Nyngan Solar Plant Biodiversity Offset Site

Annual Ecological Monitoring Report Year 4 – 2020/2021

Final | Rev B

March 3, 2021

AGL

Nyngan Solar Plant Biodiversity Offset Site

Project No:	IS361800
Document Title:	Annual Ecological Monitoring Report Year 4 – 2020/2021
Document No.:	Final
Revision:	Rev B
Date:	March 3, 2021
Client Name:	AGL
Project Manager:	Matt Consterdine
Author:	Tim Maher
File Name:	IS361800_Annual Monitoring Report_Nyngan_Year 4_FINAL

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
Level 7, 177 Pacific Highway
North Sydney NSW 2060 Australia
PO Box 632 North Sydney
NSW 2059 Australia
T +61 2 9928 2100
F +61 2 9928 2444
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Draft	12/01/2021	Draft	J. Bayada	M Consterdine	M Consterdine	M Consterdine
Draft Rev B	28/01/2021	Draft	T.Maher	M Consterdine	M Consterdine	M Consterdine
Final	26/02/2021	Final	T.Maher	M Consterdine	C Thomson	C Thomson

Contents

Executive Summary **1**

1. Introduction **3**

1.1 Background and study area 3

1.2 Monitoring objectives 3

2. Monitoring method **5**

2.1 Requirements 5

2.2 Field survey 5

2.2.1 Vegetation condition assessment and establishment of monitoring plots 6

2.2.2 Habitat evaluation 9

2.2.3 Fencing evaluation 9

2.2.4 Solar plant revegetation area - assessment 9

2.2.5 Data collection and analysis 9

2.3 Limitations 9

2.3.1 Climatic conditions 9

2.3.2 Grazing pressure 10

3. Monitoring results **11**

3.1 Plot data descriptions and benchmark comparisons 11

3.1.1 Open White Cypress Pine Woodland 11

3.1.2 White Cypress Pine – Poplar Box Woodland 13

3.2 Monitoring survey results summary and discussion 16

3.2.1 Native species richness 16

3.2.2 Cover of native and exotic vegetation 16

3.2.3 Discussion 18

3.3 Weeds, disturbance and pests 18

3.4 Fauna Habitats 19

3.5 Fence maintenance 21

3.6 Recommended future management actions 21

4. Solar Plant revegetation area **22**

4.1 Overview and monitoring methodology 22

4.2 Revegetation area condition assessment 24

4.2.1 Vegetation monitoring 24

4.2.2 Tubestock survival rate 25

4.2.3 Natural regeneration 25

4.2.4 Fencing 25

4.2.5 Weed infestation 26

4.2.6 Habitat evaluation 26

4.3 Recommended future management actions 26
5. Management Actions 28
6. Conclusions 34
6.1 Conditions at the offset site 34
6.2 Conditions at the solar plant revegetation area 34
7. References 35

Appendix A. Flora species list and opportunistic fauna list
Appendix B. Condition of Approval (COA) C5

Executive Summary

Background

In 2014, AGL Energy Limited (AGL) constructed the Nyngan Solar Plant, a solar photovoltaic (PV) plant with a nominal capacity of up to 106 megawatts (MW) at Nyngan in central west New South Wales (NSW). The project was approved by the then NSW Department of Planning and Infrastructure (DP&I) on the 15 July 2013.

The approval included the Ministers Conditions of Approval (MCoA) of which included that an Offset Management Package be developed to offset the ecological values lost as a result of the project (MCoA C5). Additionally, the biodiversity offset site is required to be monitored for a period of up to 30 years to ensure that ecological values are maintained or improved, and the results reported annually to the NSW Department of Planning, Industry and Environment (DPIE). Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the site.

Four monitoring surveys have been conducted at the Nyngan Solar Plant Biodiversity Offset Site (the offset site); January 2018 (Year 1), January 2019 (Year 2), December 2019 (Year 3) and November 2020 (Year 4).. This report outlines the results of the fourth annual monitoring survey of the offset site (conducted by Jacobs in November 2020). The first annual monitoring survey was conducted by Jacobs in January 2018, while the baseline study was recorded in the Biodiversity Offset Management Plan (BOMP) by NGH in 2014.

In addition, this report provides a condition assessment for the revegetation area at the Nyngan Solar Plant, which was required by the condition of approval B18 (October 2011). The revegetation area was to provide both visual screening along the southern boundary of the Solar Plant as well as future compensatory habitat for the Grey-crowned Babbler in the immediate area where habitat has been removed and where the species is known to occur and breed.

Offset site condition

Overall, the Year 4 monitoring results demonstrate that the vegetation and habitat condition across the site have considerably improved (from the previous surveys) with regards to floristic diversity, and in some measures of cover and condition when compared to the vegetation community benchmarks (DECC 2008). However, these measures are still mostly below baseline survey results recorded by NGH (2014), likely a result of below average rainfall over the previous two years prior to the 2020 monitoring event.

