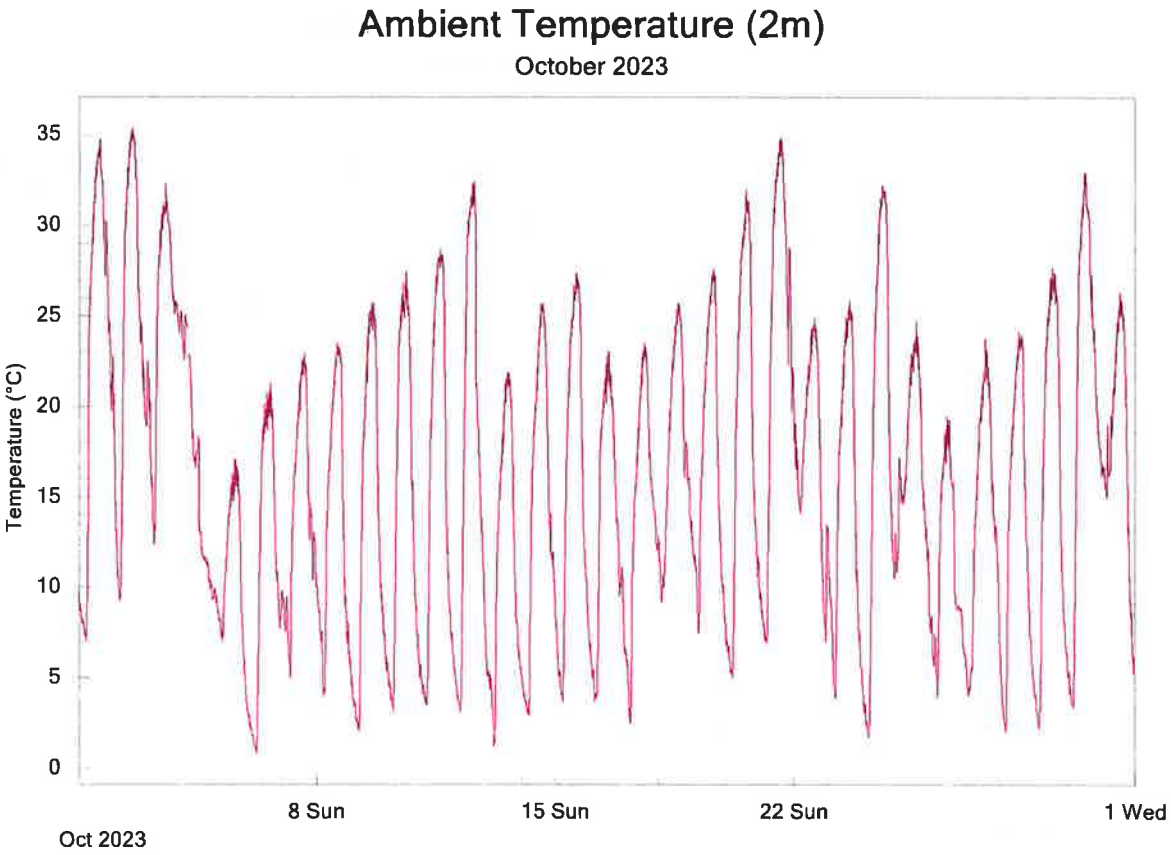


Figure 5: Ambient Temperature for October 2023

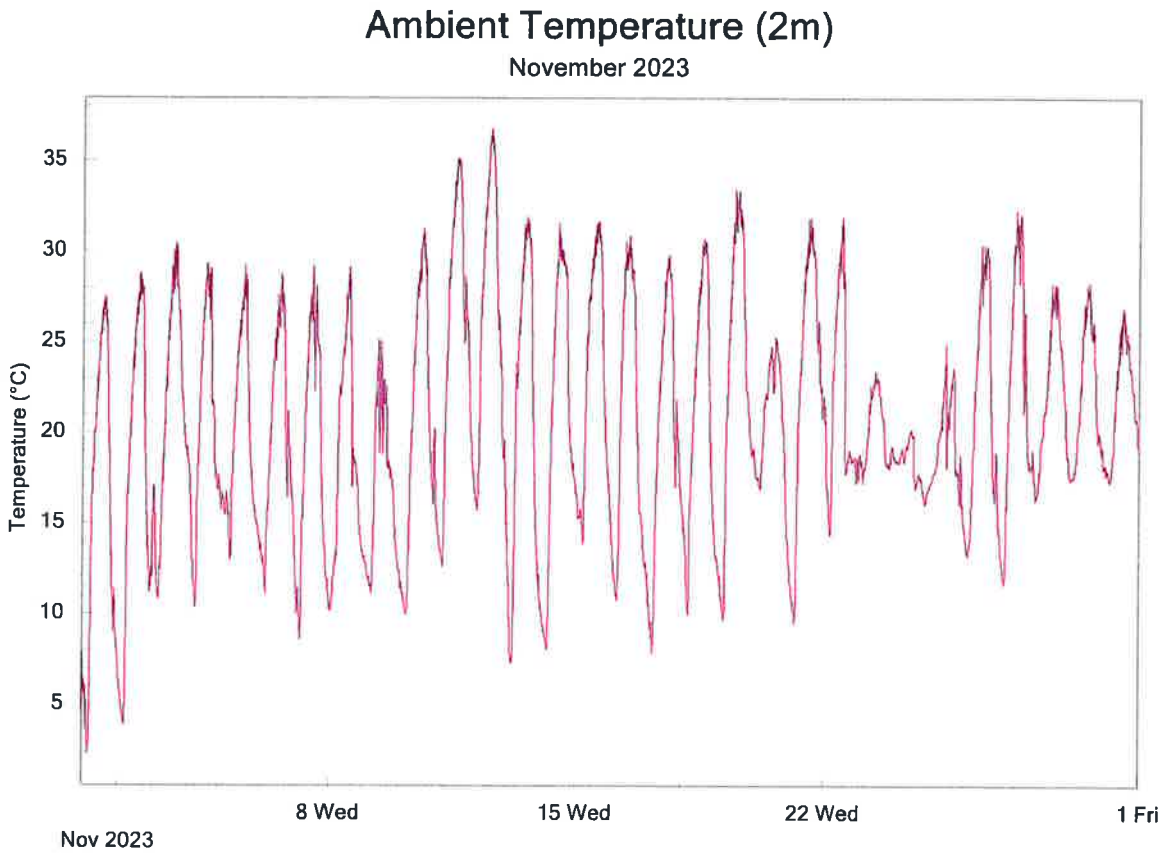


Figure 5: Ambient Temperature for November 2023

