Broken Hill Solar Plant Biodiversity Offset Site

Annual Ecological Monitoring Report Year 7 – 2023

Final

February 28th, 2024

AGL

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Author:	Emma Weatherstone and Kirsty Raines
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Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
Level 4, 12 Stewart Avenue
Newcastle West, NSW 2302
PO Box 2147
Dangar, NSW 2309
Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

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Contents

Executive Summary

As per the requirements of the Conditions of Approval (COA) the Broken Hill biodiversity offset site is required to be monitored and the results reported annually to the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW). Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the offset site.

The monitoring program commenced in 2018 and this report outlines the methods and results from monitoring change in condition in 2023 (year 7).

Monitoring within the offset site has occurred during both drought conditions and years of high rainfall. Ultimately, during drought years, the monitoring surveys indicated lower species diversity, cover, and condition, where, in contrast, during years of higher rainfall, these statistics showed significant improvement. Generally, when compared to the vegetation community benchmarks (DECC, 2008), it is evident that these benchmarks were within or were exceeded during years of higher rainfall. It is likely that vegetation is still recovering from the impacts of 2018 and 2019 drought conditions. Year 7 monitoring shows that favourable weather conditions have generally maintained and improved the post-drought recovery of native vegetation within the offset site compared with the baseline assessment.

The key results are summarised as follows:

- Further small increases in native vegetation cover, particularly in the ground layers of the site, have occurred during 2023, adding to the substantial increases experienced in 2020.
- An increase in native species richness in this year compliments the post-drought recovery of vegetation on the offset site. The species richness was noted to be equal to or higher than the benchmark levels, where the native groundcover of forbs and shrubs increased overall from the previous monitoring period (Year 6). Native tussock grasses were observed to have slightly decreased since the previous year, likely due to natural factors as native species compete for space and nutrients and are dependent on seasonal changes.
- Plant health across the site appears optimal and most native plants exhibit dense foliage cover. Chenopods, Acacias and Senna shrubs show signs of normal reproduction (flowering and seeding) and extended periods of average or higher rainfall should see further recruitment.
- There has been a continued slight decrease in the cover of exotic plant species following the substantial increase recorded in Year 4 (2020) (when the drought ended). Weed infestations are still generally low but remain present due to increased rainfall and are present in several of the drainage line areas. Weed control work was undertaken in April, July and October 2023, which was effective in killing some Velvet Mesquite (*Prosopis velutina*) and African Boxthorn (*Lycium ferocissimum*) (Weeds of National Significance). Further work is required for eradication these species.
- Stock proof fencing around the offset site remains in good condition, and repairs made in May 2021 have withstood further heavy rain events.
- Fauna habitats across the offset site are somewhat diverse and include chenopods, rocky patches, tussock grasses, clay crevices and some taller shrubs. These habitats have been maintained, and the groundcover and vegetative cover has increased due to higher rainfall since 2020.

The management actions outlined in this report will further assist in the natural regeneration of the site over the next twelve months.

1. Introduction

1.1 Background and study area

In 2014, AGL Energy Limited (AGL) constructed the Broken Hill Solar Plant (the solar plant), a solar photovoltaic (PV) plant with a nominal capacity of 50 MW, at Broken Hill in western NSW as part of the Commonwealth Solar Flagships Program. The solar plant is located on a property to the west of the Broken Hill township at Lot 6806 DP 823918 and is approximately 200 hectares (ha) in area. The location of the solar plant, access and transmission easements and offset site are shown in **Figure 1-1**.

The project was approved by the former NSW Department of Planning and Infrastructure (DP&I) on 27 March 2013. It is a condition of approval (COA) that an Offset Management Package be developed to offset the ecological values lost as a result of the project (COA C5 is provided in **Appendix B**). AGL engaged the existing lessee of the solar plant site to include a suitable area of land for offsetting within the scope of the project.

The offset site is located 1.5 km west of the solar plant site, comprising the western portion of the same lot, Lot 6806 DP 823918, covering approximately 162 ha (see **Figure 1-1**).

AGL are responsible for ongoing monitoring and management at the offset site.

1.2 Objectives

This report documents the results of the annual (Year 7) ecological monitoring event for the offset site as required under COA C5. Monitoring is required to demonstrate an 'improve or maintain' outcome for the identified biodiversity values at the offset site and to identify any management or remedial actions required to achieve these outcomes as informed by the annual monitoring program.

Monitoring requires the collection of ecological data, consistent with the methodology described in the Biodiversity Offset Management Plan (BOMP) prepared by NGH Environmental (2013). The results are described and analysed with comparison to the 2013 PCT benchmark data, the baseline data from the BOMP (NGH Environmental, 2013), and temporal monitoring in years 1-6 (Jacobs 2018-2023). The objective of the monitoring is to determine if there have been any significant changes in the vegetation and habitat conditions and the consistency of these with the objective of improving or maintaining the biodiversity values on the offset site.

In addition, an evaluation was undertaken of any required management actions and their effectiveness, as outlined in the BOMP (NGH Environmental, 2013), and the standard management actions required to be undertaken at offset sites outlined in the BioBanking Assessment Methodology (BBAM, DECC 2009). This includes management of grazing for conservation, weed control, management of fire for conservation, management of human disturbance, retention of regrowth and remnant native vegetation, replanting or supplementary planting where natural regeneration will not be sufficient, retention of dead timber, erosion control and retention of rocks.

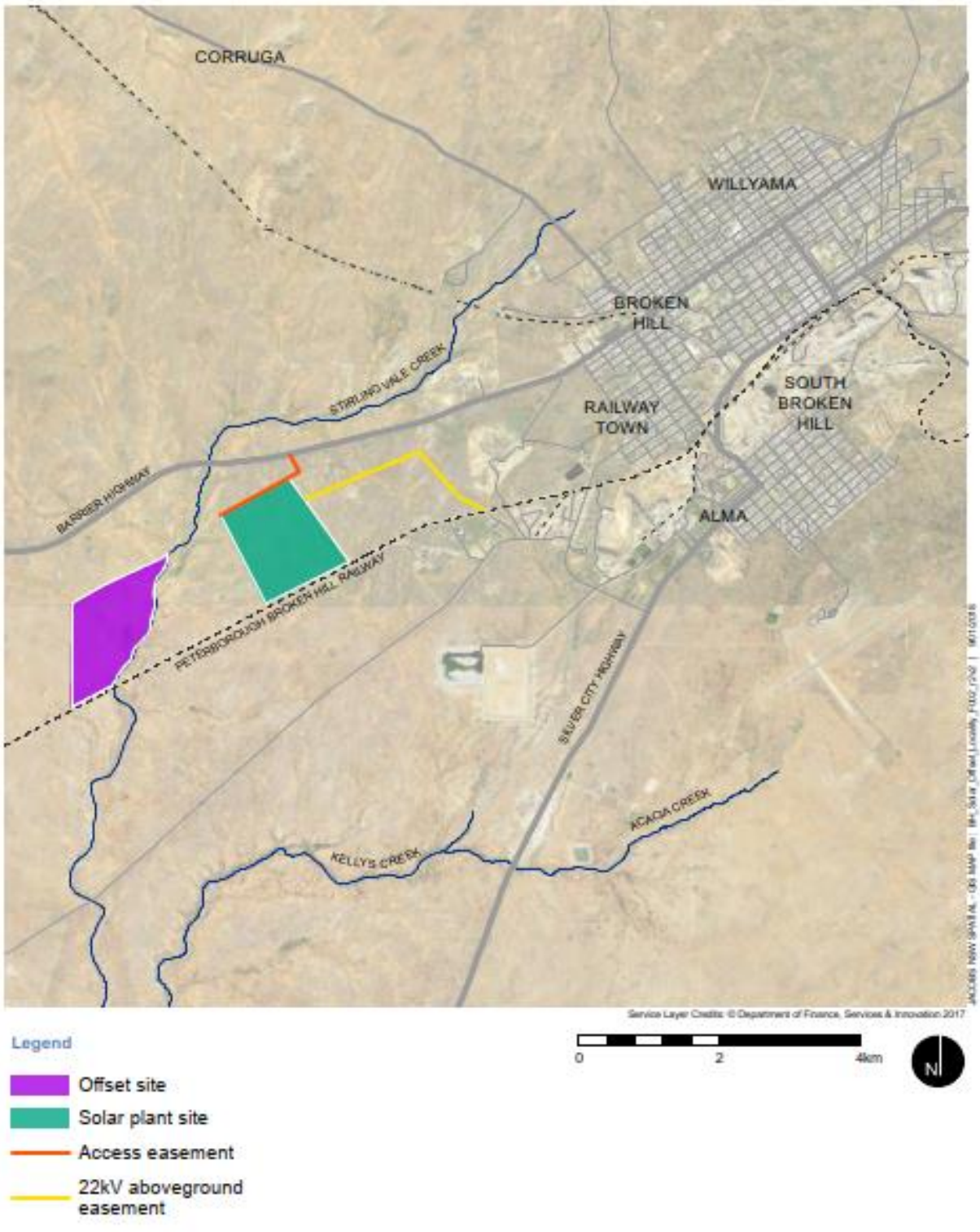

Figure 1-1. Broken Hill Solar Plant and Offset Site Location

2. Monitoring method

2.1 Requirements

The monitoring method is consistent with the methodologies outlined in the BOMP (NGH Environmental, 2013) and meets the requirements of the COA C5. In particular, COA C5(b) stipulates the requirement of the offset site to achieve an 'improved or maintained' outcome for the biodiversity values of the offset site. Improved or maintained outcomes for the biodiversity values of the offset site have been evaluated through the comparison of monitoring data against the initial baseline (benchmark data at the start of monitoring) and the results of the annual monitoring events for each surveyed vegetation community as well as the evaluation of weed infestation and fauna habitat. An overview of the monitoring methods used include:

- **Vegetation condition assessment**: Follows the methodology used in the BOMP (NGH Environmental, 2013), and to provide a direct comparison between monitoring events, an assessment was undertaken using the BBAM (DECC, 2009) to collect data on vegetation structure, cover and quality across transects and within monitoring plots. This data was then compared with the NGH Environmental (2013) baseline data, where available, and the 2013 PCT benchmark data for each vegetation community type using the Vegetation Benchmarks Database (DECC, 2008). The BBAM has now been replaced with the Biodiversity Assessment Methodology 2020 (BAM) which no longer uses the Modified Braun Blanquet method to assess floristic cover and abundance. Given that this study originally used the BBAM (with Modified Braun Blanquet cover/abundance data), this method has been continued in order to enable comparison of vegetation condition between previous years. The current vegetation condition assessment monitors change in 2023 and was completed in mid January 2024 (Year 7)), the condition is compared with:
  - Benchmark data (DECC, 2008)
  - Baseline study (included in the BOMP, NGH Environmental, 2013)
  - Monitoring data (Jacobs2017-2022).
- **Habitat evaluation**: Notes on fauna habitat were taken across the broader site while traversing the offset site to reach the monitoring plots. At each monitoring plot detailed notes were taken.
- **Fencing evaluation**: Fences were assessed through observation by driving and walking around the perimeter of the offset site, identifying any areas requiring maintenance.

2.2 Field survey

The field survey was undertaken by two Jacobs Ecologists, Emma Weatherstone and Kirsty Raines, on 17 January 2024 across the five vegetation types identified within the offset site (listed in **Table 2-1** below and shown on **Figure 2-2**) by NGH Environmental (2013). Details on the vegetation types and number of plots sampled is outlined in **Table 2-1**. Monitoring was conducted in January 2024 to capture change in condition over 2023 from previous sampling in December 2022.