All cover categories pertaining to overstorey groundcover shrub, mid-storey groundcover shrub, groundcover grass, groundcover shrub and groundcover other experienced an increase in cover scores, notably the groundcover-grass category exhibited the biggest increase. The increases in vegetation cover observed are likely to be due to a period of above average rainfall in 2020, compared to below average rainfall over the previous two years and possibly a reduction in grazing pressure.

Above average rainfall in August to October of 2020 appears to have caused the growth and recovery of many grass and forb species. More adequate rainfall would further increase the species diversity at the site and likely show closer consistency with the baseline data. The management actions outlined in this report will further assist the natural regeneration of the site over the next twelve months, an overview of these management actions is provided below.

Stock proof fencing around the offset site was installed in early 2018 and is still in good condition. It is likely that with fencing in place that the biodiversity values of the site will improve through the exclusion of some feral pests and grazing livestock, allowing opportunities for natural regeneration to occur, with adequate rainfall.

Fauna habitats across the site are diverse and include fallen logs, standing dead trees (stags), hollow bearing trees and grass/forb groundcover. These habitats have generally been maintained in similar condition, except for

the grass/forb groundcover habitat, that has increased since last year, but is still below the NGH (2014) baseline survey.

Weed infestations across the site have increased slightly since last year but are generally low to moderate and can be maintained by spot treatment as outlined in the management actions (Table 5.1). None of the weeds identified within the site are declared as state or regional priority weeds under the *Biosecurity Act 2015* or the Western Regional Strategic Weed Management Plan 2017-2022 (LLS 2017). One species present on site, Saffron thistle (*Carthamus lanatus*), is recorded on the Biodiversity Assessment Method (BAM) 'High Threat' weeds list.

Solar plant revegetation area

The estimated survival rate of the planted tubestock has remained the same as last year and many of these plants that have survived have shown considerable growth. Additional planting is recommended in 2021 (although should be planned around cooler months and average rainfall outlooks where possible).

The diversity of native grasses and forbs observed has increased on the previous two years, likely in response to greater than average rainfall in recent months. However, this remains at a moderate level and the high diversity of native species previously recorded in the groundcover is likely to require sustained average or above average rainfall to return.

Fencing around the site is in good condition and will assist in excluding any wandering livestock and some feral pests and as such further support the natural regeneration process.

It is recommended that replacement planting be undertaken after several months of average or higher rainfall have occurred within the revegetation area, in autumn, late winter or early spring. It is recommended that only a small number of plants, approximately 200, be planted in clusters across each revegetation area using a mix of those species that have survived since the last planting (see section 4.3). Smaller numbers of tubestock planted in clusters will allow for concentrated watering and improve survivals rates. Further clusters may be added over time. Tree guards are required for all tubestock to protect plants against grazing and create a microclimate around the plant that assists in moisture retention and cooling. Carton guards are recommended over plastic guards because of their ability to more readily breakdown if lost in the surrounding environment and their ease of installation. Intensive watering is required at the time of planting and follow up watering at a rate inversely proportional to rainfall until plants to become established.

Further to supplementary planting, it is recommended that brush matting be used with the revegetation area to assist the natural regeneration of native vegetation. Collection of native seed is to be undertaken by a qualified Bush Regeneration contractor and placed within the site on branches scattered along and around the original planting rip lines. Branches should be left with seed in-situ, allowing seeds to disperse naturally and lay dormant within the ground layer until favourable weather conditions activate germination. This process is to be undertaken in early spring after suitable withholding periods post targeted weed spraying.

Targeted weed spraying is required throughout the revegetation area in early spring 2021 to further assist in the regeneration of native vegetation and growth of planted tubestock. It is important that spraying of herbaceous weeds or exotic grass is undertaken before plants are able to seed.

No Grey-crowned Babblers were observed within the revegetation area or solar plant area. The revegetation area does not provide suitable habitat for this target species. As the ground layer cover improves and planted shrub species and overstorey Eucalypts grow habitat values may improve, however it is likely to take at least 10 years before the overstorey is a suitable height for nesting habitat.

1. Introduction

1.1 Background and study area

In 2014, AGL Energy Limited (AGL) constructed a solar photovoltaic (PV) plant (the Nyngan Solar Plant) with a nominal capacity of up to 106 megawatts (MW) at Nyngan in Central West New South Wales (NSW). The solar plant is located approximately 10 kilometres (km) to the west of the Nyngan township. The site is approximately 300 hectares (ha) in area with additional areas of land for linear easements for the connection of the project's electrical infrastructure to the Nyngan – Cobar 132 kilovolt (kV) transmission line. 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 then Department of Planning and Infrastructure (DP&I) on the 15 July 2013. The Ministers Condition of Approval (MCoA) prescribed that an Offset Management Package be developed to offset the ecological values lost as a result of the project (MCoA C5 detailed in Appendix B).