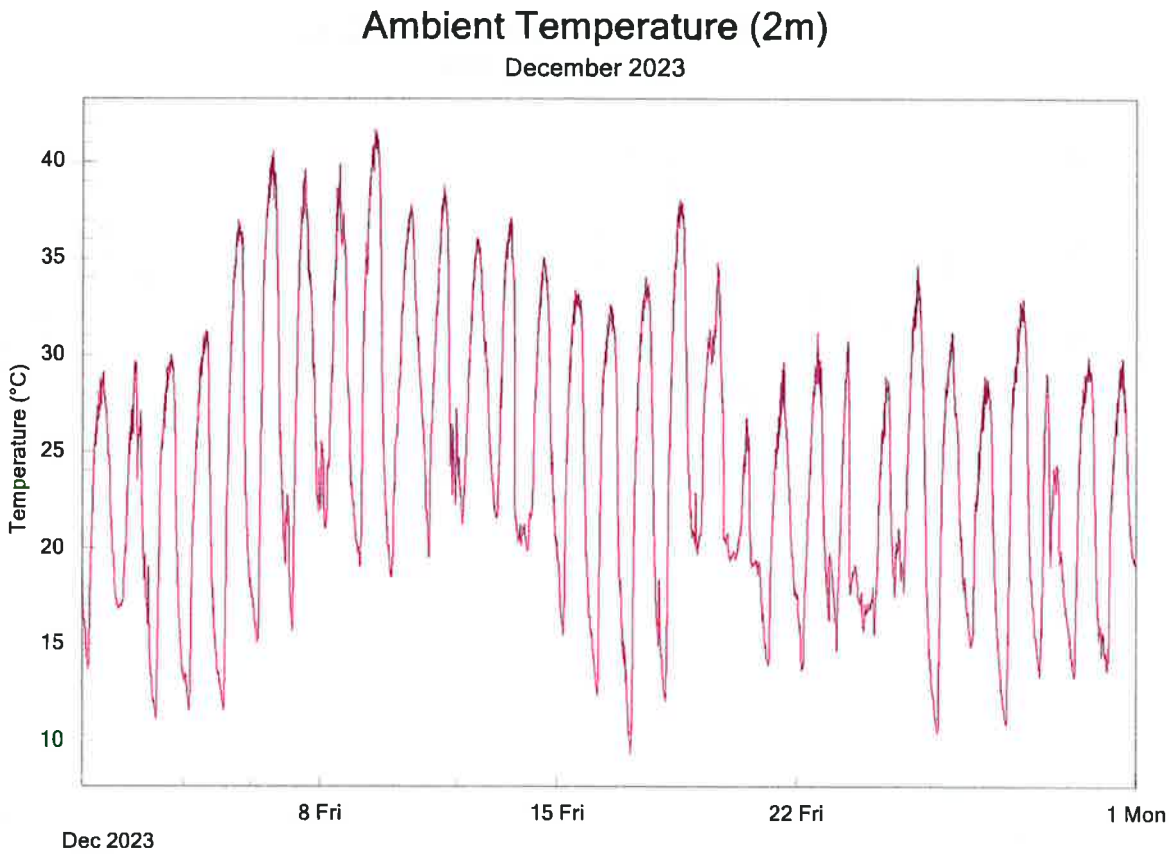


Figure 5: Ambient Temperature for December 2023

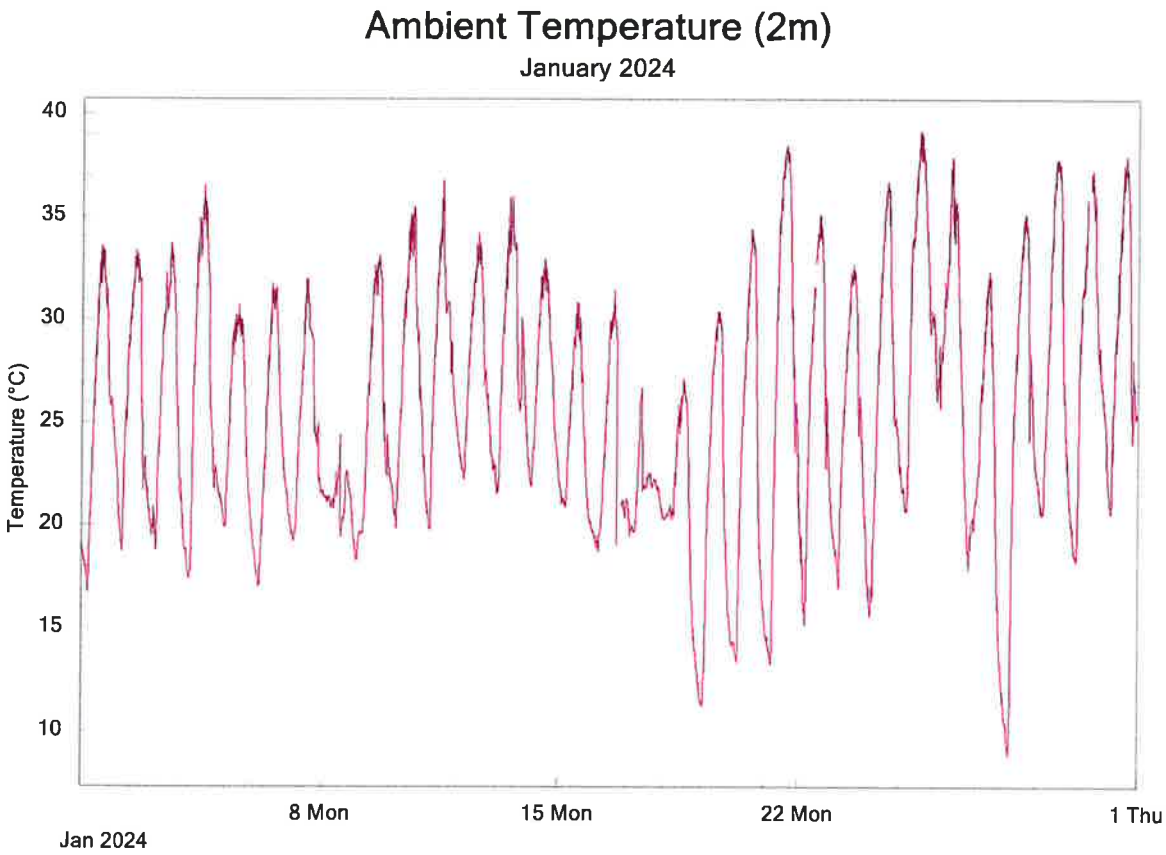


Figure 5: Ambient Temperature for January 2024

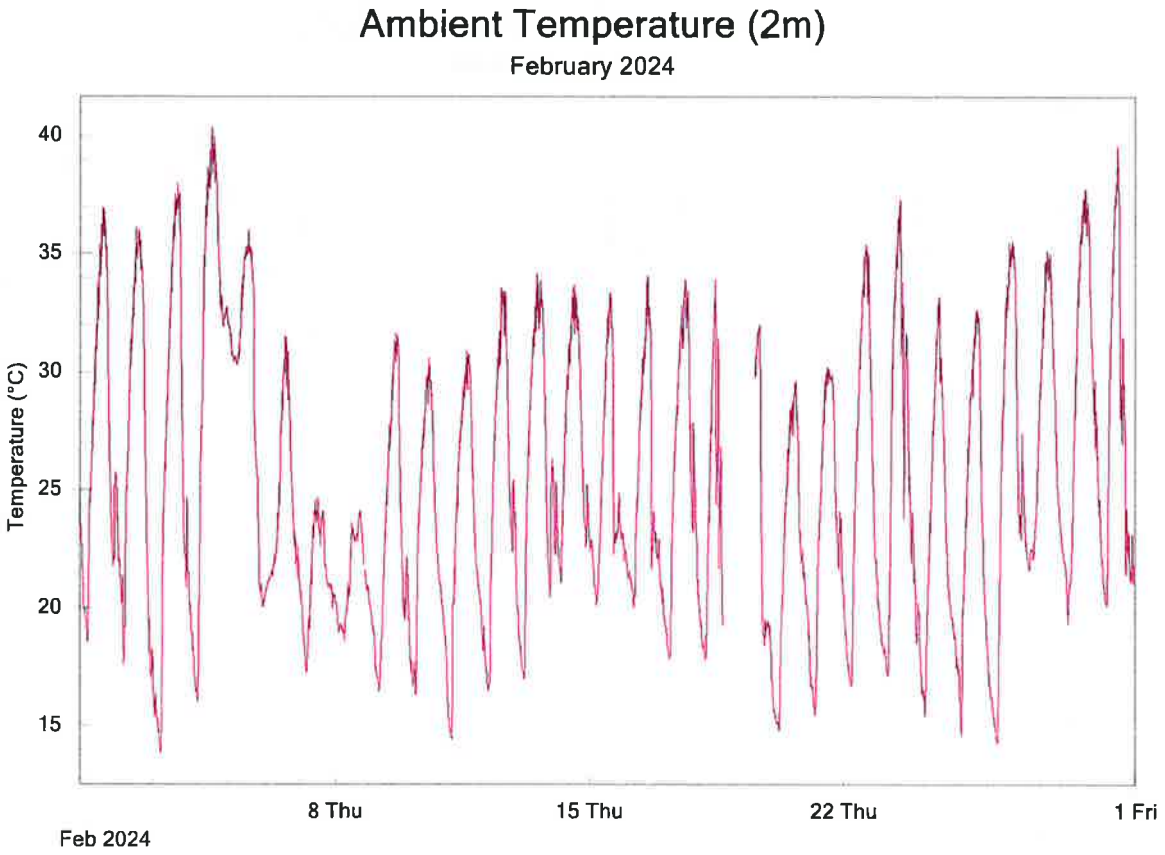