Table 2-1 Vegetation types within the offset site and details of plots sampled

Vegetation Type (DECC 2008)	PCT ID	Area in offset site (ha)	Monitoring plots sampled by NGH Env. (2013)	Monitoring plots sampled (2017-2023)	Threat category (Benson *et al.* 2006)*
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	221	141.8	M03 (1 plot)	M03 & M07 (2 plots)	Near threatened
Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone	136	8.5	M01 (1 plot)	M01 (1 plot)	Least concern
Narrow-leaved Hopbush - Scrub Turpentine – Senna shrubland of semi-arid and arid sandplains and dunes	143	1.9	M04 (1 plot)	M04 (1 plot)	Least concern
Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions	123	1.5	M02 (1 plot)	M02 (1 plot)	Near threatened
Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)	159	3.2	Not surveyed by NGH Env. (2013)	M05 & M06 (2 plots)	Critically Endangered*

* This category is according to Benson *et al.* (2006); none of these communities are listed under State or Commonwealth legislation

2.2.1 Vegetation condition assessment and establishment of monitoring plots

Monitoring plots were sampled using the BioBanking Assessment Methodology (BBAM) (DECC 2009), as required by COA C5 (**Appendix B**) and in the BOMP (NGH Environmental, 2013), to provide a comparison between baseline data and the recorded benchmarks (NGH Environmental, 2013).

Floristic data was collected to enable a comparison between baseline data and benchmarks recorded in the BOMP (NGH Environmental, 2013). The four monitoring plots established by NGH Environmental (2013), were located at the offset site using recorded GPS coordinates. The three additional plots (M05, M06, M07) were installed during the 2017 monitoring by Jacobs to cover additional vegetation areas and types. All plots were previously marked in the field using wooden stakes driven into the ground to facilitate future replication. Stakes were placed at the start and end of a 50 m transect and their coordinates recorded. Start points were delineated with a silver pin hammered into the top of the stake. A 20 x 20 m quadrat required by the BBAM (DECC 2009) was conducted within an area bounded by the first 20 m of the transect and extending 10 m either side (see **Figure 2-1**). Where required, stakes that had deteriorated in the field over time were replaced with new, thicker stakes and pins. Photographs were taken at the start and end of each monitoring plot. The location of all vegetation types and monitoring plots are shown in **Figure 2-2**.

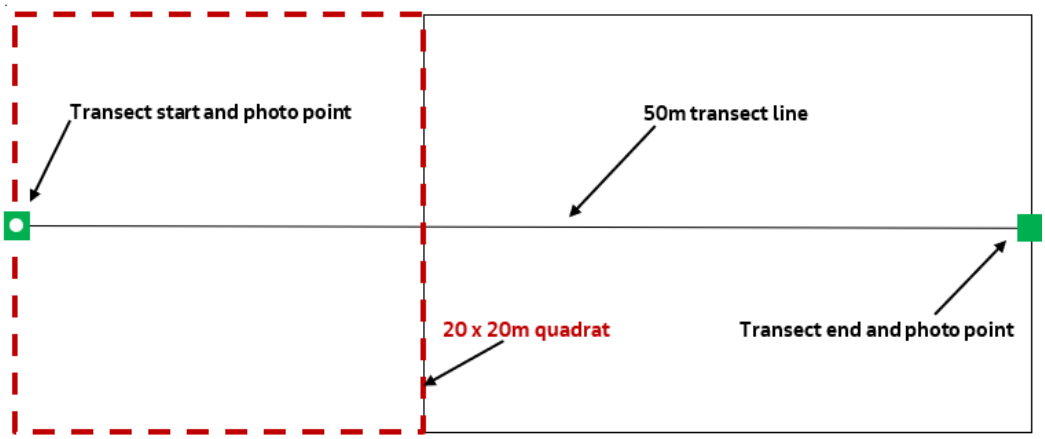

Figure 2-1: Monitoring plot method

Data collected during each monitoring year has been collated into one electronic database using Microsoft Excel, along with the NGH Environmental (2013) baseline data and the benchmark data for each vegetation community to enable future analysis of data.

Baseline data collected by NGH Environmental (2013) at the offset site was limited to a simple presence absence record of plants within monitoring plots. As such, this does not allow for a more detailed analysis to be undertaken to compare data. Therefore, the Modified Braun Blanquet method (see **Table 2-2**) was used for recording floristic cover/abundance data within each monitoring plot, which allowed for more detailed analysis. This method has been applied since the commencement of the monitoring program.

Table 2-2 Modified Braun Blanquet method used for the monitoring survey

Modified Braun Blanquet criteria (plant cover abundance scale)	
1	1 to a few individuals present, less than 5% cover
2	Many individuals present, but still less than 5% cover
3	5-<20% cover
4	20-<50% cover
5	50-<75% cover
6	75-100% cover

The coordinates for each monitoring plot are provided in **Table 2-3** to enable repeat and consistent monitoring in the future.

Table 2-3 Coordinates for each of the monitoring plots

Plot name	Transect start		Transect end	
	Latitude*	Longitude*	Latitude*	Longitude*
M01	533641.52	6458408.77	533693.98	6458429.85
M02	533599.64	6458791.57	533663.43	6458774.15
M03	533978.53	6459970.07	533992.65	6459922.92
M04	534146.70	6460116.23	534183.12	6460141.86

Plot name	Transect start		Transect end	
	Latitude*	Longitude*	Latitude*	Longitude*
M05	534122.66	6458659.4	534144.39	6458705.5
M06	534154.88	6458721	534175.37	6458766.9
M07	534543.53	6459880.4	534546.53	6459929.4

* Co-ordinates are in MGA zone 54 relative to the WGS84 datum

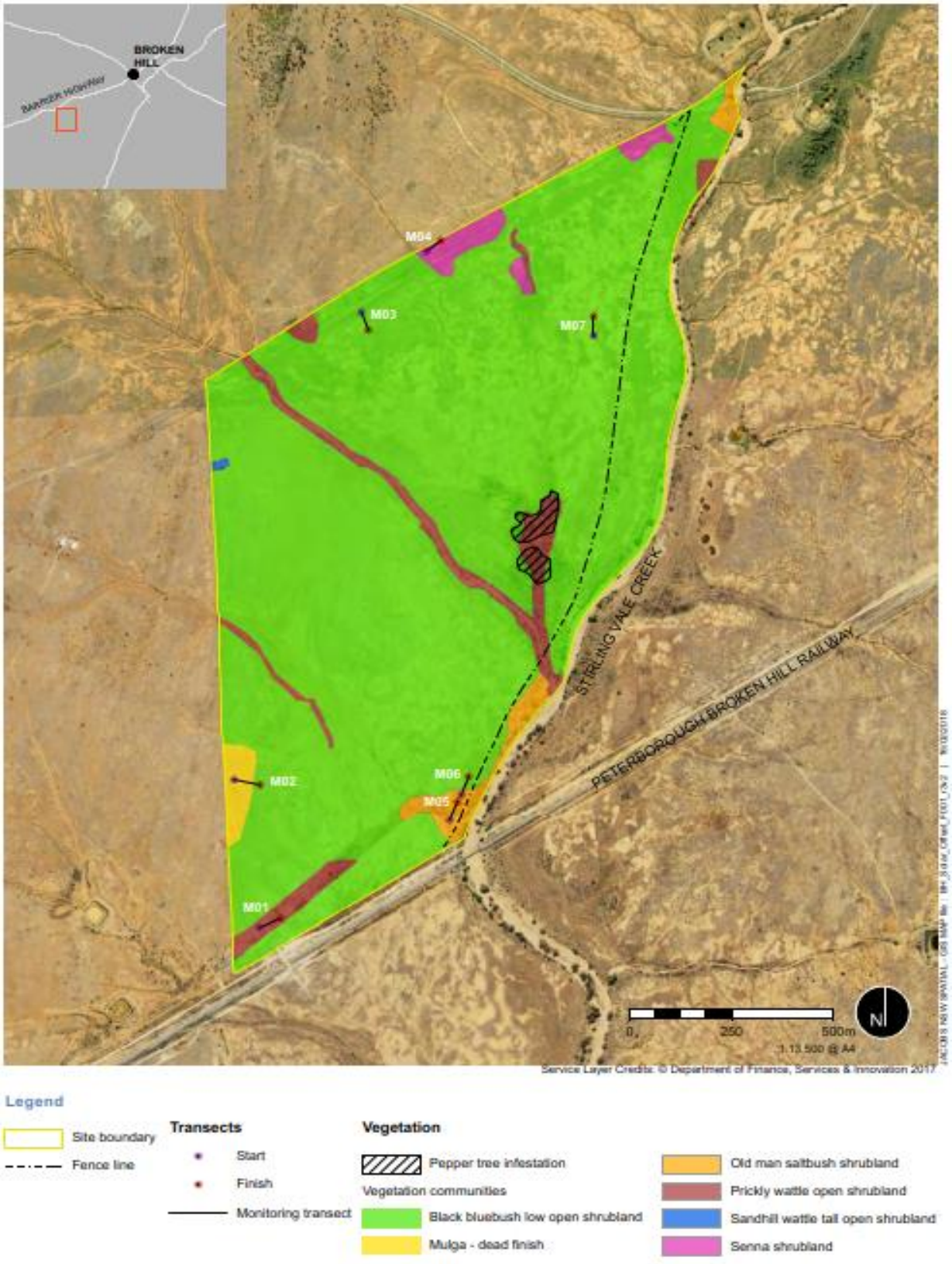

Figure 2-2. Vegetation types and monitoring plots within the Broken Hill Offset Site

2.2.2 Habitat evaluation

Detailed habitat notes were taken at each of the monitoring plot locations and included the percentage cover of the following habitat features within the entire 50 x 20 m plot:

- Tussock grasses
- Chenopod shrubs
- Mulga (or other overstorey species)
- Bare ground
- Cracking clay
- Rocks and logs.

2.2.3 Grazing pressure

Grazing pressure is evaluated by visual inspections for fauna within the offset site.

2.2.4 Fencing evaluation

Fences were inspected for any required maintenance issues whilst driving around the perimeter of the offset site (where safely accessible) and whilst traversing the site by foot during monitoring surveys.

2.2.5 Data collection and analysis

Data collected during each monitoring year has been collated into one electronic database using Microsoft Excel, along with NGH Environmental (2013) baseline data and the benchmark data for each vegetation community to enable future analysis of data. Photographs of each monitoring plot are captured annually using regular photo points.

2.2.6 Climatic conditions

Broken Hill is located in atypically dry, semi-arid region that experiences low annual rainfall, with an average of only 249.6 mm per annum. Following drought years in 2018 and 2019, the last four years have had many months of above average rainfall due to repeat La Niña events. During 2023, the months of January and June were recorded with above average rainfall (see **Figure 2-3** below). In January 2024, Broken Hill recorded the highest January rainfall total since 1974, equating to 132.6 mm. Additionally, previously significant rainfall events occurred in 2021 (March, June, July and November) and 2022 (March, April and October). The rainfall events throughout January and June 2023 provided significant levels of rainfall resulting in a continuation of improved conditions for plant growth, as observed in the previous 2022 monitoring data. This has generally maintained the species richness counts from previous years, as well as contributed to significant growth of native forbs. Furthermore, the record rainfall experienced in January 2024, is likely to contribute further to the growth of native plant species in the subsequent 12 months, further improving species richness.