In addition to this condition of consent, the proponent also committed to the following mitigation measures relating to offsets within the Nyngan Solar Plant Submissions Report (NGH Environmental June 2013):

An Offset Plan would be developed with input from OEH and the CMA and according to the strategy provided in Appendix G of the Biodiversity Assessment (which included a proposed 1:5 offset ratio). It would be finalised prior to any construction impacts, as outlined in the Biodiversity Assessment. The objective of offsetting is to ensure that an overall 'maintain or improve' outcome is met for the project; where impacts cannot be avoided, or sufficiently minimised, the residual impact would be offset in perpetuity.

Prior to finalising the offset site boundaries, the proponent would validate the area impacted by construction to ensure that the actual, not estimated, impacted area is offset.

The offset site management actions and their outcomes would be reported annually to the NSW DPIE for the duration of the project (up to 30 years) to demonstrate that a 'maintain or improve' outcome has been met. This monitoring period may vary, depending on the outcomes recorded across the site at each monitoring event, at the discretion of DPIE.

AGL secured an offset site approximately 10 km southwest of the solar plant site. The offset site is in the north-western corner of Lot 30 in Deposited Plan 752879 and is approximately 50 ha in area (see Figure 1.1). As an additional compensatory measure, AGL also created a five-hectare revegetation area within the solar plant site to further mitigate the loss of habitat for the Grey-crowned Babbler.

AGL are responsible for the ongoing maintenance of the offset site and revegetation area.

1.2 Monitoring objectives

This report documents the results of the fourth annual ecological monitoring event for the offset site as required under Condition of Approval (CoA) C5. The objective of the annual monitoring is to demonstrate an 'improve or maintain' outcome for the identified biodiversity offset values at the offset site and to identify any management/remedial actions required to achieve these outcomes.

Monitoring requires the collection of ecological data, consistent with the methodology described in the Biodiversity Offset Management Plan (BOMP) prepared by NGH Environmental (2014). The results are described and analysed with comparison to the baseline data from the BOMP (NGH 2014), and those of the first, second and third year monitoring events to determine if there have been any significant changes in the vegetation and habitat conditions that are not consistent with improving or maintaining the biodiversity values of the offset site.

In addition, an evaluation was undertaken of any required management actions and their effectiveness, as outlined in the BOMP (NGH 2014). The BioBanking Assessment Methodology (BBAM) (DECC 2009) also lists the

standard management actions required to be undertaken at offset sites. 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.