Figure 5: Ambient Temperature for February 2024

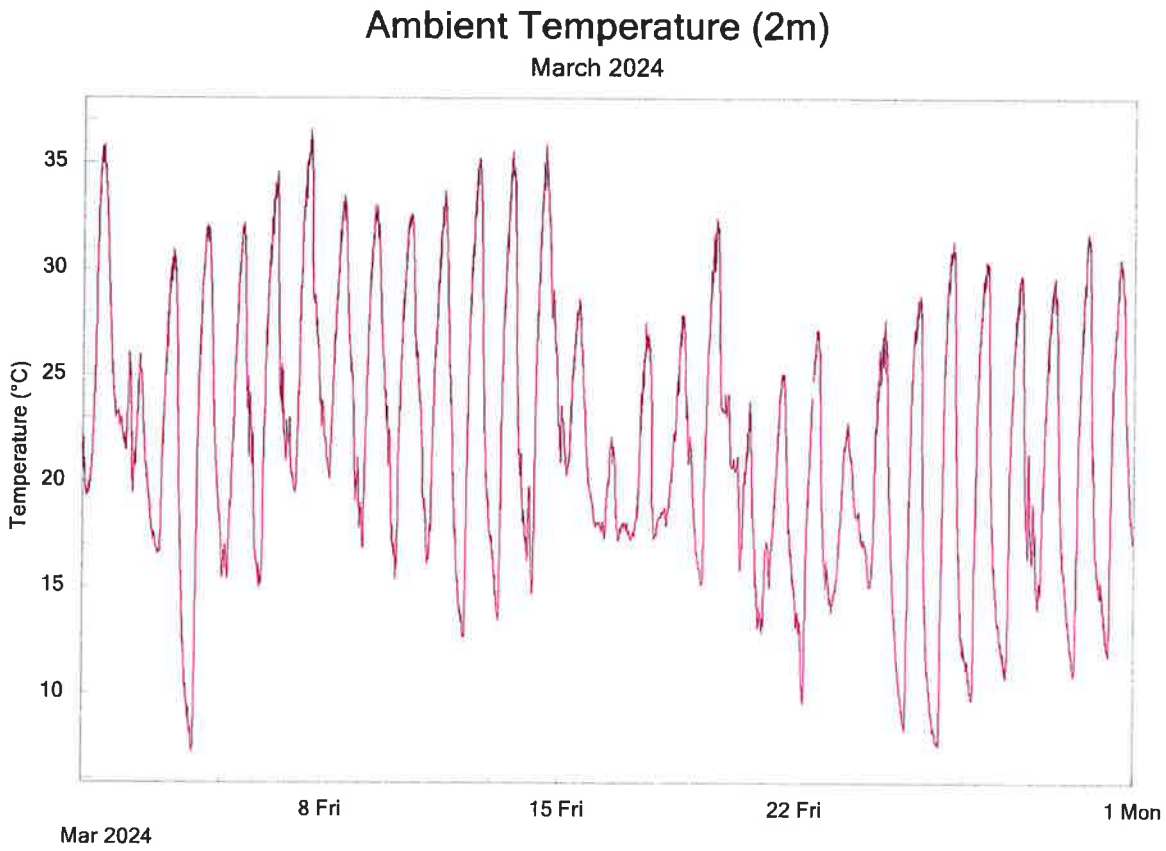


Figure 5: Ambient Temperature for March 2024

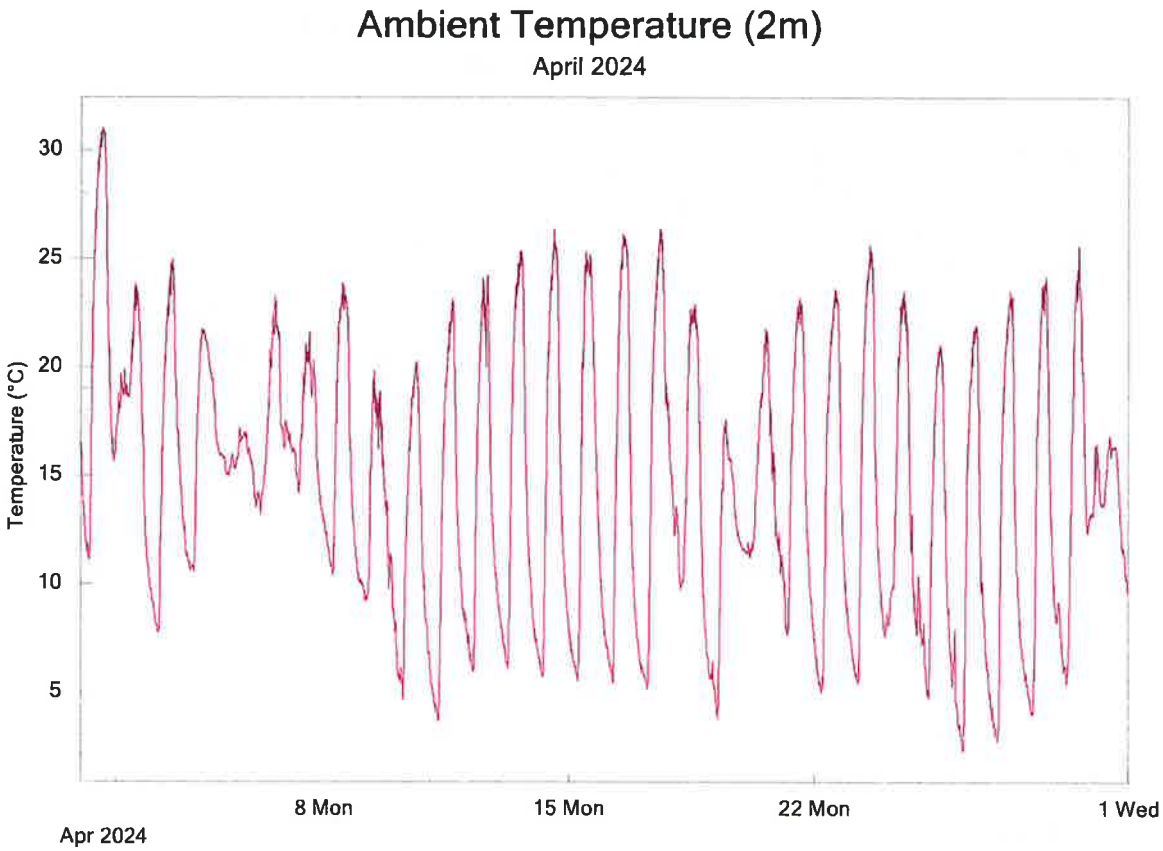