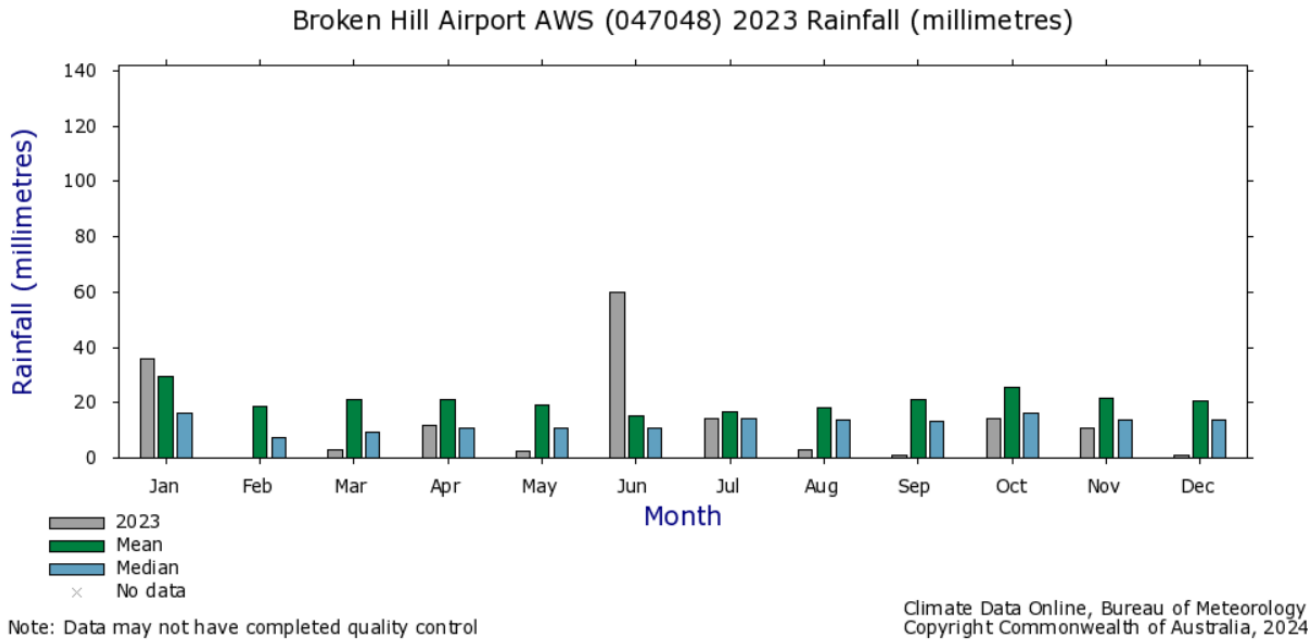

Figure 2-3. Rainfall in Broken Hill in 2023 (source: Australian Bureau of Meteorology, 2024)

3. Monitoring results

3.1 Plot data descriptions and benchmark comparisons

The data and description of the monitoring results for each surveyed vegetation community are listed below. Photographs taken at the start and end of each monitoring plot are also provided. A species list specific to the 20m x 20m monitoring plot within the larger transect area is provided in **Appendix A**.

3.1.1 Black Bluebush low open shrubland

The Black Bluebush low open shrubland community is the dominant vegetation type within the offset site. It is dominated by *Maireana pyramidata* (Black Bluebush) with other chenopod shrubs as sub-dominants including, *Atriplex* spp. (Saltbushes) and *Sclerolaena* spp. (Copperburrs). Grasses were largely absent from this community in the drought years of 2018 and 2019 due to lack of rainfall. A return to favourable conditions in 2020, with higher rainfalls, led to the resurgence of several native grass species. Data from the year 7 monitoring period, recorded a marginal decline in the cover of grasses compared with the previous year. The exception was M03 which has increased by approximately three per cent (see **Table 3-1**). The native grasses *Austrostipa scabra* subsp. *scabra* (Spear Grass) and *Enneapogon avenaceus* (Bottle Washers) were commonly recorded in M03 and M07. Weed species were not extensive in this community, however, exotic species including *Carrichtera annua* (Ward's Weed) and *Medicago minima* (Medicago) were present in low abundance in M03, comparable to the previous Year 6 monitoring period.

The monitoring plot data along with the benchmarks for this vegetation type are shown in **Table 3-1** and

Table 3-2. Species richness (i.e., the number of native species, is shown in **Table 3-1** as 'Native Spp. #') has increased this year, particularly as the M07 plot sustained a trend of an increase in diversity of thirteen native species, after only seven species recorded in 2021 and twelve species recorded in 2022. Species richness in M07 has now reached the benchmark value for this community (13 species) and species richness in M03 (16 species) remains above both the benchmark and baseline scores for this community. No over-storey or mid-storey vegetation was present, which is consistent with the baseline score of each plot. Cover of native grass remains higher than the drought years of 2018 and 2019. The shrub-layer remains close to the maximum benchmark values for this community. The largest increases were in the groundcover 'other' group (excluding grasses). These categories are scoring within benchmark range for the community, although are overall still slightly below the baseline scores for each plot.

The native groundcover other (forbs) category has vastly increased since last year and has approximately 15% cover. For contrast, the drought years of 2018 and 2019 were 0% cover. This cover is within benchmark values for the community and will likely increase further if there is a continuation of above average rainfall and optimal conditions.

Grass cover in both plots (M03 and M07) is still less than Year 1 monitoring although is within the benchmark cover range for M03. A slight decline of grass cover in M07 this year means that the value is below benchmark range, although the native groundcover other (forbs) has increased. As per previous surveys, Hollow Bearing Tree (HBTs) and logs were absent from this community.

Overall, this community continues to recover from the drought years of 2018 and 2019 years and historical grazing pressure prior to establishing as an offset. This slight increase in vegetation cover is shown in **Table 3-1** and

Table 3-2 below. Monitoring photographs for plot M07 and M03 shown in **Plate 1** to **Plate 4**. The health and condition of native plants has generally remained consistent, though slightly declined since last year, likely due

to the survey timing. This is a result of ongoing above average rainfall during 2021 and 2022, as well as exclusion of sheep and goats from the offset site.

Table 3-1 Benchmark and monitoring plot data comparison for Black Bluebush low open shrubland M03 – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
Baseline (NGH Env. 2013)	10	0%		0%		52%		24%		0%		0	0
Year 1 Plot M03	13	0%		0%		16%		20%		34%		0	0
Year 2 Plot M03	8	0%		0%		0%		14%		2%		0	0
Year 3 Plot M03	6	0%		0%		0%		14%		0%		0	0
Year 4 Plot M03	12	0%		10%		9%		16%		4%		0	0
Year 5 Plot M03	12	0%		12%		8%		19%		5%		0	0
Year 6 Plot M03	14	0%		12%		5%		22%		9%		0	0
Year 7 Plot M03	16	0%		4%		8%		14%		16%		0	0

Table 3-2 Benchmark and monitoring plot data comparison for Black Bluebush low open shrubland M07 – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	13	4%	20%	0%	0%	5%	20%	2%	15%	5%	20%	0	0
Baseline (NGH Env. 2013)	n/a	n/a		n/a		n/a		n/a		n/a		0	0
Year 1 Plot M07	8	0%		0%		4%		12%		58%		0	0
Year 2 Plot M07	7	0%		0%		0%		6%		0%		0	0
Year 3 Plot M07	6	0%		0%		0%		5%		0%		0	0
Year 4 Plot M07	9	0%		10%		3%		10%		5%		0	0
Year 5 Plot M07	7	0%		10%		4%		12%		7%		0	0
Year 6 Plot M07	12	0%		11%		3%		15%		10%		0	0
Year 7 Plot M07	13	0%		0%		1%		14%		14%		0	0

Plate 1. Black Bluebush low open shrubland M03 Year 6 (December 2022)

Plate 2. Black Bluebush low open shrubland M03 Year 7 (January 2024)

Plate 3. Black Bluebush low open shrubland M07 Year 6 (December 2022)

Plate 4. Black Bluebush low open shrubland M07 Year 6 (January 2024)

3.1.2 Mulga-Dead Finish on stony hills

The Mulga-Dead Finish on stony hills community is restricted to a small area on a rise in the west of the offset site where the soils are characteristically shallow and stony. *Acacia aneura* (Mulga) is absent within the offset site, however, it occurs on the property to the west. Dominant shrubs include *Acacia tetragonophylla* (Dead Finish), *Senna artemisioides* subsp. f*ilifolia* (Senna) and *Senna phyllodinea* (Silver Leaf Cassia). The ground cover consists of a patchy distribution of grasses, forbs, bare earth and scattered rock. Vegetation is continuing to recover from drought conditions experienced in 2018 and 2019. Weed species *Sonchus oleraceus* (Common Sowthistle) and *Conyza bonariensis* (Fleabane) are present in low abundance. Vegetation remains in similar condition to2022 (Year 6) (See **Plate 5** and **Plate 6**).

The monitoring plot data along with the benchmarks for this vegetation type (DECC, 2008) are shown in **Table 3-3**. Species richness was the highest recorded for this plot, above both the baseline and benchmark scores for this community. Native species *Arabidella trisecta* and *Acacia sp.* Were recorded for the first time in M02. No overstorey cover was recorded in this community due to the absence of Mulga within the offset site, which based on the benchmark range, can be typical of the community.

Mid-storey cover and groundcover-shrub covers exceed the benchmarks. Mid-storey cover was found to be slightly lower than last year, and groundcover-shrub cover has decreased slightly on last year's cover score. These trends are mainly attributed to dead mid-storey species, though importantly, these mid-storey species were observed as smaller plants, i.e., regenerating, and therefore did not contribute to the mid-storey scores.

Grass cover decreased slightly since the previous year, though remains higher than the benchmark range for this community. Other native groundcovers (forbs) also increased and are above benchmark range and baseline scores for this community. The increase in groundcovers (forbs) is likely attributed to the slight decrease in grass cover, enabling reduced natural competition for the native forb species. As grass species benefit from a higher rainfall, due to the decrease in annual rainfall, it has contributed to the reduction in grass cover. As grass cover decreases, it can create space and resources for other plant species, such as forbs. This shift often occurs due to changes in environmental conditions leading to an increase in forb species diversity. Due to the decrease in grass cover, this has allowed forb species to exploit newly available niches. Additionally, the Eastern Grey Kangaroo (*Macropus giganteus*) was observed within the offset site during the monitoring survey, which may have marginally contributed to the reduction in the cover of native grasses due to grazing pressures.

Hollow Bearing Trees (HBTs) and fallen logs are absent from this community.

Overall, this community is in moderate condition, with increased species richness and native vegetation cover this year. Weed cover has increased slightly but is not notable. Vegetation in plot M02 has retained a healthy condition and is shown in **Plates 5** and **6**. This is a result of the above average rainfall in 2022 and moderate rainfall in 2023 and reduced grazing pressure from herbivores.

Table 3-3 Benchmark and monitoring plot data comparison for Mulga-Dead Finish on stony hills M02 – Broken Hill offset site

	Native Spp. #	Native Cover Overstorey		Mid-storey		Native Groundcover Grasses		Shrubs		Other		HBTs	Logs
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	17	0%	3%	1%	3%	1%	5%	1%	5%	1%	5%	0	3
Baseline (NGH Env. 2013)	15	0%		8%		52%		14%		2%		0	0

	Native Spp. #	Native Cover Overstorey Min	Max	Mid-storey Min	Max	Native Groundcover Grasses Min	Max	Shrubs Min	Max	Other Min	Max	HBTs	Logs
Year 1 Plot M02	18	0%		6%		24%		32%		38%		0	0
Year 2 Plot M02	12	0%		4%		0%		10%		0%		0	0
Year 3 Plot M02	9	0%		4%		0%		8%		0%		0	0
Year 4 Plot M02	18	0%		10%		6%		10%		2%		0	0
Year 5 Plot M02	20	0%		10%		10%		11%		3%		0	0
Year 6 Plot M02	23	0%		11%		15%		14%		8%		0	0
Year 7 Plot M02	27	0%		7%		14%		10%		18%		0	0

Plate 5. Mulga – Dead Finish on stony hills M02 Year 6 (December 2022)

Plate 6. Mulga – Dead Finish on stony hills M02 Year 7 (January 2024)

3.1.3 Prickly Wattle open shrubland

The Prickly Wattle open shrubland community typically occurs in drainage lines and depressions across the offset site. *Acacia victoriae* (Prickly Wattle) dominated the mid-storey of this community with no overstorey recorded. Dominant shrubs included *Atriplex vesicaria* (Bladder Saltbush), *Maireana pyramidata* (Black Bluebush) and *Rhagodia spinescens* (Spiny saltbush). Groundcover is consistent and comprises of shrubs and forbs (see **Plate 7** and **Plate 8**). Weed species remained lower than the previous year and included *Asphodelus fistulosus* (Onion

Weed), *Carrichtera annua* (Ward's Weed) and *Prosopis velutina* (Velvet Mesquite). However, regenerating *Lycium ferocissimum* (African Boxthorn) was also present in small occurrences (see **Plate 15**).