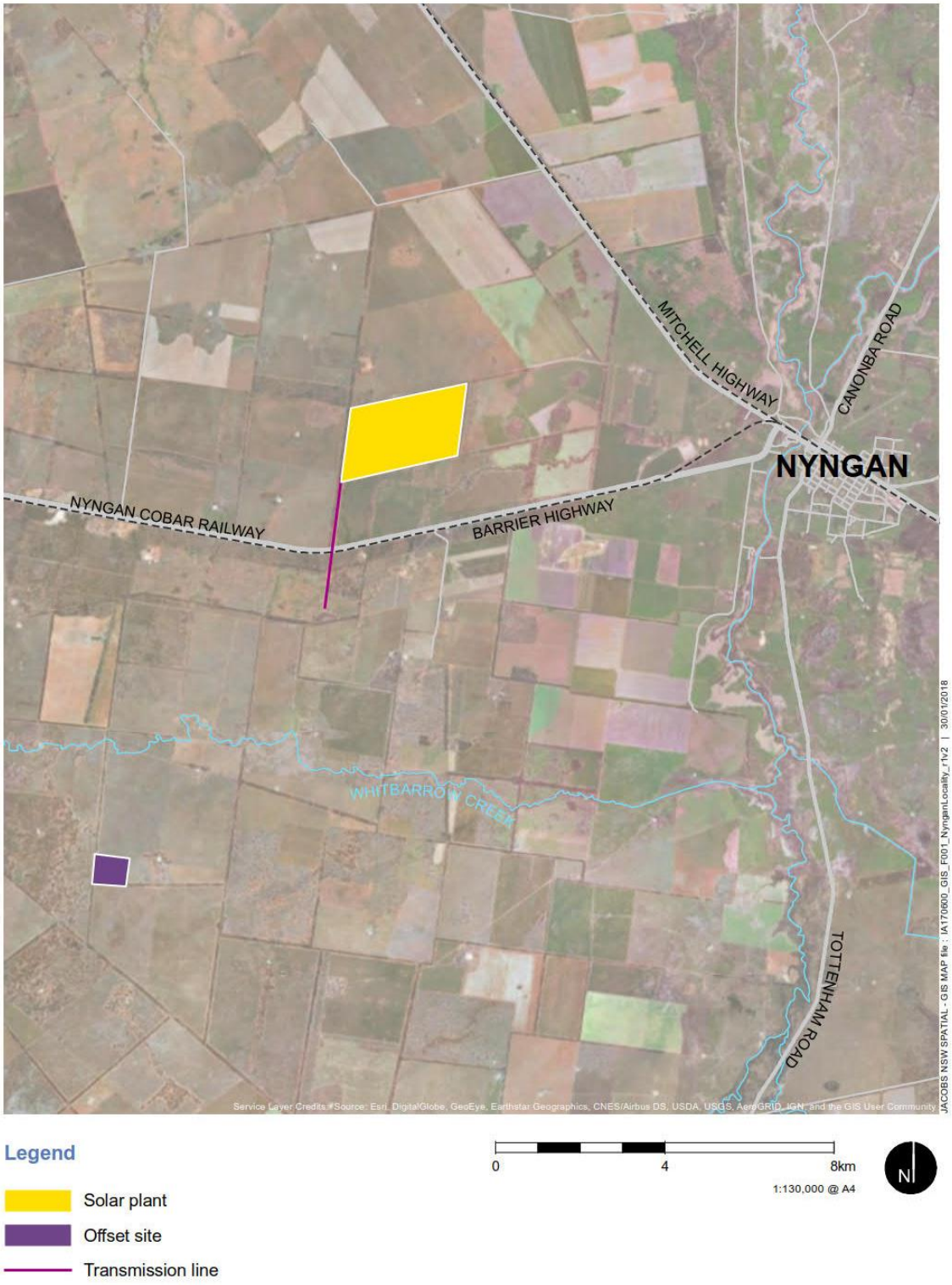

Figure 1.1 | Nyngan solar plant and offset site location

2. Monitoring method

2.1 Requirements

The monitoring method is consistent with the methodologies outlined in the BOMP (NGH 2014) and meets the requirements of the CoA C5, outlined in Appendix B. CoA C5(b) stipulates the requirement of the offset site to achieve an 'improved or maintained' outcome for the biodiversity values of the site. Improved or maintained outcomes for the biodiversity values of the offset site have been evaluated through the comparison of ecological monitoring data against the benchmark and baseline data for each surveyed vegetation community as well as the evaluation of weed infestation and fauna habitat. An overview of the monitoring method used for the offset site include:

- Vegetation condition assessment. Following the methodology used in the BOMP (NGH 2014), assessment was undertaken using the BioBanking Assessment Methodology (BBAM) (DECC 2009) to collect data on vegetation structure, cover and quality across transects and within plots. This data was then compared with the NGH (2014) baseline data and the benchmark data for each vegetation community type using the OEH 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 vegetation condition for November 2020 (Year 4, this report) is compared with:
    - Benchmark data
    - Baseline study (included in the BOMP, NGH 2014)
    - Year 1 monitoring (Jacobs, 2018)
    - Year 2 monitoring (Jacobs, 2019)
    - Year 3 monitoring (Jacobs, 2020)
- Habitat evaluation. Notes on fauna habitat were taken across the broader offset site while traversing the site to reach the monitoring plots. At each monitoring plot, detailed notes were also taken to report on habitat condition.
- Fencing evaluation. Fences were assessed through observation by driving and walking around the perimeter of the offset site, to assess general condition and identify any areas requiring maintenance.

The methodology for monitoring the revegetation area of the solar plant is described in section 2.2.4 and section 4.

2.2 Field survey

A field survey was undertaken by two Jacobs Ecologists, Matt Consterdine and Timothy Maher on the 25th of November 2020 across the two vegetation types identified within the offset site (listed in Table 2.1 and shown on Figure 2.2) by NGH (2014).

The predominant vegetation within the offset site was described by NGH (2014) as Poplar Box – Gum-barked Coolabah-White Cypress Pine shrubby woodland (Veg ID 103) (Benson *et al.* 2006). NGH (2014) also notes some characteristics of White Cypress Pine – Polar Box woodland on footslopes and peneplains (ID 72), particularly regarding the dominance of White Cypress Pine (*Callitris glaucophylla*) and the presence of groundcover species. The Biometric benchmarks for these vegetation types are the same (DECC 2008). Difference in structure and species composition occur across the offset site, most likely due to past disturbance and land management, which have resulted in two main forms of the community being present (NGH 2014):

1) Open White Cypress Pine Woodland
2) White Cypress Pine Polar Box Woodland

Table 2.1 shows the area occupied by these vegetation types within the offset site and the monitoring plots sampled in each.

In addition, NGH (2014) describes a small area (0.66 ha) of vegetation dominated by Budda (*Eremophila mitchellii*), see Figure 2.2. The dominance of Budda in this area is considered most likely due to the removal of overstorey and mid-storey species by past landholders, thus eliminating competition, or other past disturbance such as a localised fire (NGH 2014). This area was described qualitatively and mapped by NGH (2014) but not surveyed in detail by NGH. This area is considered part of the Open White Cypress Pine Woodland. It does not constitute a different vegetation type and does not contain any annual monitoring sites.