Figure 5: Ambient Temperature for April 2024

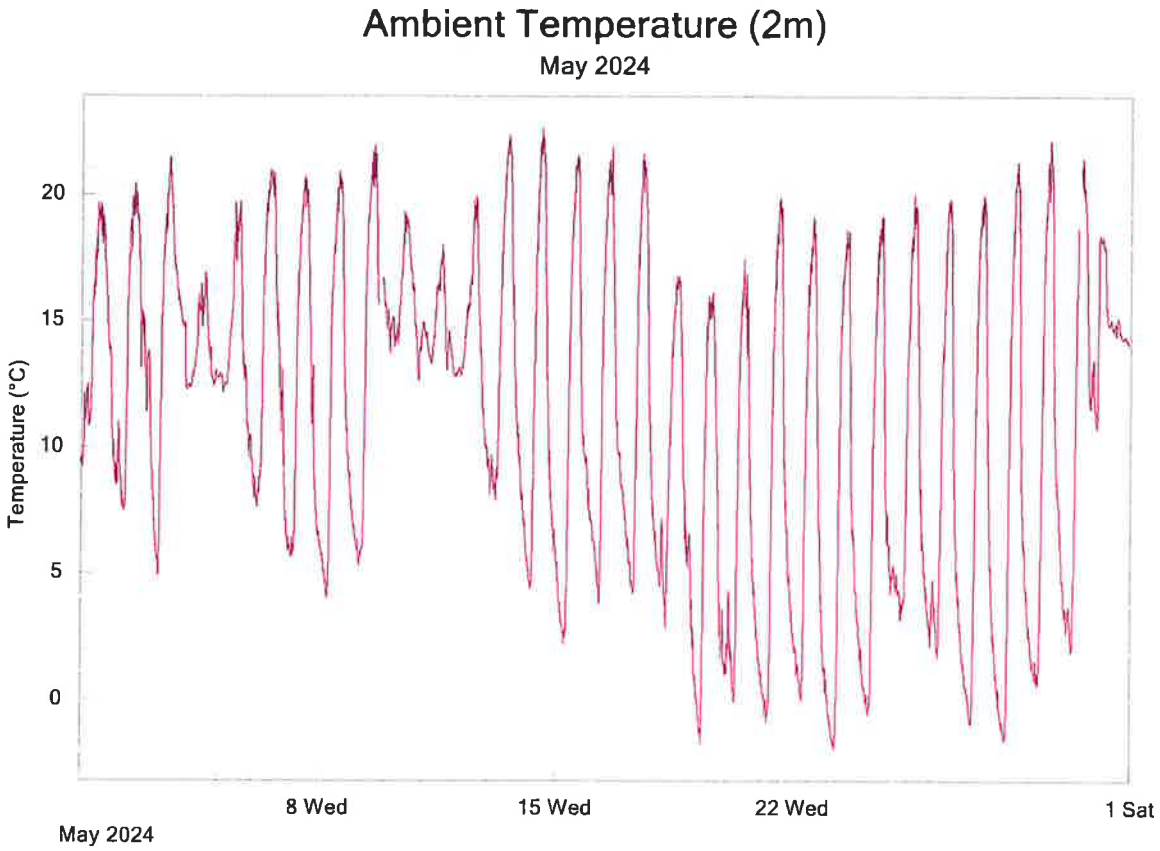


Figure 5: Ambient Temperature for May 2024

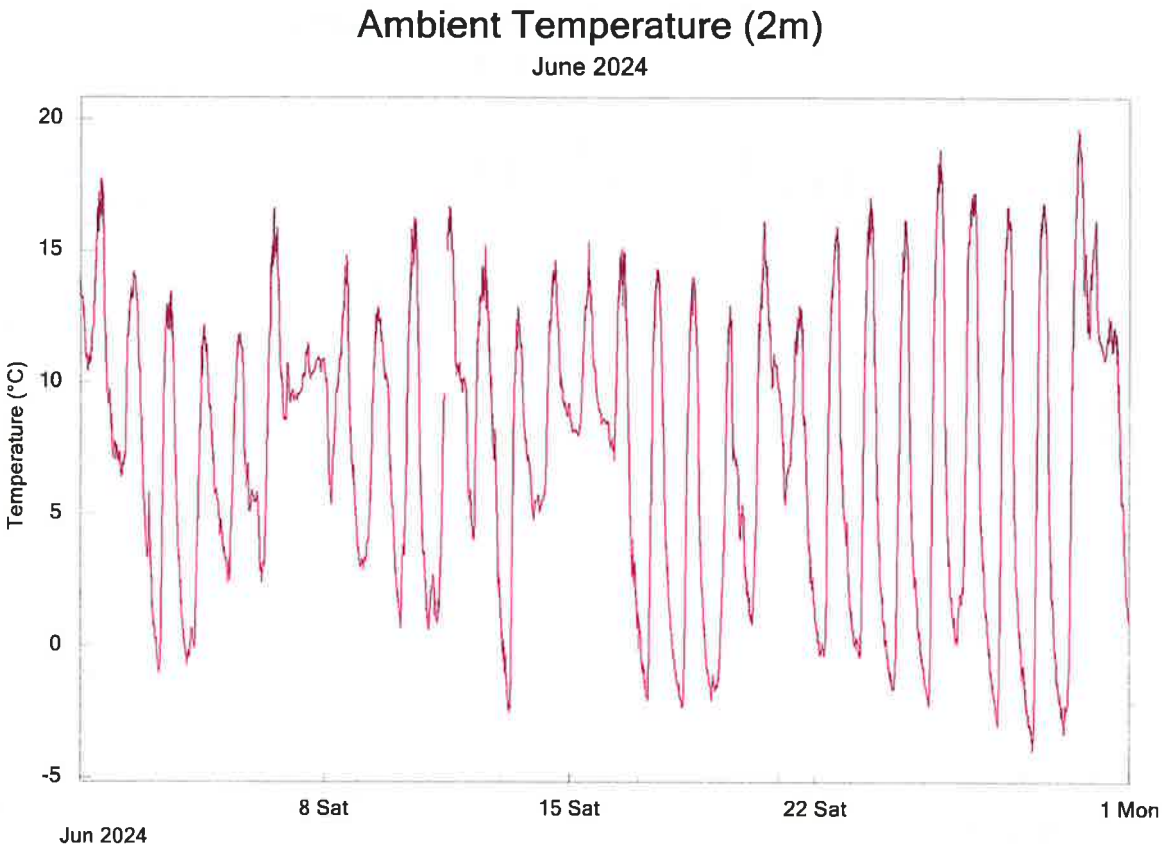


Figure 5: Ambient Temperature for June 2024