The monitoring plot data along with the benchmarks for this vegetation type (DECC, 2008) is shown in **Table 3-4**. The number of native species has increased from 2022 and remains higher than the benchmark and baseline range. Overstorey cover was absent which is consistent with the benchmark range and considered typical for this community. Mid-storey cover decreased slightly, though remains above that of the baseline survey and benchmark values. Groundcover-shrub cover is significantly greater than the benchmark for this community, though has decreased since last year's monitoring. The cover of grasses has decreased since 2021 and 2022, though remains within benchmark range for the community (although not yet at baseline scores). The decrease in grasses is likely attributed to a decrease in rainfall from 2022 and natural seasonal variation. Dominant grasses included *Austrostipa scabra* subsp. *scabra* (Speargrass), *Rytidosperma caespitosum* (Ringed Wallaby Grass), *Chloris truncata* (Windmill Grass) and *Enneapogon avenaceus* (Bottle Washers). Native groundcover-other (forbs) continues to increase as a result of recent rainfall and reduced natural competition with grass species. The native forb cover is well within benchmark values. Hollow Bearing Trees (HBTs) and fallen logs were absent from this community.

Overall, the condition of this community continues to improve following the previous drought conditions. Cover percentages of most vegetation categories have slightly decreased, though remain within or are exceeding the benchmark levels in plot M01. This is likely a result of continued favourable conditions and reduced grazing pressure from herbivores.

Table 3-4 Benchmark and monitoring plot data comparison for Prickly Wattle open shrubland M01– Broken Hill Offset site

	Native Spp. #	Native Cover Overstorey		Mid-storey		Native Groundcover Grasses		Shrubs		Other		HBTs	Logs
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	11	0%	0.1%	0%	0%	2%	20%	1%	10%	1%	20%	0	0
Baseline (NGH Env. 2013)	12	7%		5%		14%		38%		2%		0	1.5
Year 1 Plot M01	12	10%		16%		8%		32%		28%		0	0
Year 2 Plot M01	11	0%		21%		0%		22%		0%		0	0
Year 3 Plot M01	5	0%		15%		0%		18%		0%		0	0
Year 4 Plot M01	18	0%		20%		5%		20%		5%		0	0
Year 5 Plot M01	16	0%		22%		10%		22%		15%		0	0
Year 6 Plot M01	20	0%		24%		13%		25%		18%		0	0
Year 7 Plot M01	21	0%		16%		8%		16%		20%		0	0

Plate 7. Prickly Wattle low open shrubland M01 in Year 6 (December 2022)

Plate 8. Prickly Wattle low open shrubland M01 in Year 7 (January 2024)

3.1.4 Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland

This vegetation type occurs as discrete patches along the northern boundary of the offset site. The mid-storey is dominated by *Senna phyllodinea* (Silver Cassia) and *Senna artemisioides* subsp. f*ilifolia* (Punt Bush). Groundcover is dominated by a range of shrubs including *Maireana pyramidata* (Black Bluebush), *Maireana ciliata* (Fissure-weed), *Atriplex stipitata* (Mallee Saltbush) and *Rhagodia spinescens* (Spiny saltbush).

Weed cover remains similar to last year, though marginally lower in this community, with weeds including *Asphodelus fistulosus* (Onion weed)*, Carrichtera annua* (Ward's Weed), *Echium plantagineum* (Paterson's Curse)*, Limonium lobatum* (Winged Sea Lavender) and *Centaurea melitensis* (Maltese Star-thistle).

The monitoring plot data along with the benchmarks for this vegetation type (DECC, 2008) are shown in **Table 3-5**. The number of native species recorded increased slightly, resulting in higher than benchmark levels and on par with baseline scores. Overstorey cover was absent from this community which is below the benchmark and baseline data (NGH Environmental, 2013). At 11%, the mid-storey cover for this community was above the benchmark range, though slightly lower than the previous year. This is likely contributed to natural seasonal variation. Groundcover-shrub cover is higher than the previous year, resulting in above the benchmark range though remains lower than that recorded during the baseline and Year 1 surveys. Native grass cover has remained consistent with the previous year and is within benchmark values. The cover of other native groundcover (forbs) increased substantially since last year and is just below benchmark values, although is still well above baseline levels. Importantly, as previously mentioned, the general decline in grasses across the offset sites has created opportunities for native forb species to exploit newly available niches. Specifically, in the case of M04, where there was no additional cover of grasses, forbs have utilized the available space and resources to establish and increase in abundance with the reduced competition with grasses.

Hollow Bearing Trees (HBTs) and fallen logs were absent from this community.

Overall, this community is still in moderate condition. The health and condition of native plants has generally remained consistent, though slightly declined since last year, likely due to the survey (see **Plate 9** and **Plate 10**).

Since Dec 2022 species richness has reached baseline levels, native groundcover remains within or above benchmark values, though native overstorey and mid-storey cover are still substantially lower, which is likely a result of the drought from Years 2 (2018) and 3 (2019).

Table 3-5 Benchmark and monitoring plot data comparison for Senna shrubland M04 – Broken Hill Offset site

	Native Spp. #	Native Cover Overstorey		Mid-storey		Native Groundcover Grasses		Shrubs		Other		HBTs	Logs
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	12	1%	14%	1%	8%	5%	25%	2%	15%	2%	25%	0	2
Baseline (NGH Env. 2013)	23	3%		0%		48%		24%		2%		0	0
Year 1 Plot M04	20	0%		10%		0%		34%		24%		0	0
Year 2 Plot M04	19	0%		4%		0%		6%		0%		0	0
Year 3 Plot M04	11	0%		4%		0%		5%		0%		0	0
Year 4 Plot M04	24	0%		10%		8%		10%		5%		0	0
Year 5 Plot M04	21	0%		12%		11%		12%		4%		0	0
Year 6 Plot M04	22	0%		13%		14%		14%		5%		0	0
Year 7 Plot M04	23	0%		11%		14%		16%		24%		0	0

Plate 9. Narrow-leaved Hopbush – Scrub Turpentine - Senna Shrubland M04 in Year 6 (December 2022)

Plate 10. Narrow-leaved Hopbush – Scrub Turpentine - Senna Shrubland M04 in Year 7 (January 2024)

3.1.5 Old Man Saltbush shrubland

Natural occurrences of the Old Man Saltbush shrubland community are rare within the landscape and due to its reduction in extent and poor representation within the reserve system, it is of conservation concern (Benson *et al*., 2006) (see **Plate 11 to Plate 14**). This community occurs adjacent to the drainage line along the eastern side of the offset site and has spread to the man-made drainage line in the south of the offset site following disturbance.

The mid-storey of this community is dominated by *Atriplex nummularia* (Old Man Saltbush) and *Maireana pyramidata* (Black Bluebush). *Atriplex vesicaria* (Bladder Saltbush), *Enchylaena tomentosa* (Ruby Saltbush), *Dissocarpus paradoxus* (Cannonball Burr) and *Rhagodia spinescens* (Spiny Saltbush) make up the shrub component of the ground layer. Weed cover has decreased slightly in this vegetation community in the past two years, likely a result of the lower rainfall experienced in 2023 compared to 2021 and 2022. Exotic species include *Carrichtera annua* (Ward's Weed), *Echium plantagineum* (Paterson's Curse), *Limonium lobatum* (Winged Sea Lavender), *Asphodelus fistulosus* (Onion weed), *Carthamus lanatus* (Saffron thistle), among others. Occasional *Lycium ferocissimum* (African Boxthorn) and *Prosopis velutina* (Velvet mesquite*)* plants were also recorded (both species are state and regional weeds to be targeted under *Biosecurity Act 2015*).

The monitoring plot data along with the benchmarks for this vegetation type (DECC, 2008) are shown in **Table 3-6** and

Table 3-7. This community was not surveyed by NGH Environmental (2013); therefore, no baseline data has been collected and as such, the Jacobs (2017, Year 1) survey data will form the baseline for this community. Species richness exceeds the benchmark and baseline values for both M05 and M06, where last year, Year 6, M05 was just below the benchmark value.

Overstorey cover was absent from this community and remains below the benchmark data. Canopy species often associated with Old Man Saltbush shrubland include *Eucalyptus largiflorens* (Black Box), *Eucalyptus coolabah* (Coolibah) and *Acacia pendula* (Weeping Myall). The absence of these species from the surrounding areas and locality means that there is limited potential for them to occur within the offset site, and overstorey scores for this community may never reach the benchmark values. Old Man Saltbush shrubland is highly variable and does not always contain Eucalypts or Acacias, meaning that the overstorey benchmark values may be of little relevance to measuring the condition of this community. The *Eucalyptus camaldulensis* (River Red Gums) along Stirling Vale Creek to the immediate east of the offset site form a separate vegetation community.

Mid-storey cover was higher than the benchmark range and has remained similar or increased slightly since last year's monitoring. Native grass cover decreased substantially, though is consistent with the baseline values for this community. Both the native groundcover – shrub and native groundcover – other (forbs) cover have increased since Year 6 and remains well above the scores recorded in the drought years of 2018 and 2019. They are above the benchmark range and is approaching baseline cover score for this community. Overall, this vegetation community is in moderate condition and has improved in health to 2022. There has been an increase in species richness and cover scores overall. Improved average rainfall and reduced grazing pressure has seen this community improve following drought conditions.

Table 3-6 Benchmark and monitoring plot data comparison for Old Man Saltbush shrubland at M05 – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
Baseline (NGH Env. 2013)	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
Year 1 Plot M05	9	0%		64%		0%		34%		16%		0	0
Year 2 Plot M05	10	0%		39%		0%		20%		2%		0	0
Year 3 Plot M05	4	0%		30%		0%		20%		0%		0	0
Year 4 Plot M05	12	0%		35%		5%		25%		2%		0	0
Year 5 Plot M05	11	0%		37%		9%		27%		3%		0	0
Year 6 Plot M05	14	0%		40%		7%		31%		5%		0	0
Year 7 Plot M05	17	0%		32%		0%		46%		10%		0	0

Table 3-7 Benchmark and monitoring plot data comparison for Old Man Saltbush shrubland at M06 – Broken Hill Offset site

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Benchmark	15	2%	20%	0%	3%	0%	10%	1%	20%	0%	5%	0	0
Baseline (NGH Env. 2013)	n/a	n/a		n/a		n/a		n/a		n/a		n/a	n/a
Year 1 Plot M06	11	0%		3%		0%		74%		16%		0	0
Year 2 Plot M06	13	0%		10%		0%		22%		0%		0	0
Year 3 Plot M06	11	0%		8%		0%		18%		0%		0	0
Year 4 Plot M06	15	0%		10%		5%		25%		0%		0	0
Year 5 Plot M06	14	0%		11%		4%		24%		2%		0	0
Year 6 Plot M06	19	0%		12%		5%		26%		8%		0	0
Year 7 Plot	18	0%		13%		0%		40%		12%		0	0

	Native Spp. #	Native Cover Overstorey Min	Max	Mid-storey Min	Max	Native Groundcover Grasses Min	Max	Shrubs Min	Max	Other Min	Max	HBTs	Logs
M06													

Plate 11. Plate 11 Old Man Saltbush shrubland M05 in Year 6 (December 2022)

Plate 12. Old Man Saltbush shrubland M05 in Year 7 (January 2024)

Plate 13. Old Man Saltbush shrubland M06 in Year 6 (December 2022)

Plate 14. Old Man Saltbush shrubland M06 in Year 7 (January 2024)

3.2 Weeds and disturbance

Weed infestation across the offset site was low to moderate. Monitoring plots M05 and M06 recorded the greatest coverage of weeds, while M05 had the greatest diversity of weeds. There were no new weed species observed in the site that were not previously recorded. Although, due to the survey timing, mid-January, and the slightly reduced rainfall from the previous two years, there was seen to be an alteration in the type of weed species present and a lower coverage than previously observed. The weed species with the highest coverage during the Year 7 monitoring period consisted of *Asphodelus fistulosus* (Onion Weed), *Carrichtera annua* (Ward's Weed) and *Medicago minima*.

The centre of the offset site (see **Figure 2.2**) still contained the exotic species *Schinus molle* var. *areira* (Peppercorn Tree). The Peppercorn trees, being the only overstorey vegetation (>3m) within the offset site provide shelter from predators and the harsh climatic conditions, particularly for native bird species. Removal of this infestation (mature trees and emerging saplings) should occur gradually while native mid-storey plants gradually grow and replicate the habitat (e.g., *Alectryon oleifolius subsp. canescens, Acacia victoriae, Acacia aneura* and *Acacia tetragonophylla*).