Table 2.1 Vegetation types monitored within the offset site

Vegetation Type (DECC 2008)	Area in offset site (ha)	Monitoring plots sampled by NGH (2014)	Monitoring plots sampled by Jacobs (2017-2020)
Open White Cypress Pine Woodland	41.55	M01 & M02 (2 plots)	M01 & M02 (2 plots)
White Cypress Pine – Poplar Box Woodland	8.5	M03 & M04 (2 plots)	M03 & M04 (2 plots)

2.2.1 Vegetation condition assessment and establishment of monitoring plots

BioBanking plots were surveyed according to the BBAM (DECC 2009), as outlined in COA C5 (Appendix B) and in the BOMP (NGH 2014). Baseline surveys undertaken by NGH (2014) set up two monitoring plots per vegetation community. Jacobs (2020) have replicated their approach (see Table 2.1).

Floristic data was collected to enable comparison between baseline data and benchmarks recorded in the BOMP (NGH 2014). The four monitoring plots established by NGH (2014), were located at the site using recorded GPS coordinates. These plots were previously marked in the field using star pickets driven into the ground to facilitate future replication. Pickets were placed at the start and end of a 50 metre transect and their coordinates recorded. Start points were delineated with white spray paint sprayed on the top of the picket. A 20 x 20 metres quadrat required by the BBAM (DECC 2009) was conducted within an area bounded by the first 20 metres of the transect and extending 10 metres either side as shown in Figure 2.1. 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.

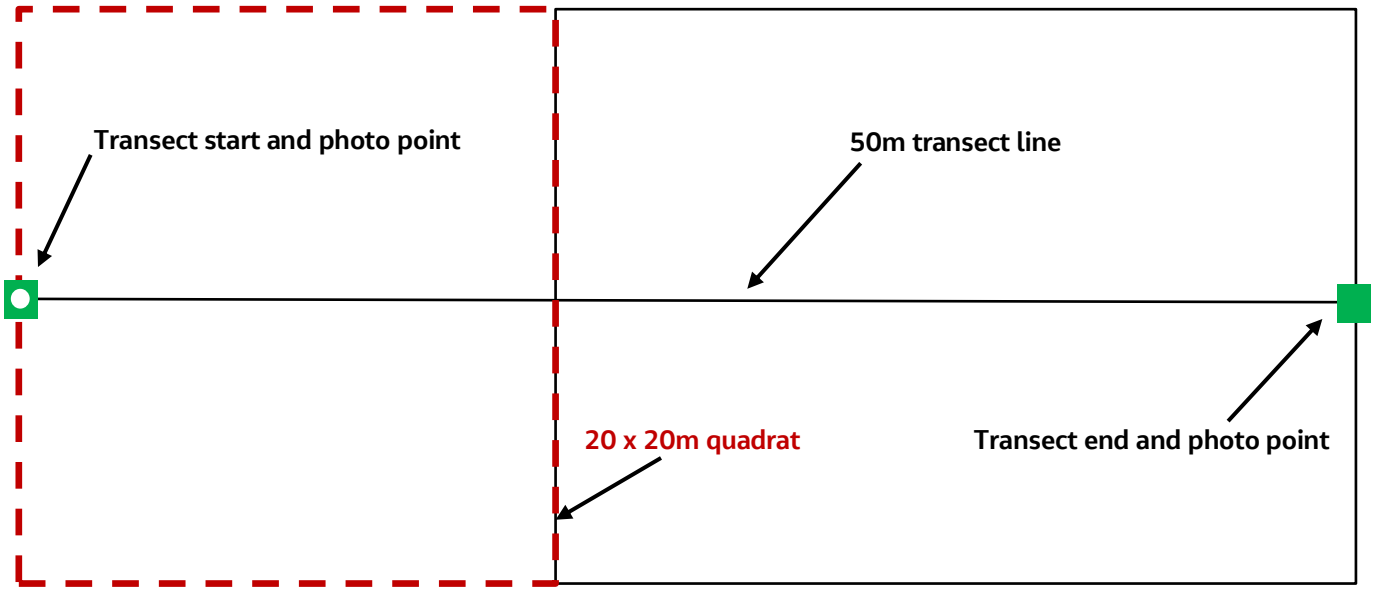

Figure 2.1: Monitoring plot layout

Data collected during each monitoring year has been collated into one electronic database using Microsoft Excel, along with the NGH (2014) baseline data and the benchmark data for each vegetation community to enable future analysis of data. Jacobs has used the Modified Braun Blanquet method (see Table 2.2) for recording floristic abundance data within each monitoring plot.