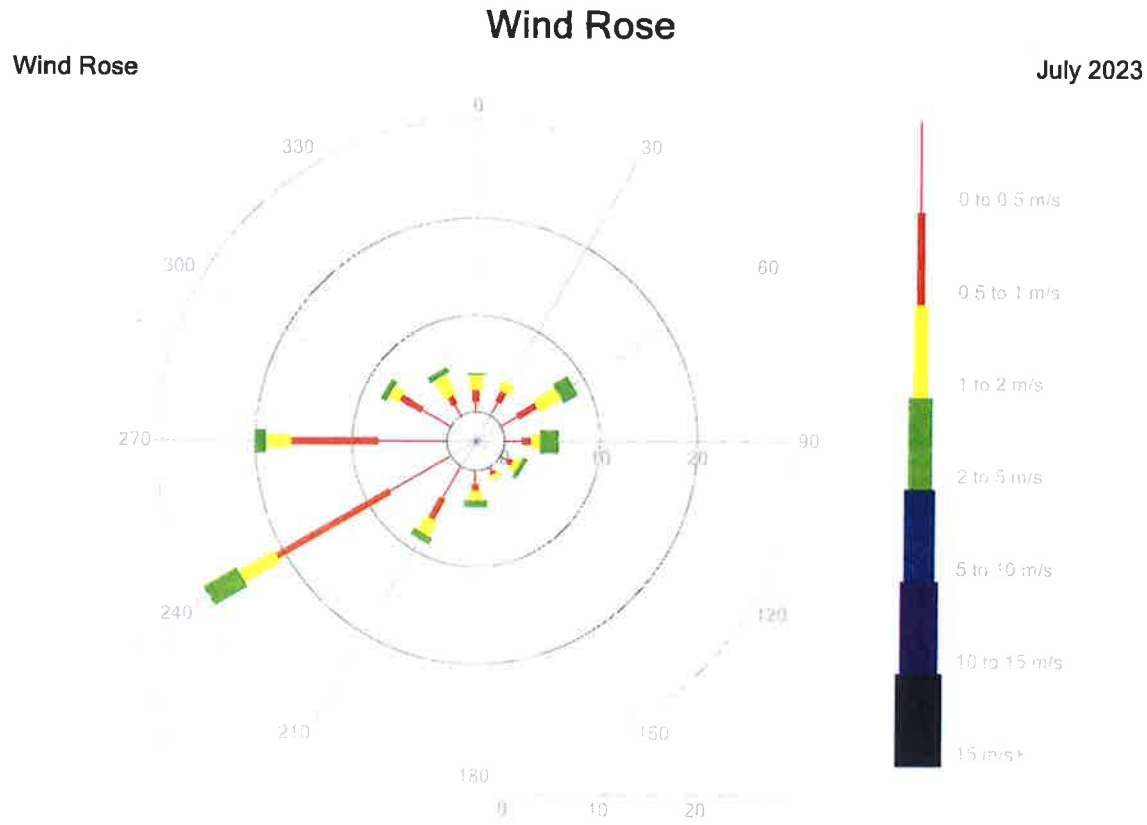


Figure 7: Windrose for July 2023

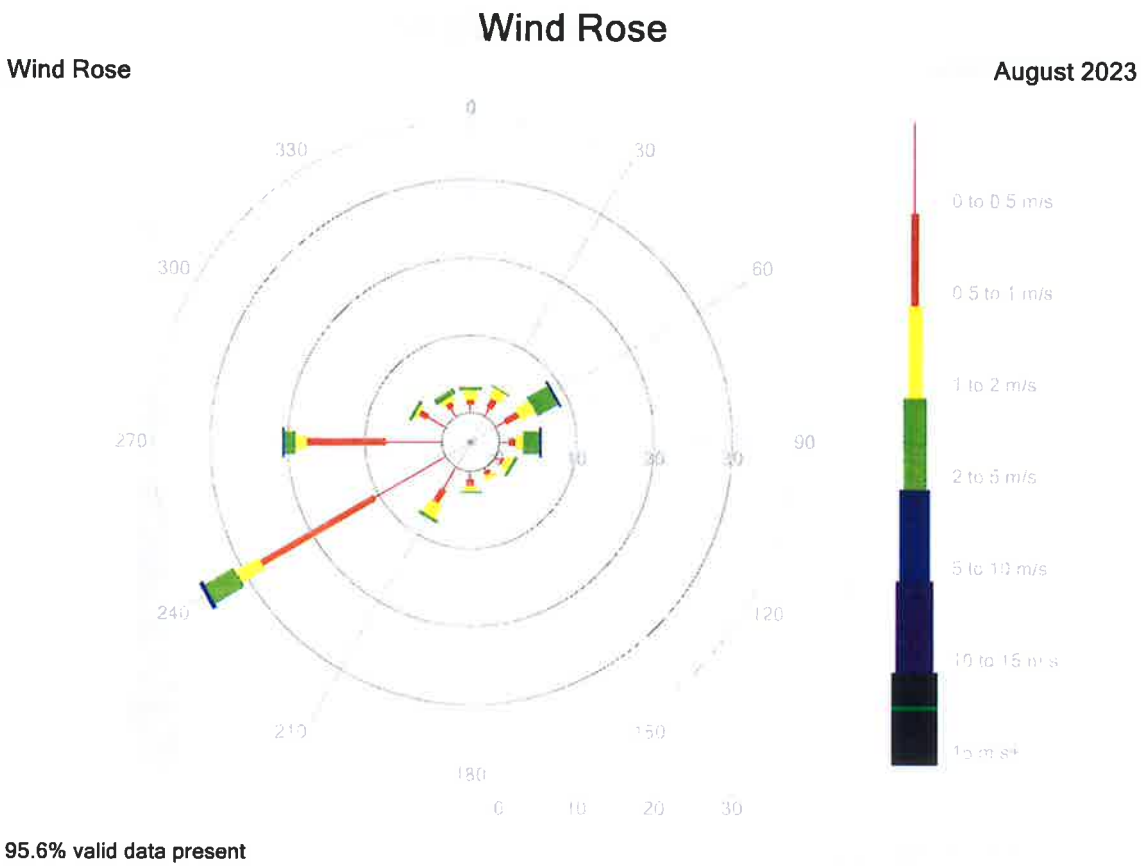
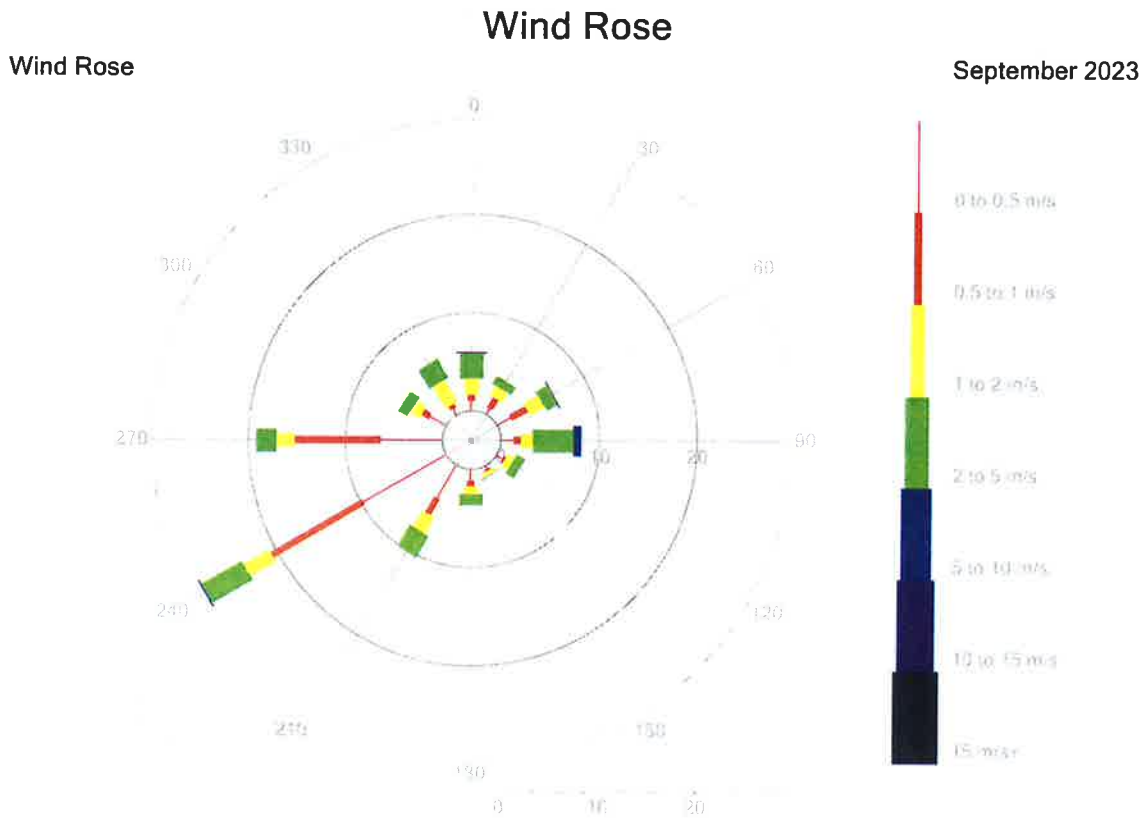
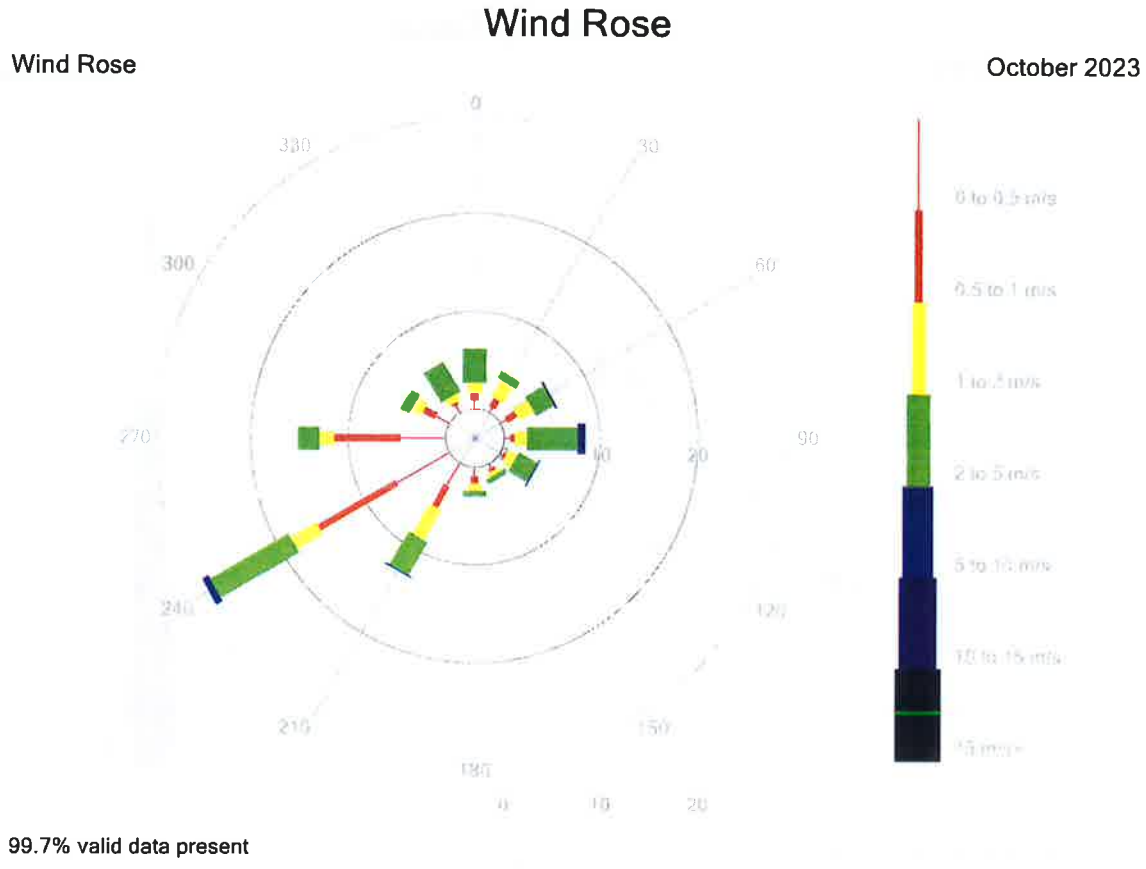