Two of the weeds recorded within the offset site (see **Plate 15**and **Plate 16**); *Prosopis velutina* (Velvet Mesquite) and *Lycium ferocissimum* (African Boxthorn) are declared as state and regional priority weeds under the *Biosecurity Act 2015*, as listed in Appendix 1.1 and 1.2 of the Western Regional Strategic Weed Management Plan 2023-2027 (LLS, 2022). Both weeds are also listed as Weeds of National Significance and are required to be eradicated from the land, and the land is to be kept free of the plant to mitigate the risk of the plant spreading. These weed species are also recorded on the Biodiversity Assessment Method (BAM) 'High Threat' weeds list.

Ongoing weed control works were undertaken in April, July and October 2023. This is slowly reducing the abundance of Peppercorn trees, Noogoora Burr, African Boxthorn and Mesquite within the offset site. However, during the monitoring survey, some Velvet Mesquite and African Boxthorn plants appeared alive, regenerating in areas and will likely require further treatment (see photos below). A small number of Peppercorn trees are also

still alive in the drainage line areas of the site. It is noted that additional weed control actions are scheduled for 2024. Management of these weeds needs to continue to achieve eradication.

In general, spot herbicide-treatment is required for weed species across the offset site (see **Appendix A**), concentrating on perennial weeds and those areas identified as having the greatest need, i.e., around disturbance areas such as the man-made drainage line to the south of the offset site, along site boundaries adjacent to access roads and other areas disturbed by the formation of tracks.

Plate 15. *Lycium ferocissimum* (African Boxthorn) is persisting and regenerating in 2023

Plate 16. *Prosopis velutina* (Velvet Mesquite) occurs sporadically along drainage lines

3.3 Fauna Habitats

Table 3-8 shows the percentage habitat cover at each of the monitoring plots and compares these to the baseline data recorded in the BOMP (NGH Environmental, 2013) and previous monitoring surveys. Throughout the offset site chenopods provide the greatest habitat, which is comparable to the baseline survey results recorded by NGH Environmental (2013). Following drought conditions in 2018 and 2019, tussock grass habitat has increased slightly across the offset site as a result of improved rainfall. However, these levels are still below the baseline survey, and it is expected that a longer period of favourable rainfall will be required for baseline levels to begin to return. Rocky habitat occurs towards the southern end of the offset site. Numerous reptiles have previously been observed using the various habitats across the offset site during surveys, such as the Central Bearded Dragon (*Pogona vitticeps*). Importantly, due to the unfavourable wet conditions during the Year 7 monitoring period, there were no reptiles incidentally observed, though potential reptile habitat such as rocks and burrows were noted. **Appendix A**, **Table A-2** provides a list of fauna species identified during opportunistic surveys undertaken this year.

Overall habitat appears to have been maintained since the baseline surveys undertaken by NGH Environmental (2013), with recent increases in vegetative cover of shrubs and groundcover across the offset site (See

Plate 17and **Plate 18** below). Following recent repairs, the fencing appears to be excluding goats and other herbivores from the offset site, which will assist natural regeneration. No non-native grazing animals were recorded during the survey. Kangaroos were observed in small numbers within the offset site during the Year 7 monitoring. Grazing pressure is considered to be low-moderate and is notably lower than 2019 (Year 3) due to exclusion of goats and sheep since the establishment of the offset site.

Table 3-8 Habitat cover assessment – Broken Hill offset site

	Plot	Year	Habitat component					
			Tussock grasses	Chenopods	Trees/ tall shrubs	Bare ground	Cracking clay	Rocks/ logs
Cover estimates to nearest 5%	M01	BL	5%	40%	15%	60%	0%	5%
		Year 1	0%	50%	15%	45%	0%	10%
		Year 2	0%	25%	10%	50%	0%	10%
		Year 3	0%	20%	10%	60%	0%	10%
		Year 4	0%	40%	15%	40%	0%	10%
		Year 5	20%	45%	15%	25%	0%	10%
		Year 6	25%	50%	20%	20%	0%	10%
		Year 7	5%	50%	0%	30%	0%	5%
	M02	BL	70%	5%	0%	30%	0%	10%
		Year 1	0%	20%	5%	25%	0%	10%
		Year 2	0%	15%	5%	65%	0%	10%
		Year 3	0%	15%	5%	70%	0%	10%
		Year 4	5%	20%	5%	60%	0%	10%
		Year 5	15%	30%	5%	40%	0%	10%
		Year 6	30%	30%	5%	30%	0%	10%
		Year 7	15%	25%	5%	40%	0%	5%
	M03	BL	50%	20%	0%	50%	0%	10%
		Year 1	5%	50%	0%	50%	0%	5%
		Year 2	0%	15%	0%	75%	0%	5%
		Year 3	0%	15%	0%	80%	0%	5%
		Year 4	5%	20%	0%	70%	0%	5%
		Year 5	5%	30%	0%	60%	0%	5%
		Year 6	10%	35%	0%	50%	0%	5%
		Year 7	10%	20%	5%	50%	0%	5%
	M04	BL	60%	20%	0%	40%	0%	0%
		Year 1	0%	25%	5%	40%	0%	0%
		Year 2	0%	10%	5%	70%	0%	0%
		Year 3	0%	10%	5%	80%	0%	0%
		Year 4	5%	15%	10%	70%	0%	5%
		Year 5	5%	25%	10%	60%	0%	5%
		Year 6	10%	30%	10%	60%	0%	5%
		Year 7	20%	40%	0%	40%	0%	5%
	M05	Year 1	0%	10%	5%	10%	0%	0%
		Year 2	0%	10%	5%	30%	0%	0%
		Year 3	0%	10%	5%	60%	0%	0%
		Year 4	0%	15%	10%	40%	10%	5%

	Plot	Year	Habitat component					
			Tussock grasses	Chenopods	Trees/ tall shrubs	Bare ground	Cracking clay	Rocks/ logs
		Year 5	5%	20%	10%	35%	10%	5%
		Year 6	5%	25%	10%	30%	15%	5%
		Year 7	0%	25%	30%	15%	0%	0%
	M06	Year 1	0%	10%	5%	10%	0%	0%
		Year 2	0%	5%	5%	40%	0%	0%
		Year 3	0%	10%	5%	70%	0%	0%
		Year 4	0%	20%	5%	60%	0%	5%
		Year 5	5%	25%	5%	55%	0%	5%
		Year 6	5%	30%	5%	50%	0%	5%
		Year 7	0%	50%	0%	25%	0%	0%
	M07	Year 1	0%	10%	0%	45%	0%	0%
		Year 2	0%	5%	0%	75%	0%	0%
		Year 3	0%	10%	0%	75%	0%	0%
		Year 4	0%	10%	0%	80%	0%	10%
		Year 5	0%	15%	0%	75%	0%	10%
		Year 6	0%	20%	0%	70%	0%	10%
		Year 7	0%	25%	0%	65%	0%	10%

*BL = baseline

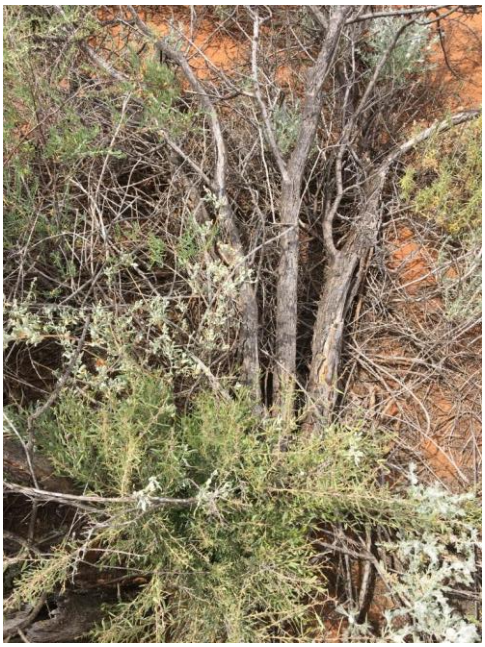

Plate 17. Shelter habitat provided by wood debris and regrowth native shrubs

Plate 18. Shelter habitat provided by chenopod regrowth (recovering from drought)

3.4 Results summary and discussion

The observed changes in the vegetation of the offset site since its establishment are summarised and discussed below. The summary focuses on the change in species richness and cover of native species and weed species since 2017. The monitoring shows a general slight increase in the health of mature plants, which exhibit dense foliage cover in the plots. Additionally, there has been an increase in species richness, which is consistent with the 'improve and maintain' objective.

3.4.1 Native species richness

Species richness has increased significantly from the previous years and remains considerably higher than the Year 2 and Year 3 monitoring periods (see **Figure 3-1**). Importantly, the species richness was noted to be equal to or higher than the benchmark levels, where the native groundcover of forbs and shrubs increased overall from the previous monitoring period. Native tussock grasses were observed to have slightly decreased since the previous year. This is likely due to natural factors as native species compete for space and nutrients and are dependent on seasonal changes. Annual and short-lived perennial species recorded that were not present during the drought periods (2018 and 2019) remain within the offset site and have since regenerated. Some new native species were recorded for the first time this year including *Arabidella trisecta* and *Acacia sp.*, demonstrating native flora recruitment.

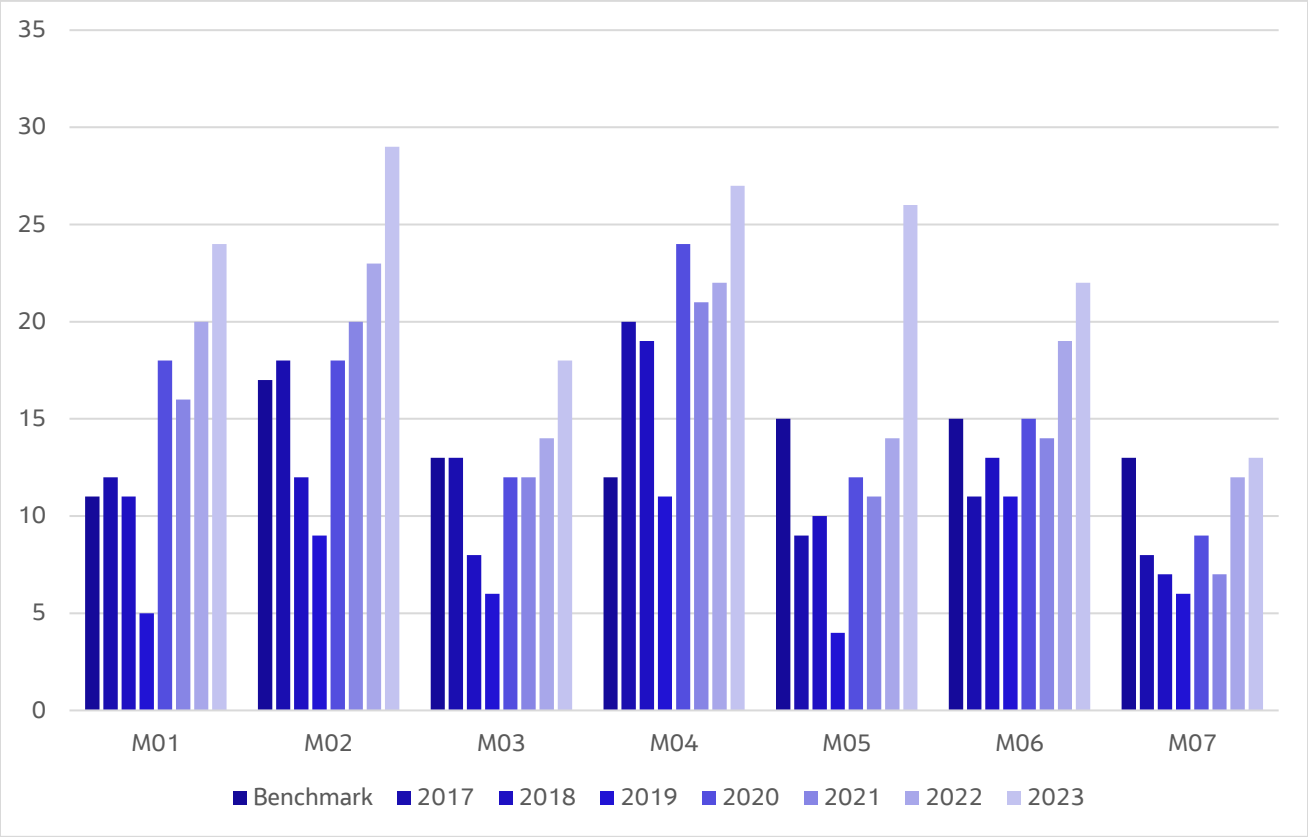

Figure 3-1 Number of native species (richness) recorded during each monitoring period

3.4.2 Cover of native and exotic vegetation

The cover of native vegetation has increased in comparison with last year (Year 6) and is much higher than 2018 and 2019 levels for all structural layers. The most pronounced increase observed was in the groundcover layer, comprising forbs (see **Figure 3-2**), and the groundcover shrub layer increased significantly in plots M05 and M06. Mid-storey – shrub layer cover has decreased overall, where the 5% decrease is attributed to plants dying off, reducing new foliage growth.