Table 2.2: Modified Braun Blanquet scale method used for the monitoring survey

Modified Bruna Blanquet (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

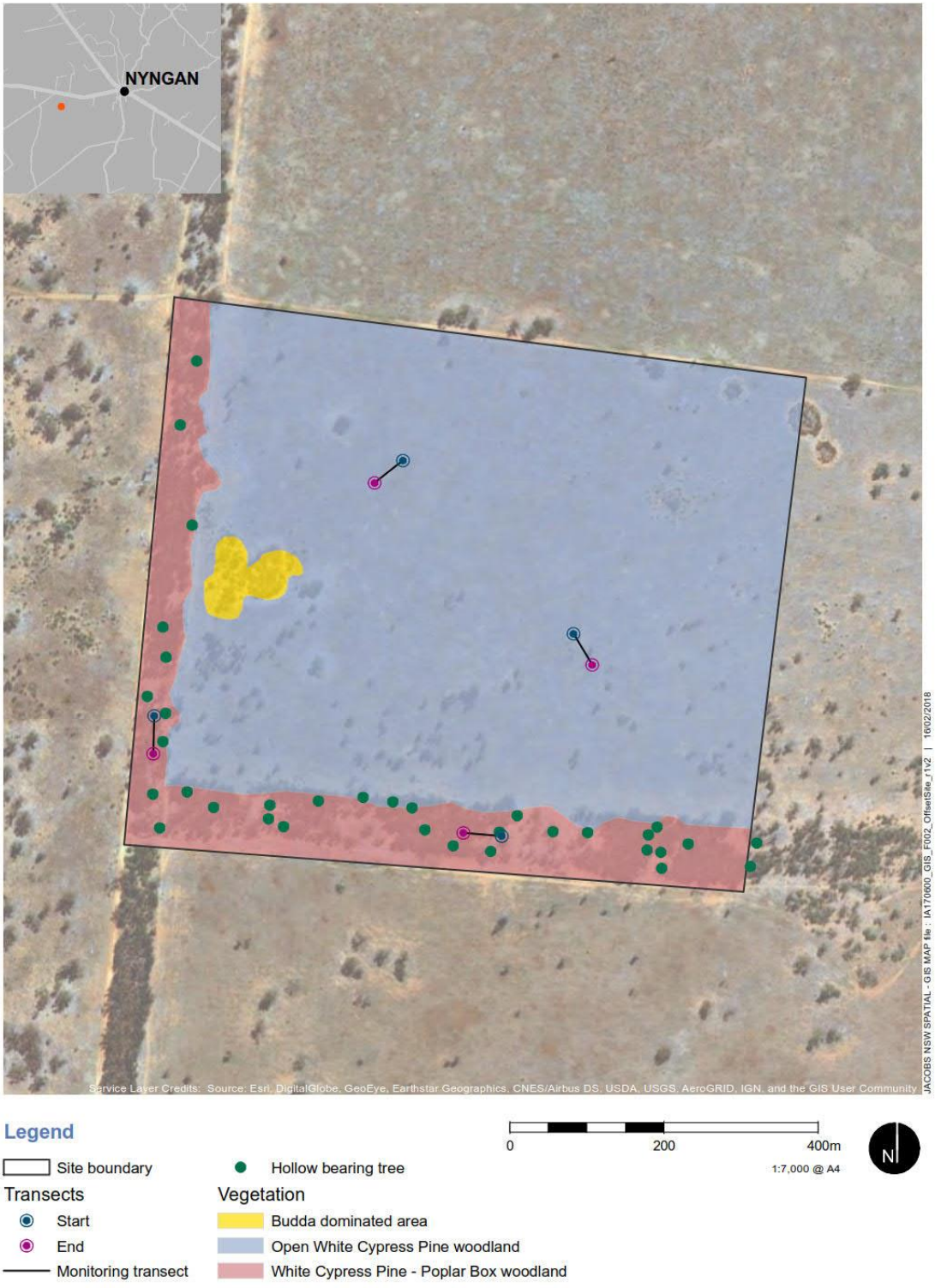

Figure 2.2 | Vegetation types, hollow bearing trees and monitoring plots within the Nyngan offset site

2.2.2 Habitat evaluation

General habitat notes were made for the entire offset site whilst detailed habitat notes were taken at each of the monitoring plot locations and included the presence of habitat trees, logs and opportunistic fauna observations. In addition to, the percentage cover of the following habitat features within the entire 50 x 20 metres monitoring plots were recorded:

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

2.2.3 Fencing evaluation

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

2.2.4 Solar plant revegetation area - assessment

The revegetation area within the solar plant site was assessed by a count of planted species to determine approximate percentage survival rates and for weed infestation. A general plant species list was created for the area and any management actions listed. Section 4 describes the assessment results for the revegetation area and provides recommendations for future management actions. Management actions for the revegetation area are also included in Section 5.

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 (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.