Figure 7: Windrose for August 2023



88.6% valid data present

Figure 7: Windrose for September 2023



99.7% valid data present

Figure 7: Windrose for October 2023

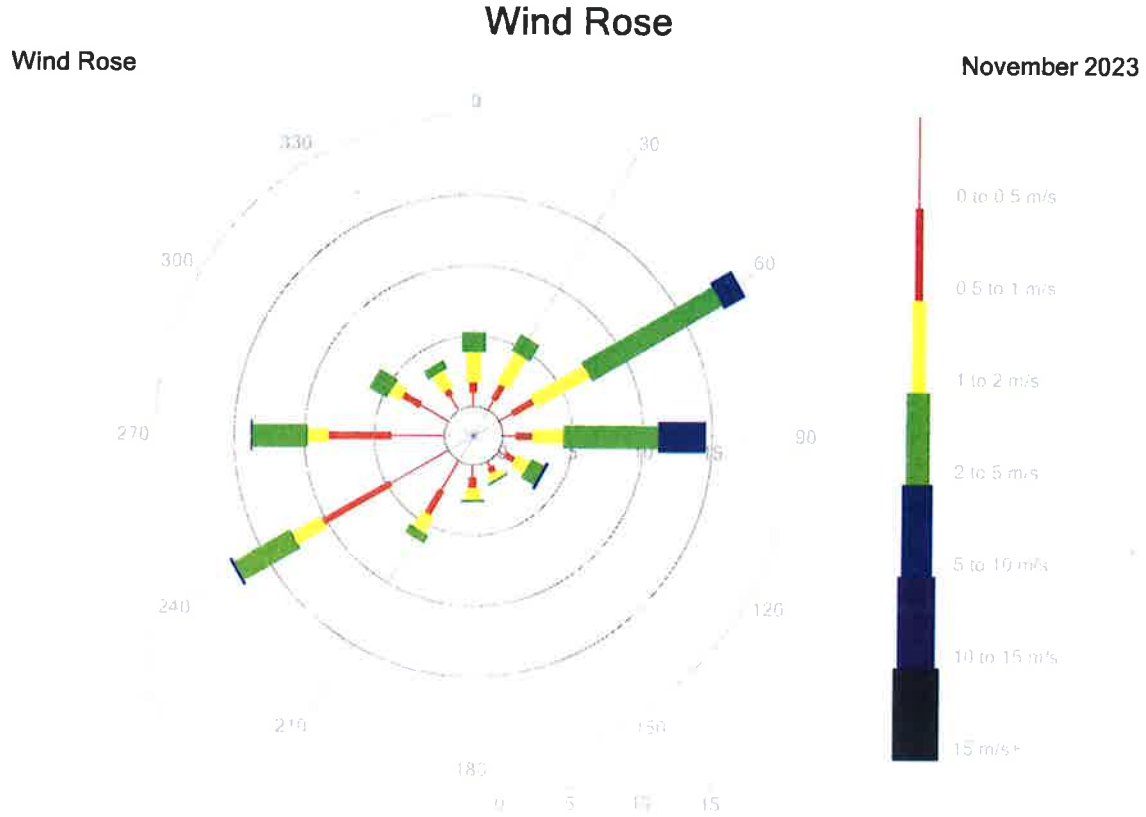
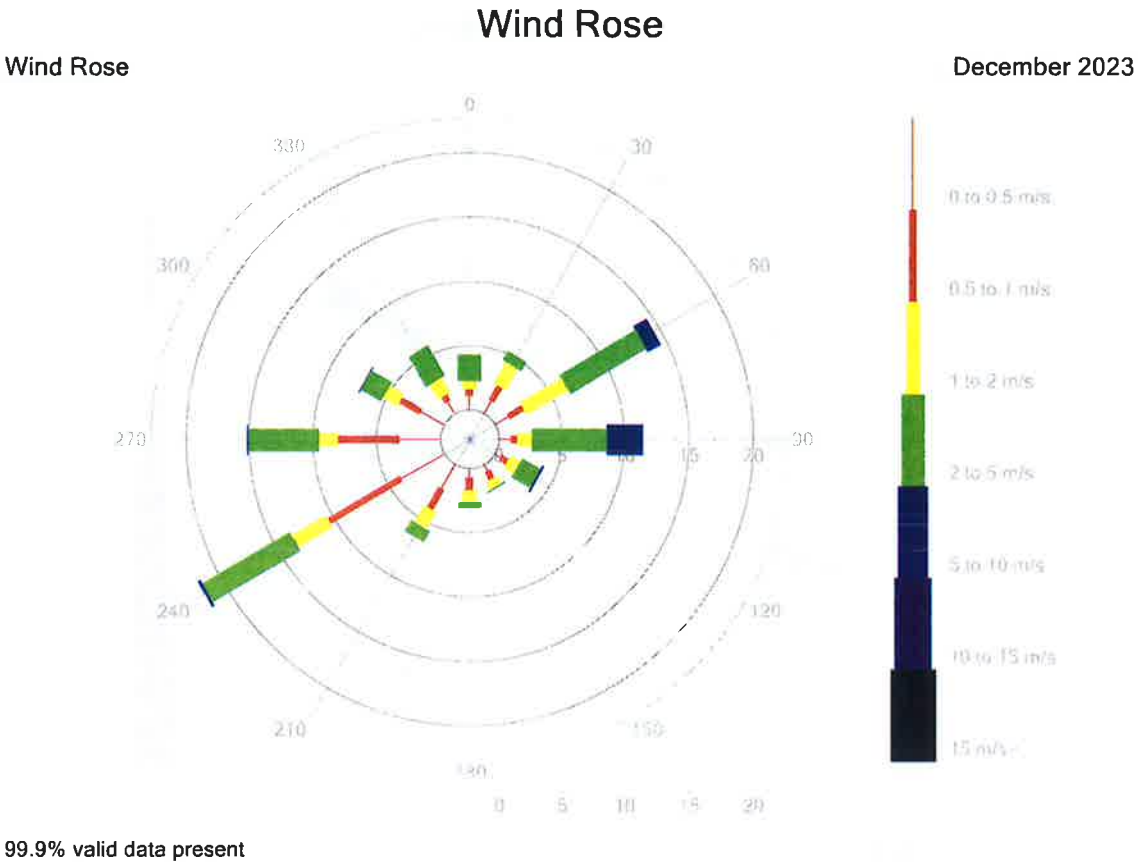
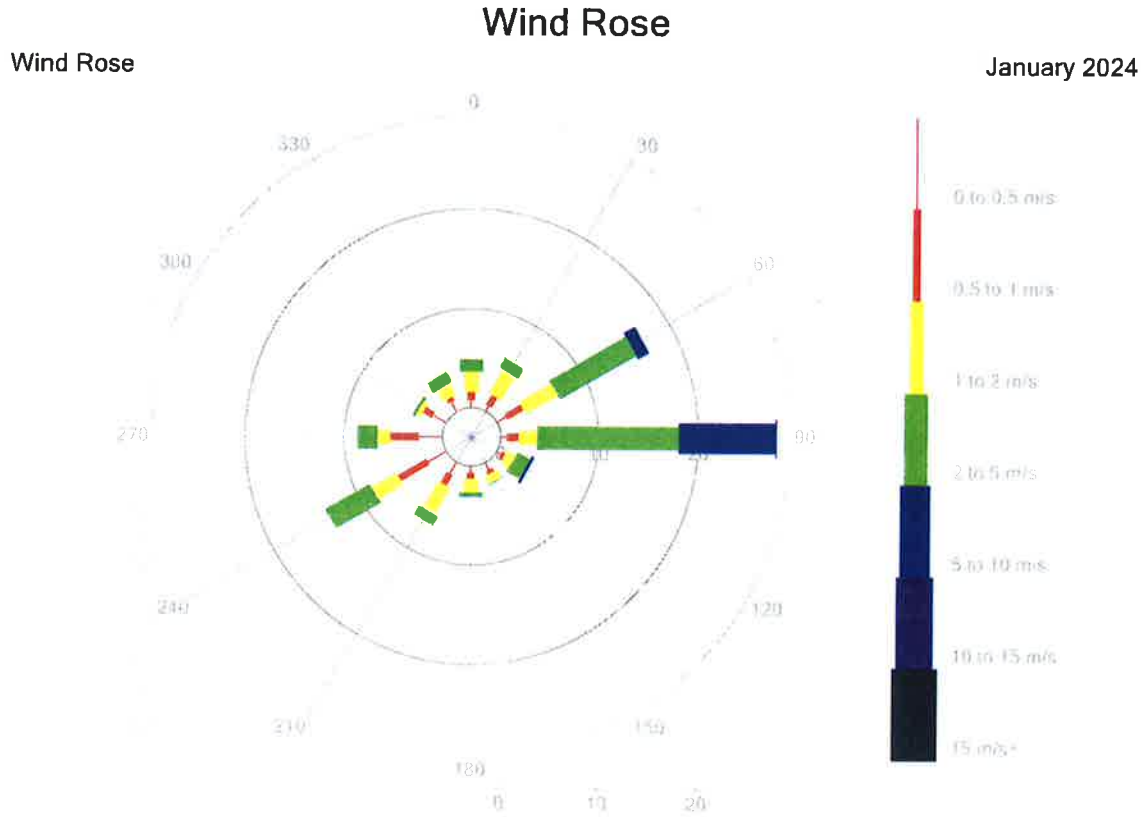