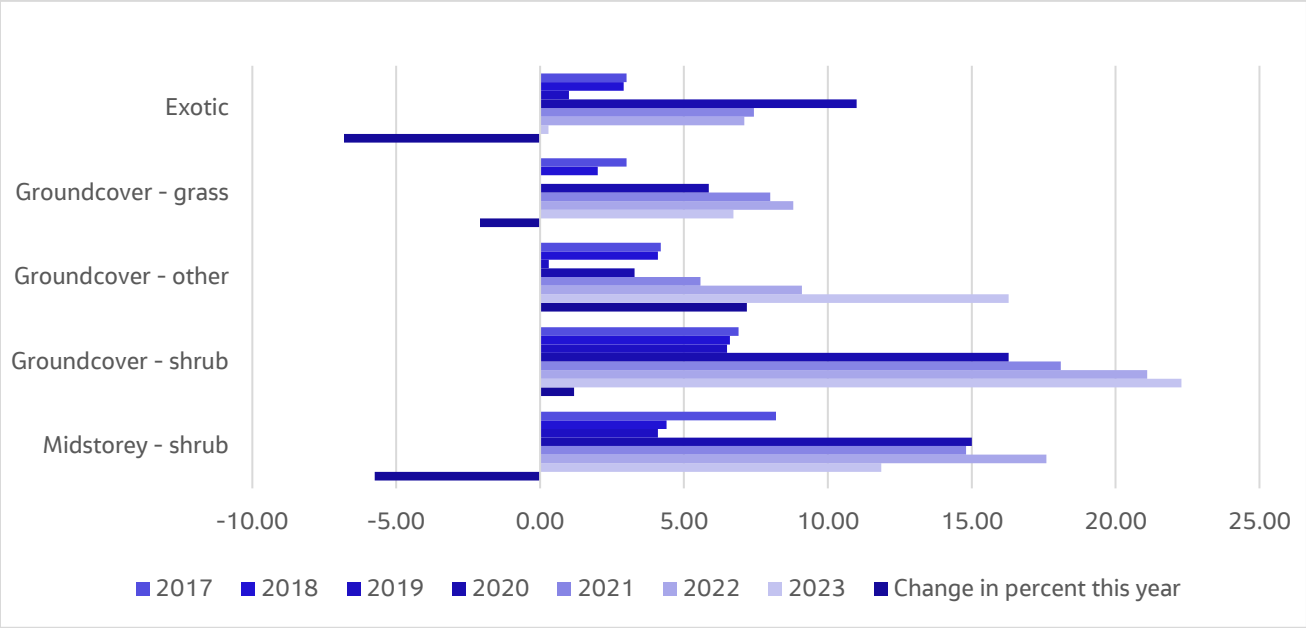

Figure 3-2 Changes in the cover (Braun Blanquet scores) of native and exotic vegetation

Groundcover – shrub category is generally exceeding benchmark levels for each plant community, and plots M03 and M07 cover percentages remain within the benchmark range (see **Figure 3-5**).

There has been a slight decrease in the exotic species cover, following the substantial increase recorded in Year 4 (following the break in drought conditions). This change is likely to be attributable to the combination of natural factors, including increased competition with native species, reduced annual rainfall, and weed management in 2021.

The cover of grasses and other groundcovers remains substantially higher than Year 3 (drought) levels and are all within benchmark levels for most plots, except for M07, which did not meet the minimum benchmark for grass cover (see **Figure 3-3** and **Figure 3-4**). M07 plot still contains a large proportion of bare ground and may still be recovering from drought conditions and historical damage from grazing. It is expected that this part of the offset site will continue to improve under favourable climatic conditions and continued exclusion of goats and other grazing animals.

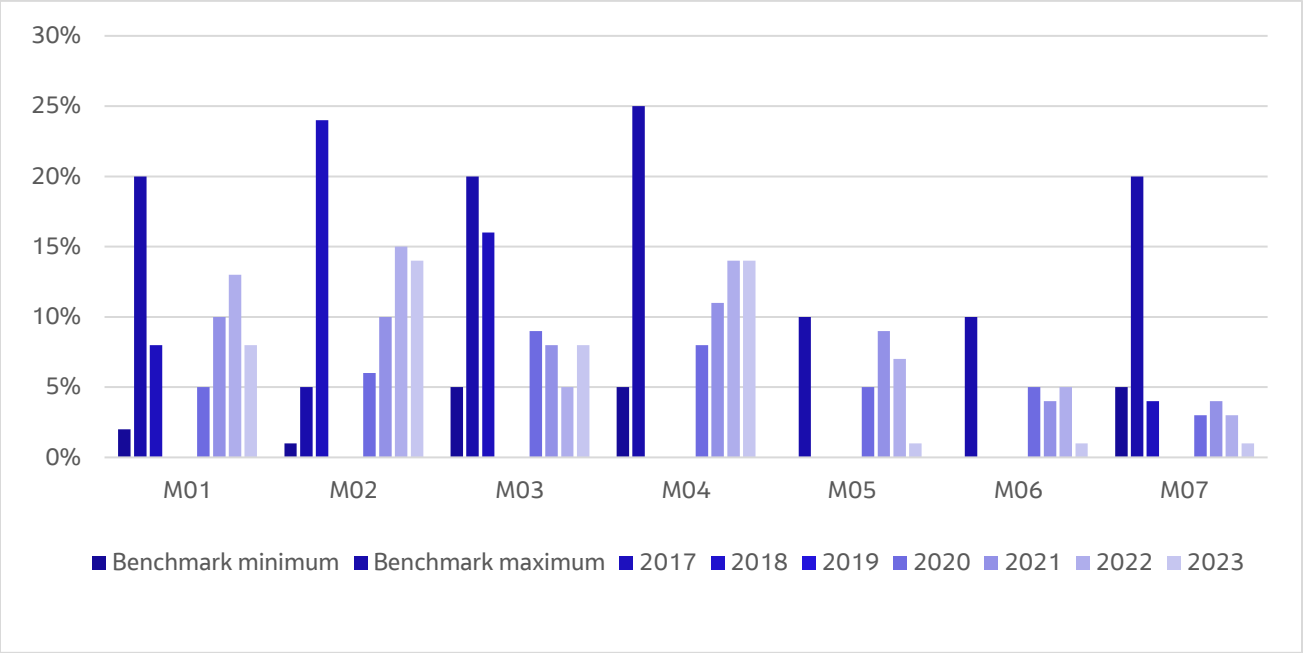

Figure 3-3 Native groundcover - grass (percentage cover)

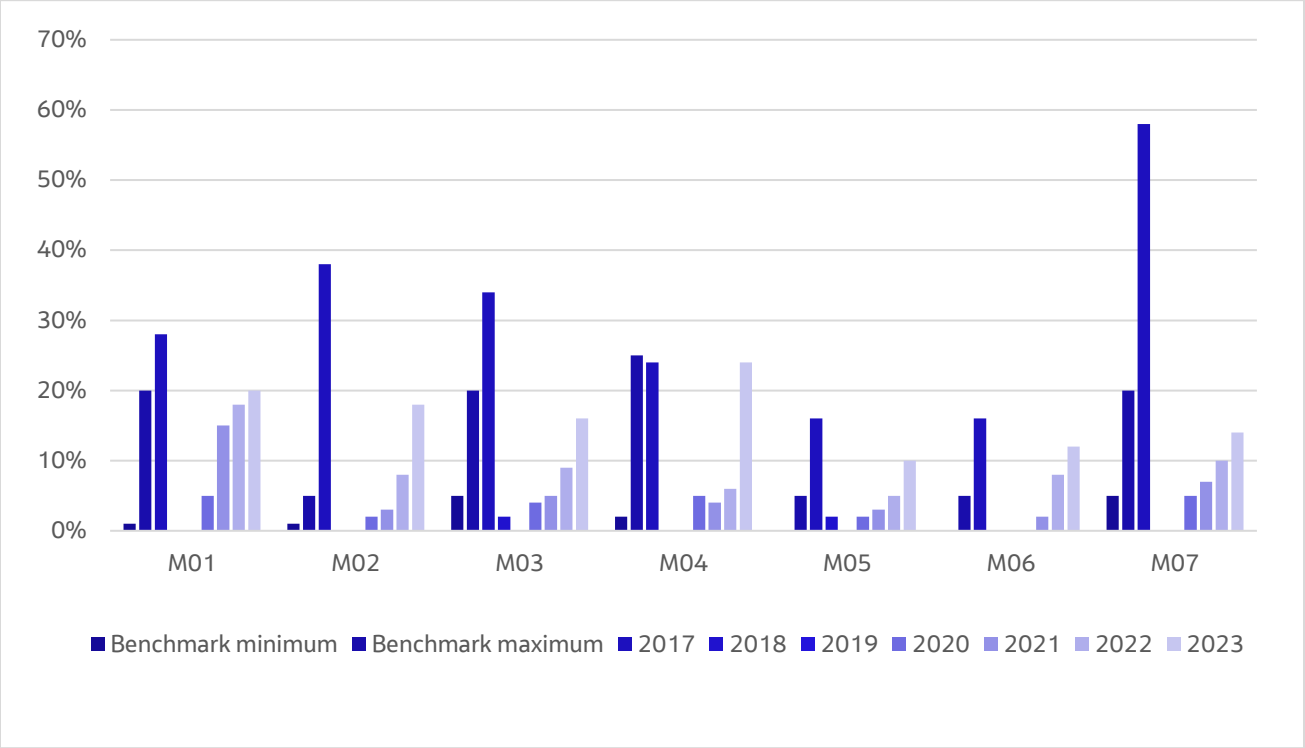

Figure 3-4 Native groundcover - other (percentage cover)