2.3 Limitations

2.3.1 Climatic conditions

Nyngan is a typically dry, semi-arid area that experiences low annual rainfall. While the area received above average rainfall in February, March and April 2020, Nyngan experienced much lower rainfall than average for the remainder of 2020 except for August. The sporadic rainfall events throughout February, March and April 2020 provided significant levels of rainfall at the start of 2020 and is likely to have resulted in improved conditions for plant growth to flourish and regenerate as observed during the Year 4 survey. This has led to a considerable increase in species richness across monitoring plots compared to last year's conditions. Meteorological conditions from January 2020 to December 2020 are shown in Figure 2.3.

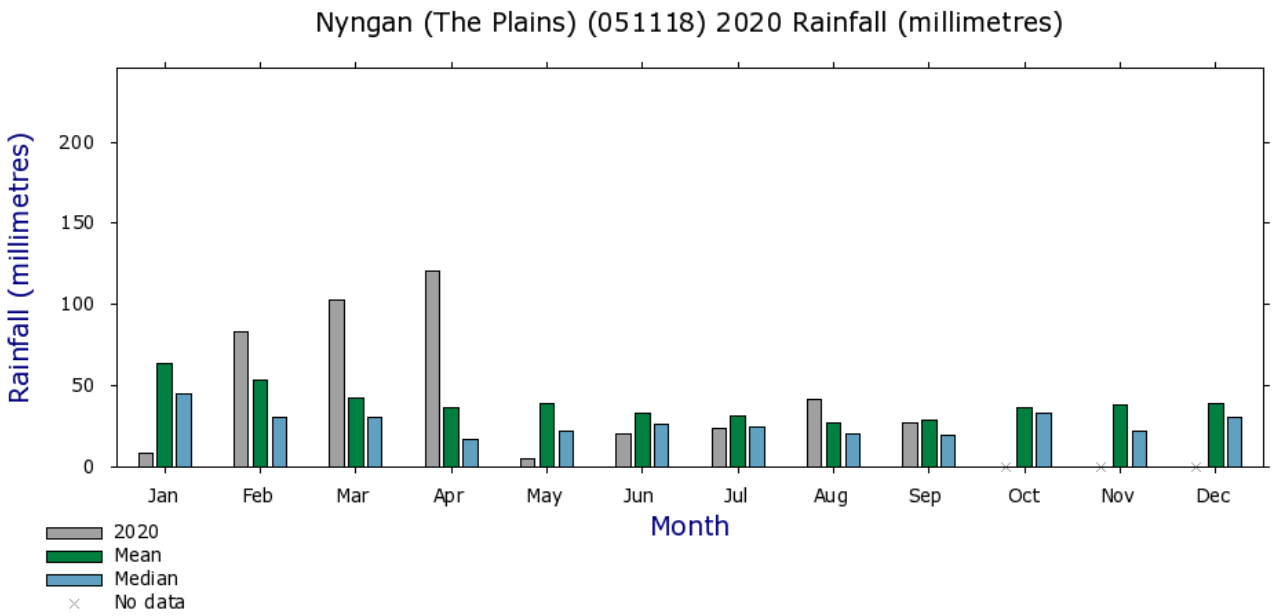

Figure 2.3: Rainfall preceding Year 4 monitoring (source: Australian Bureau of Meteorology)

2.3.2 Grazing pressure

The offset site has been fenced for approximately three years by the time of this survey. Kangaroos were not observed within the site and evidence of rabbit and sheep activity was minimal. Grazing pressure is considered to be relatively low compared to previous years.

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. The coordinates for each monitoring plot are provided in Table 3.1 to enable repeat and consistent monitoring in the future. Photographs taken at the start and end of each monitoring plot are also provided in sections 3 and 4. A species list specific to the 20m x 20m monitoring plot within the larger transect area is provided in Appendix A.

Table 3.1: Coordinates for each of the monitoring plots

Plot Name	Transect start		Transect end	
	Easting*	Northing*	Easting*	Northing*
M01	501365.4948	6498409.989	501388.4344	6498371.304
M02	501144.511	6498635.457	501106.7714	6498605.313
M03	500822.2086	6498302.868	500820.4033	6498254.1
M04	501271.0288	6498145.767	501221.3488	6498151.204

* Co-ordinates are in MGA zone 54 relative to the GDA94 datum

3.1.1 Open White Cypress Pine Woodland

The Open White Cypress Pine Woodland community is the dominant vegetation type within the offset site (approximately 41.55 hectares). The overstorey is sparse and comprised of scattered patches of White Cypress Pine (*Callitris glaucophylla*) with the occasional mature Poplar Box (*Eucalyptus populnea* subsp. *bimbil*). The mid-storey is also very sparse and mostly comprised of regenerating White Cypress Pine. Isolated Wilga (*Geijera parvifolia*) and Budda (*Eremophila mitchellii*) individuals also occur.