Figure 7: Windrose for November 2023



99.9% valid data present

Figure 7: Windrose for December 2023



99.1% valid data present

Figure 7: Windrose for January 2024

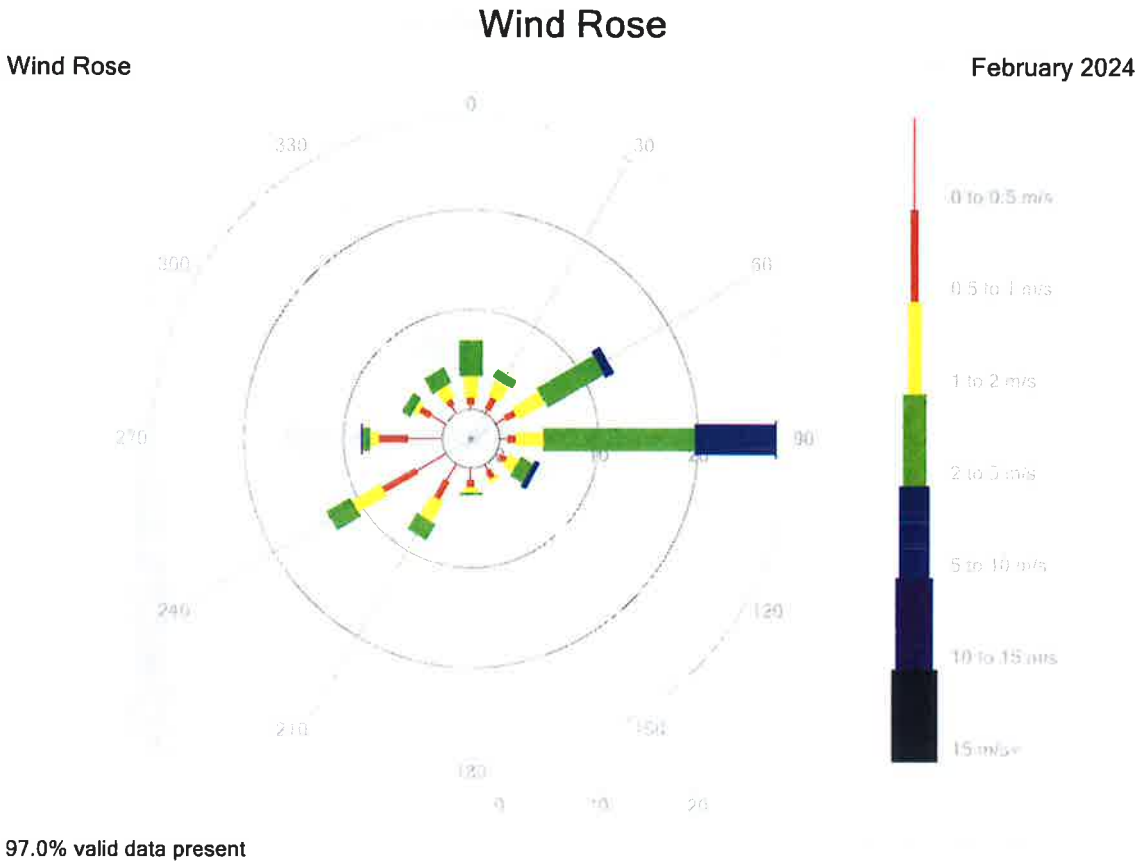
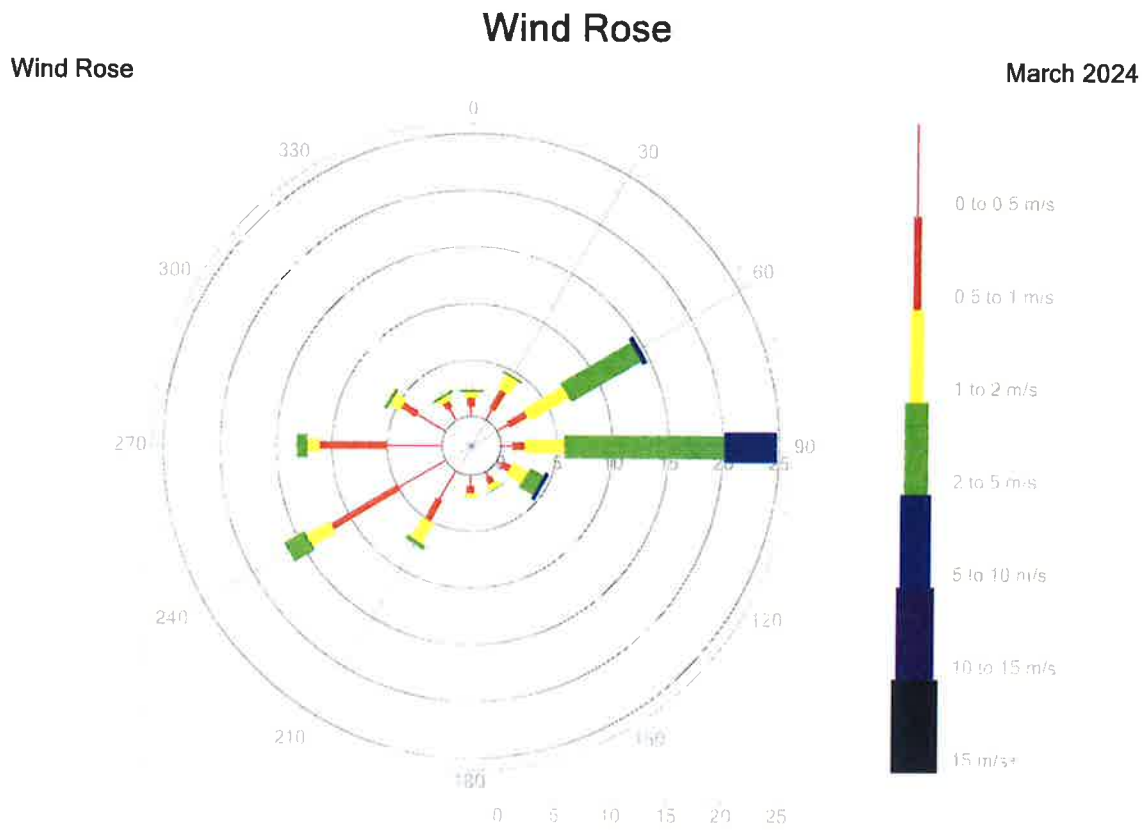