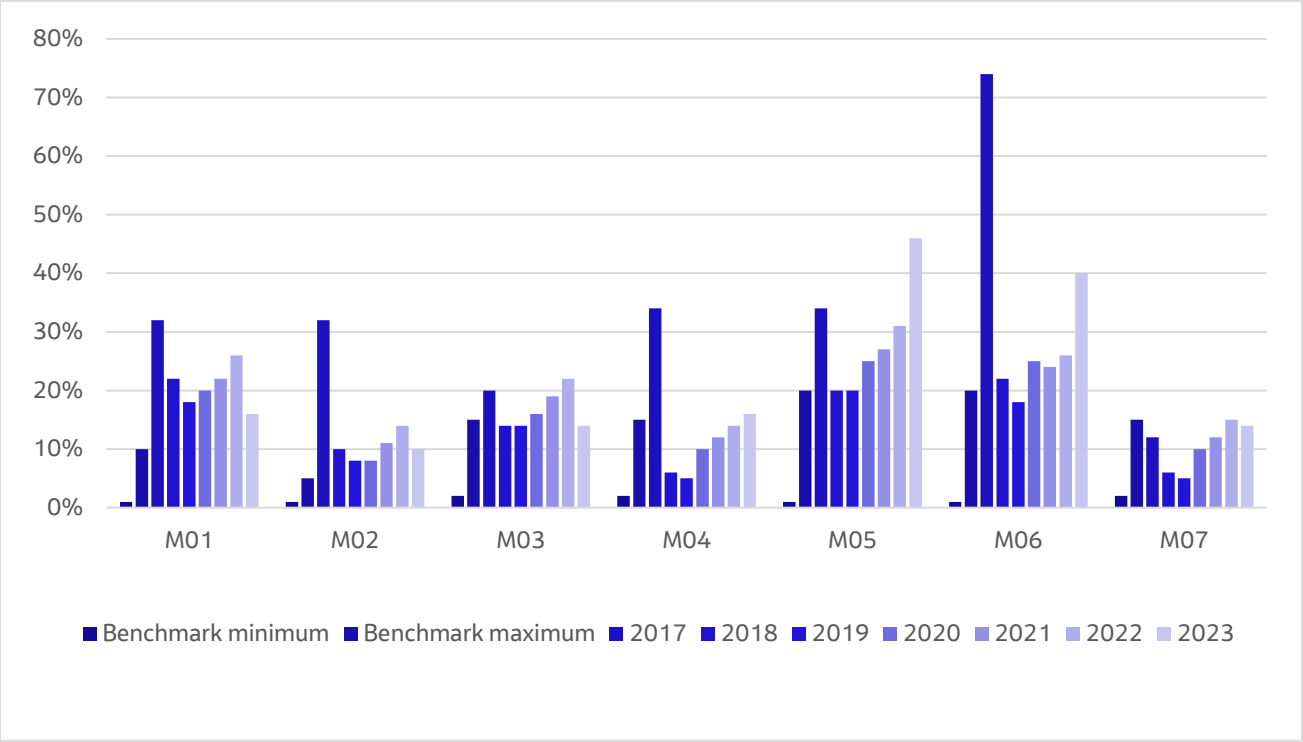

Figure 3-5 Native groundcover - shrubs (percentage cover)

3.4.3 Discussion

As a result of consecutive La Niña climate events, above average rainfall in western NSW had continued throughout 2022, with a slight decrease in rainfall during 2023. The favourable weather conditions have maintained and improved native vegetation within the offset site compared with the baseline assessment. This is in line with the COA C5(b) requirement to achieve an 'improved or maintained' outcome for the biodiversity values of the offset site.

Further small increases in native vegetation cover have occurred during 2023, adding to the substantial increases experienced in 2020.

Similarly, a further increase in native species richness this year is likely a result of these conditions and compliments the post-drought recovery of the offset site. The change in native species composition since the previous monitoring period, i.e., higher forb and groundcover shrub layer species, is consistent with natural seasonal variation and shows a positive relationship between ecological succession. Plant health appears optimal and most native plants exhibit dense foliage cover. Chenopods, Acacias and Senna shrubs appeared to be seeding and extended periods of average or higher rainfall will hopefully see further recruitment, though a predicted El Niño will likely see a continued decrease in vegetation cover and diversity. Importantly, the monitoring plots are generally within or exceeding the benchmark and baseline values, in addition to receiving ongoing management. Future fluctuations in vegetation quality are anticipated to primarily stem from seasonal changes, resulting in periodic fluctuations in vegetation quality, rather than experiencing continuous exponential growth.

Weed infestations across the offset site are still generally low but remain present due to increased rainfall over the past few years. Weeds of concern in the offset site include the state and regional priority weeds (LLS, 2022) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the offset site to prevent further spread to surrounding lands. Ongoing weed control works were undertaken in April, July and October 2023. Repeated herbicide application is reducing the abundance of Peppercorn trees, Noogoora Burr, African Boxthorn and Mesquite within the offset site. However, during the monitoring survey, some Velvet Mesquite and African Boxthorn plants appeared alive, regenerating and will likely require further treatment. A small number of Peppercorn trees are also still alive in the drainage line areas of the site. It is noted that additional weed control actions are scheduled for 2024. Management of these weeds needs to continue to achieve eradication.

Grazing pressure on grasses and herbs by kangaroos appears sustainable due to more plant biomass being available compared to previous years. No evidence of goat or sheep impacts were observed meaning exclusion fencing is effective.

The monitoring has shown an improvement in overall condition of native vegetation on the offset site. Where percentage covers of native plant stratums are not within benchmark values, they are not far below. This means a continuation of suitable climatic conditions will likely bring the plot measurements toward benchmark values. Continued favourable conditions is likely to yield more meaningful information regarding the improvement or maintenance of biodiversity values as a result of site management.

3.4.4 Fence observations

Stock proof fences were installed around the entire offset site approximately in mid-2017. A combination of ring lock style of fencing and plain and barbed wire strand fencing has been used around the offset site. Fences are generally located on the boundary of the offset site (i.e., the perimeter of the offset site), except for the eastern fence which is between about 50 m and 150 m west of the eastern site boundary as mapped in the Biodiversity Offset Management Plan, Broken Hill Solar Plant (NGH Environmental, 2013).

Gaps beneath the fence previously identified have been fixed and goats and other herbivores appeared to be absent from the offset site. During heavy rain in 2020 two sections of the boundary fence were pushed down by the flow of water and debris, at the intersection with an unnamed tributary of Stirling Vale Creek (see **Plate 19** and **Plate 20**). These sections were repaired in May 2021 (see **Plate 21** and **Plate 22**). These sections were checked again this year and appeared to have withstood heavy rain in 2022 and 2023. There were no areas of fence identified during the Year 7 monitoring period which required further maintenance (see **Plate 23** and **Plate 24**).

Plate 19. Damaged fence observed in 2020

Plate 20. Damaged fence observed in 2020

Plate 21. Fence repairs made in May 2021

Plate 22. Fence repairs made in May 2021

Plate 23. Existing well-maintained fence observed in January 2024

Plate 24. Existing well-maintained fence observed in January 2024

4. Management Actions

The following management measures in **Table 4-1** were outlined in the BOMP (NGH Environmental, 2013) and were to be actioned and adapted based on annual monitoring results. **Table 4-1** provides an evaluation of the need for each management action, the timing, and who is required to undertake the action. Actions undertaken since previous monitoring session and recommended adaptive measures are also described.

Table 4-1 : Management Actions for the Broken Hill offset site

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2024	Adaptive measures / recommended actions for 2024 / Timing
Management Measures of the BOMP (Note: In the first four columns, the original BOMP text is black, while text added since the original BOMP is blue)						
Weed control	To minimise the occurrence of weeds within the offset site particularly Weeds of National Significance (WoNS) and listed noxious weeds. Target state and regional priority weeds (Mesquite and African Boxthorn) to eliminate from site and prevent spread as required under the *Biosecurity Act* 2015 and the Western Regional Strategic Weed Management Plan 2023 – 2027 (LLS, 2022).	Survey to identify target locations for weed control. Weed control using appropriate methodologies considering target species and landscape context. Spot herbicide treatment: foliar spraying or cut/scrape and paint methods.	At establishment of the offset site. Ongoing as required. During active growth season, which is generally in Spring to early Summer, particularly after rainfall. Should be undertaken in suitable low wind conditions to prevent spray drift to other native species.	Initial spraying of Mesquite and African Boxthorn completed across site in 2018. Targeted weed treatments conducted in November 2019. Targeted weed treatments in May 2020. Targeted weed treatments in November 2020. Targeted weed treatments in November and December 2021. Targeted weed treatments in March and November 2022. Targeted weed treatments in April, July and October 2023.	Yes	Treatment of re-shooting weeds and weed seedlings required.

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2024	Adaptive measures / recommended actions for 2024 / Timing
Cat and/or fox control	To minimise the presence of cats and foxes within the offset site.	Conduct baiting or trapping if evidence of cats or foxes is detected within the offset site.	Consideration given to action on the basis of monitoring results. Annual monitoring. Control in response to detection of cats or foxes.	None required at this stage. Re-evaluate during next monitoring event. If evidence of these animals is recorded, spotlighting and/or camera trap surveys would be recommended to inform management.	No	n/a
Rabbit control	To minimise the risk of the offset site becoming a refuge for rabbits. To control rabbit numbers within the offset site and thereby prevent rabbits from substantially impacting on native flora and habitat values.	Conduct baiting or controlled grazing to reduce the ability of the site to act as a refuge to rabbits.	Consideration given to action on the basis of monitoring results. Annual monitoring. Control in response to detection of rabbits.	None required at this stage. Re-evaluate during next monitoring event.	No	n/a
Exclusion of feral goats and livestock	To minimise the presence of feral goats. To continuously exclude large non-native herbivores from the offset site and reduce grazing on native flora.	Install preventative fencing suitable for the target species. Remove goats (by trapping or other means) if detected within the offset site.	At establishment of the offset site. Ongoing as required. In response to detection of feral goats or livestock.	A fence to exclude goats and livestock is present. Allow native vegetation to regenerate over the next year and then re-evaluate fencing effectiveness during next monitoring event. Fence repairs were completed in May 2021 to fix two sections of damaged fencing and is excluding feral animals and other herbivores.	Yes	Fence monitoring and repair of any damage to continue in 2024.

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2024	Adaptive measures / recommended actions for 2024 / Timing
				Fences checked in December 2022 and January 2024. No repairs are currently required.		
Specialised measures (conducted if required) of the BOMP						
Weed control	To minimise the occurrence of weeds in the creek adjacent to the offset site, particularly Weeds of National Significance (WoNS) and listed noxious weeds.	The creek line adjacent to the site's eastern boundary would be fenced out of the offset site, however weed survey and control would be undertaken along the creek where it adjoins the offset site to ensure weeds do not become established here. Methods would be appropriate to waterways (i.e., control of spray drift).	Ongoing as required	Ongoing weed control. Targeted weed treatments conducted in November 2019. Targeted weed treatments in May 2020. Targeted weed treatments in November 2020. Targeted weed treatments in November and December 2021. Targeted weed treatments in March and November 2022. Targeted weed treatments in April, July and October 2023.	Yes	Treatment of re-shooting weeds and weed seedlings required in 2024.
Implementation of controlled burns	To re-introduce a more natural fire regime and assist in the recovery of degraded areas. To improve the natural regeneration of native flora.	If degradation is detected from monitoring, consult with NSW DCCEEW to determine if burning may be appropriate. Conduct burns as recommended by NSW DCCEEW.	Ongoing	None required at this stage. Allow native vegetation to regenerate over the next year. Re-evaluate during next monitoring event.	No	n/a

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2024	Adaptive measures / recommended actions for 2024 / Timing
Adapt measures to resident native fauna	To ensure that resident native fauna are not adversely impacted by management actions.	If resident native fauna may be impacted by management actions, adapt actions as required to address the risk of impact.	Ongoing as required	n/a	No	n/a
Additional Management Measures						
Monitoring plot survey	Repeat monitoring plot surveys to evaluate the 'improve or maintain' outcome of biodiversity values at the offset site	Repeat monitoring of all plots within the offset site	Summer	n/a	Yes	If possible, time the seasonal survey events to occur within four weeks of a significant rainfall event to better identify the diversity of plant species dormant within the ground layer.
Weed control	Target Peppercorn Tree infestation	Thinning of mature trees without active nests and new saplings treated using cut and paint techniques.	During active growth season, which is generally in Spring to early Summer, particularly after rainfall.	Contractor treated peppercorn trees in 2019, 2020, 2021, 2022 and 2023.	Yes	Undertake further treatment in 2024. Target all saplings.
Weed control	Target onion weed and saffron thistle in general weeding across the offset site. Also target newly recorded weed Noogoora Burr.	Spot spraying	During active growth season, which is generally in Spring to early Summer, particularly after rainfall. Should be undertaken in suitable low wind conditions to prevent	Ongoing weed spraying. Targeted weed spraying completed across site in 2018, November 2019, May 2020, November 2020, November 2021, December 2021, March 2022, November 2022, April 2023, July 2023 and October 2023.	Yes	Target these species when they reappear following rain in 2024. Treatment before seeding is recommended. Also treat any new occurrences of Noogoora Burr.

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2024	Adaptive measures / recommended actions for 2024 / Timing
			spray drift to other native species.			