Figure 7: Windrose for February 2024



99.8% valid data present

Figure 7: Windrose for March 2024

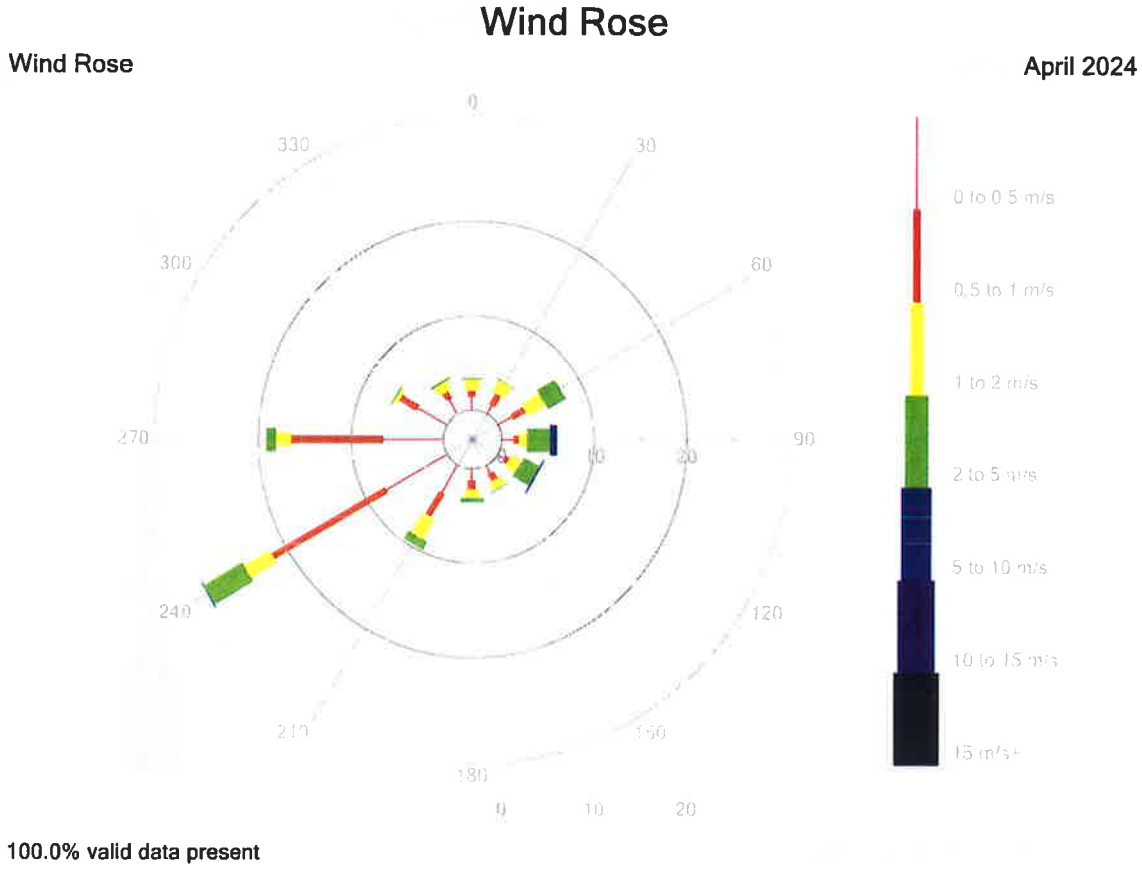
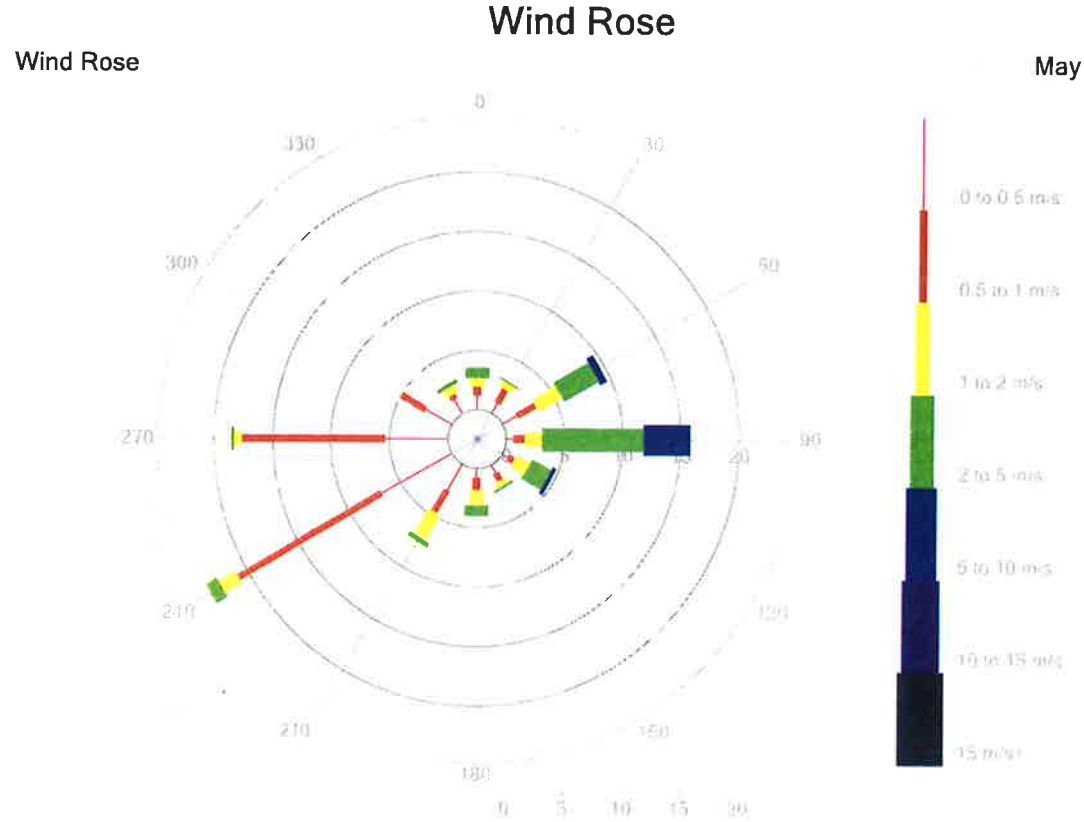


Figure 7: Windrose for April 2024



99.5% valid data present

Figure 7: Windrose for May 2024

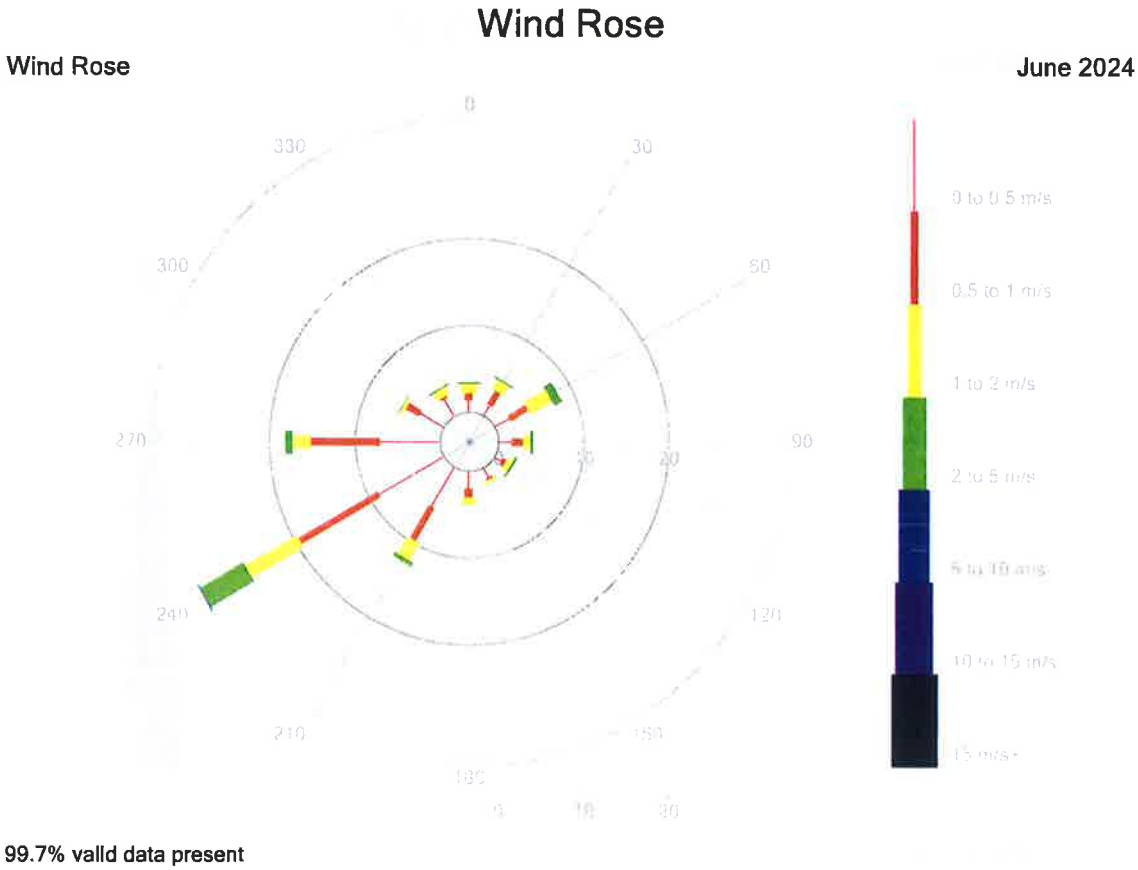


Figure 7: Windrose for June 2024

APPENDIX C

Department of Planning and Environment

Our ref: SSD-5251-PA-8
Michael Sutherland
General Manager NSW
AUSTRALIAN STRATEGIC MATERIALS LIMITED
Level 2, 88-90 Macquarie Street
Dubbo NSW 2830
26/09/2023

Subject: Dubbo Project (formerly known as the Dubbo Zirconia Mine) - Annual Review 2022-2023

Dear Mr Sutherland,

Reference is made to the Annual Review for the period 1 July 2022 to 30 June 2023, submitted to the Department of Planning and Environment (the department) on 1 September 2023 as required under Condition 4 of Schedule 5 of SSD-5251 (the consent).

The department has reviewed the Annual Review and considers it to generally satisfy the reporting requirements of the consent and the department's Annual Review Guideline (October 2015).

The department also notes from Appendices A and B:

- One likely Pink-tailed Worm-lizard sloughed skin was observed at the Glen Idol monitoring site; and
- Monitoring actions undertaken in accordance with the Biodiversity Management Plan have shown that vegetation integrity has decreased across all 5 plots, most likely due to an increase in invasive species.
-

Please make publicly available a copy of the 2022-2023 Annual Review on the company website.

Please note that the department's acceptance of this Annual Review is not an endorsement of the compliance status of the project.

Should you wish to discuss the matter further, please contact Michael Wood, on 0459890661 or email compliance@planning.nsw.gov.au

Yours sincerely

Katrina O'Reilly
Team Leader - Compliance
Compliance
As nominee of the Planning Secretary