5. Conclusions and recommendations

The 2023 monitoring data (year 7) show continued improvement in native vegetation and habitat across the offset site with regards to native vegetation coverage and quality. Importantly, the monitoring plots are generally within or exceeding the benchmark and baseline values, in addition to receiving ongoing management. Future fluctuations in vegetation quality are anticipated to primarily stem from seasonal changes, resulting in periodic fluctuations in vegetation quality, rather than experiencing continuous exponential growth.

The key results are summarised as follows:

- Further small increases in native vegetation cover, particularly in the ground layers of the site, have occurred during 2023, adding to the substantial increases experienced in 2020.
- A significant increase in native species richness this year compliments the post-drought recovery of the offset site. The species richness was noted to be equal to or higher than the benchmark levels, where the native groundcover of forbs and shrubs increased overall from the previous monitoring period (Year 6). Native tussock grasses were observed to have slightly decreased since the previous year, likely due to natural factors as native species compete for space and nutrients and are dependent on seasonal changes.
- Plant health across the site appears optimal and most native plants exhibit dense foliage cover. Chenopods, Acacias and Senna shrubs appeared to be seeding and extended periods of average or higher rainfall will hopefully see further recruitment.
- There has been a further slight decrease in the exotic species cover, following the substantial increase recorded in Year 4 (following the break in drought conditions).

Stock proof fencing around the offset site is in good condition, and repairs made in May 2021 have withstood further heavy rain events.

Fauna habitats across the offset site are somewhat diverse and include chenopods, rocky patches, tussock grasses, clay crevices and some taller shrubs. These habitats have been maintained, and the groundcover and vegetative cover has increased due to higher rainfall since 2020.

Weed infestations across the offset site are still generally low but remain present due to increased rainfall over the past few years. Weeds of concern in the offset site include the state and regional priority weeds (LLS, 2022) Velvet Mesquite and African Boxthorn, which are required to be eradicated from the offset site to prevent further spread to surrounding lands. These species were treated on three occasions in 2023, however, signs of regrowth and regeneration were evident, particularly in drainage lines. It is noted that additional weed control actions are scheduled for early 2024.

Peppercorn Tree infestations within the centre of the offset site have showed some further dieback since last year however require further treatment (if no active bird nests are present). The recommendation remains to control emerging saplings, while gradually removing the adult Peppercorn Trees. Herbicide treatment is also required for any occurrences of the weed species, Noogoora Burr, should any individuals be identified.

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Appendix A. Flora species list and opportunistic fauna list

Table A-1. Flora species list and 20m x 20m plot survey Modified Braun Blanquet scores

Family	Scientific Name	Common Name	MO 1	MO 2	MO 3	MO 4	MO 5	MO 6	MO 7	Previously recorded on site
Aizoaceae	*Sarcozona praecox*	Sarcozona	1	2	2		1	3	3	x
Amaranthaceae	*Alternanthera angustifolia*									x
Anacardiaceae	*Schinus molle* var. *areira**	Peppercorn Tree								x
Apocynaceae	*Rhyncharrhena linearis*	Purple Pentatrope								x
Asphodelaceae	*Asphodelus fistulosus**	Onion weed	2			1	2			x
Asphodelaceae	*Bulbine* sp.	Bulbine lily								x
Asteraceae	*Sonchus oleraceus**	Common Sowthistle		1			1			x
Asteraceae	*Brachyscome ciliaris* var. *lanuginosa*		4	2	2	3	2	2	2	x
Asteraceae	*Brachyscome dentata*							1	2	x
Asteraceae	*Conyza bonariensis**	Fleabane		1						x
Asteraceae	*Leiocarpa semicalva*		3	2	1				1	x
Asteraceae	*Senecio lanibracteus*									x
Asteraceae	*Xanthium spinosum**	Bathurst Burr								x
Asteraceae	*Xanthium occidentale**	Noogoora Burr								x
Asteraceae	*Carthamus lanatus**	Saffron thistle				1	1			x
Asteraceae	*Vittadinia cuneata*	Fuzzweed	1	2	2	2	2	1		x
Boraginaceae	*Heliotropium supinum**	Prostrate Heliotrope								x
Boraginaceae	*Echium plantagineum**	Paterson's Curse				1	1			x
Brassicaceae	*Arabidella* sp.		1							x
Brassicaceae	*Arabidella trisecta*			1			1			

Family	Scientific Name	Common Name	MO 1	MO 2	MO 3	MO 4	MO 5	MO 6	MO 7	Previously recorded on site
Brassicaceae	*Carrichtera annua**	Ward's Weed	1		1	1	1	1		x
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell		1						x
Chenopodiaceae	*Atriplex stipitata*	Mallee Saltbush	1			2		1		x
Chenopodiaceae	*Atriplex vesicaria*	Bladder Saltbush	2			2	2	3	3	x
Chenopodiaceae	*Atriplex nummularia*	Old Man Saltbush					4	3		x
Chenopodiaceae	*Dissocarpus paradoxus*	Cannonball Burr	1	2	2	2		3		x
Chenopodiaceae	*Einadia nutans*			1	1		2			x
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush		2		3	2			x
Chenopodiaceae	*Maireana astrotricha*	Low Bluebush				1		2		x
Chenopodiaceae	*Maireana ciliata*	Fissure-weed	1		1	2			2	x
Chenopodiaceae	*Maireana pyramidata*	Black Bluebush	3	3	4	4	2	4	3	x
Chenopodiaceae	*Maireana lobiflora*					1			2	x
Chenopodiaceae	*Sclerolaena diacantha*			2	1		2			x
Chenopodiaceae	*Sclerolaena patenticuspis*	Copperburr			2	2		3	3	x
Chenopodiaceae	*Rhagodia spinescens*	Spiny saltbush	3	1		3	2	3		x
Chenopodiaceae	*Maireana coronata*	Crown Fissure-weed			1					x
Chenopodiaceae	*Salsola australis*									x
Chenopodiaceae	*Sclerolaena divaricata*	Tangled Copperburr	1	3	2	3	2	2	2	x
Convolvulaceae	*Convolvulus remotus*		1	1	1	2	2	1		x
Crassulaceae	*Crassula tetramera*			1						x
Euphorbiaceae	*Euphorbia drummondii*	Caustic Weed		1		1	1			x
Euphorbiaceae	*Euphorbia multifaria*									x

Family	Scientific Name	Common Name	M01	M02	M03	M04	M05	M06	M07	Previously recorded on site
Fabaceae	*Vicia* sp.*									x
Fabaceae	*Acacia tetragonophylla*	Dead finish		3						x
Fabaceae	*Acacia victoriae*	Prickly wattle	3	2				1		x
Fabaceae	*Acacia burkittii*	Sand hill wattle								x
Fabaceae	*Acacia oswaldii*	Umbrella wattle								x
Fabaceae	*Acacia sp.*		1	1						
Fabaceae	*Medicago minima**				1		3	1		x
Fabaceae	*Prosopis velutina***	Velvet mesquite	1				1	1		x
Fabaceae	*Senna phyllodinea*			2		3	1			x
Fabaceae	*Senna artemisioides* subsp. *filifolia*			3		3		1		x
Goodeniaceae	*Goodenia calogynoides*									x
Lamiaceae	*Salvia verbenaca**	Vervain								x
Liliaceae	*Thysanotus sp*					1			1	x
Loranthaceae	*Lysiana exocarpi*									x
Malvaceae	*Sida corrugata*	Corrugated sida	1	3	1	3	1		1	x
Malvaceae	*Sida* sp.		1							x
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum								x
Pittosporaceae	*Pittosporum angustifolium*	Weeping pittosporum								x
Plumbaginaceae	*Limonium lobatum**	Winged Sea Lavender								x
Poaceae	*Chloris truncata*	Windmill grass	1							x
Poaceae	*Cymbopogon ambiguus*	Scent grass								x
Poaceae	*Rytidosperma caespitosum*	Ringed Wallaby Grass	1	2						x
Poaceae	*Tragus australianus*	Small Burr grass								x

Family	Scientific Name	Common Name	M01	M02	M03	M04	M05	M06	M07	Previously recorded on site
Poaceae	*Austrostipa scabra* subsp. *scabra*	Speargrass	2	3	3	3		1		x
Poaceae	*Austrostipa sp.*	Speargrass								x
Poaceae	*Enneapogon avenaceus*	Bottle Washers	1	1	2	1		1	1	x
Poaceae	*Enteropogon acicularis*	Umbrella Grass				1				x
Poaceae	*Eragrostis cilianensis**	Stinkgrass						2		
Poaceae	*Paspalidium constrictum*			2			1			x
Polygonaceae	*Rumex crispus**	Curled dock					2			x
Portulacaceae	*Portulaca oleracea*	Pigweed		1						x
Scrophulariaceae	*Eremophila sturtii*	Narrow-leaf Emu Bush								x
Scrophulariaceae	*Myoporum montanum*	Western Boobialla								x
Solanaceae	*Lycium ferocissimum***	African boxthorn					2			x
Solanaceae	*Solanum nigrum**	Blackberry Nightshade								x
Solanaceae	*Solanum sturtianum*					3				x
Zygophyllaceae	*Tribulus minutus*									x

* General weed

**State and regional weeds to be targeted (Biosecurity Act 2015)

Table A-2. Opportunistic fauna species list

Class	Species	Common Name	Sighting
Birds	*Corvus coronoides*	Australian Raven	Observed in the offset site
	Dromaius novaehollandiae	Emu	Observed in the offset site
	Eolophus roseicapilla	Galah	Observed in the offset site
	Falco tinnunculus	Common Kestrel	Observed in the offset site
	Malurus cyaneus	Superb Fairywren	Observed in the offset site
	Manorina melanocephala	Noisy Miner	Observed in the offset site
	Megalurus cruralis	Brown Song Lark	Observed in the offset site
	Milvus migrans	Black Kite	Observed in the offset site
Mammal	*Macropus giganteus*	Eastern Grey Kangaroo	Observed in the offset site

Appendix B. Condition of Approval (COA) C5

Biodiversity Offset Management Plan

C5. Following final design and prior to the commencement of construction, or as otherwise agreed to by the Director-General, the Proponent shall develop and submit a Biodiversity Offset Management Package for the approval of the Director-General. The package shall detail how the ecological values lost as a result of the Project will be offset. The Biodiversity Offset Management Package shall be developed in consultation with the OEH and shall (unless otherwise agreed by the Director-General) include, but not necessarily be limited to:

(a) an assessment of all native vegetation communities, threatened species habitat and Willyama Common land that will either be directly or indirectly impacted by the proposal;

(b) the objectives and biodiversity outcomes to be achieved (including 'improve or maintain' biodiversity values), and the adequacy of the proposed offset considered;

(c) the final suite of the biodiversity offset measures selected and secured including but not necessarily limited to;

  i) an offset proposal which is supported by a suitable metric method (such as the Biobanking Assessment Methodology);

  ii) details of the relative condition and values of communities on the offset site in comparison to those to be impacted, including all areas of native shrubland in moderate to good condition;

  iii) proposed management actions and expected gains;

(d) the monitoring requirements for compensatory habitat works and other biodiversity offset measures proposed to ensure the outcomes of the package are achieved, including:

  i) the monitoring of the condition of species and ecological communities at offset locations;

  ii) the methodology for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites;

  iii) provisions for the annual reporting of the monitoring results for a set period of time as determined in consultation with the OEH; and

(e) timing and responsibilities for the implementation of the provisions of the Package.

Land offsets shall be consistent with the *Principles for the use of Biodiversity Offsets in NSW* (NSW Office of Environment and Heritage, June 2011). Any land offset shall be enduring and be secured by a conservation mechanism which protects and manages the land in perpetuity. Where land offsets cannot solely achieve compensation for the loss of habitat, additional measures shall be provided to collectively deliver an improved or maintained biodiversity outcome for the region.

Where monitoring referred to in condition (d) indicates that biodiversity outcomes are not being achieved, remedial actions shall be undertaken to ensure that the objectives of the Biodiversity Offset Package are achieved.

Within one from approval from the Director-General the Proponent shall, in conjunction with the lessee of Western Lands Lease 14240, apply to the Crown Lands Division of the Department of Trade and Investment for a Change of Lease Purpose of Western Land Lease 14240 to appropriately record the biodiversity offset on title and within the lease conditions as a conservation area.