The ground cover comprises of a high diversity of forbs and grasses. Dominant species include: Purple Wiregrass (*Aristida ramosa*), Mulga Mitchell Grass (*Thyridolepis mitchelliana*), Longtails (*Ptilotus polystachyus*) and Yellow-bur daisy (*Calotis lappulacea*). The most abundant species during the Year 4 survey were *Jerichoensis* var. *subspinulifera, Thyridolepis mitchelliana* and *Panicum effusum.* The exotic species *Conyza bonariensis* was present in low abundance, and no other exotic species were present (see Plates 1 to 4).

The monitoring plot data along with the benchmarks for this vegetation type (DECC 2008) are shown in Table 3.2 and 3.3. Plates 1 to 4 show the photo assessment points. Species richness (the number of native species, shown in Table 3.2 as 'Native Spp. #') was above the benchmark for the community across both plots and higher than last year, but still lower than the baseline recorded by NGH (2014). Overstorey and mid-storey are within the benchmark and slightly higher than the NGH (2014) baseline data and last year's monitoring data. Native grass cover was above the benchmark for this community and has increased considerably since last year but is still below baseline levels. Similarly, other groundcover vegetation cover was above the benchmark for this community and has increased since last year but is still below baseline levels. The increase in grass and other groundcover is evident when comparing the photo monitoring points between Year 3 and Year 4 surveys (see Plates1 to 4). The increase groundcover vegetation is most likely due to the above average rainfall conditions experienced on site in early 2020.

Groundcover shrub cover was within the benchmark and was equal to the baseline (NGH 2014) for M02 and slightly below the baseline (NGH 2014) for M01. There was a slight increase in groundcover shrub cover for M01 compared to last year. As per previous surveys, no Hollow Bearing Trees (HBTs) were recorded in the plot and fallen timber remained below benchmark levels.

The Open White Cypress Pine Woodland community remains in moderate condition but has increased considerably in species richness and grass and other groundcover scores compared to last year. The increased

regeneration of overstorey species such as White Cypress Pine is further evident since last year and likely to continue over time. The health and condition of native plants has also visibly improved since last year and can be seen in photos below. Continued improvement in this community is likely, particularly if favourable weather conditions continue.

Plate 1 Open White Cypress Pine Woodland – Plot M01 Year 3

Plate 2 Open White Cypress Pine Woodland – Plot M01 Year 4

Plate 3 Open White Cypress Pine Woodland – Plot M02 Year 3

Plate 4 Open White Cypress Pine Woodland – Plot M02 Year 4

Table 3.2: Benchmark and monitoring plot data comparison for Open White Cypress Pine Woodland Plot M01

	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	3%	22%	0%	30%	5%	30%	2%	10%	2%	30%	0.1	20
Baseline (NGH 2014)	28	0%		0%		58%		4%		24%		0	5
Yr 1 M01	30	0%		0%		44%		0%		34%		0	1
Yr 2 M01	26	1%		1%		22%		0%		16%		0	15
Yr 3 M01	17	1%		1%		2%		1%		5%		0	10
Yr 4 M01	25	3%		1%		40%		3%		8%		0	10

Table 3.3: Benchmark and monitoring plot data comparison for Open White Cypress Pine Woodland M02

	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	3%	22%	0%	30%	5%	30%	2%	10%	2%	30%	0.1	20
Baseline (NGH 2014)	29	0%		0%		50%		2%		30%		0	17
Yr 1 M02	30	3%		0%		44%		0%		46%		0	1
Yr 2 M02	23	3%		<1%		22%		0%		10%		0	14
Yr 3 M02	16	3%		1%		3%		2%		3%		0	15
Yr 4 M02	21	5%		3%		40%		2%		20%		0	15

3.1.2 White Cypress Pine – Poplar Box Woodland

The White Cypress Pine – Poplar Box Woodland community is restricted to linear strips approximately 45 to 75 metres wide along the western and southern boundaries of the offset site and occupies approximately 8.5 hectares (see Figure 2.2). The overstorey is dominated by White Cypress Pine with mature Poplar Box scattered throughout. In more open areas, Poplar Box is dominant. Gum - barked Coolabah (*Eucalyptus intertexta*) is also present to a lesser extent occurring as occasional individuals. Dense White Cypress Pine recruits form a distinct small tree layer across much of the area. The mid-storey shrub layer is generally sparse and restricted to occasional individuals of Budda, Berrigan (*Eremophila longifolia*) and Sticky Hopbush (*Dodonaea viscosa* subsp. *mucronata*). Climbing saltbush (*Einadia nutans* subsp. *nutans*) is a common low shrub along with Galvanised Burr (*Sclerolaena birchii*) and Eastern Cottonbush (*Maireana microphylla*). The ground cover is patchy and dominated by species such as Mulga Mitchell Grass, Curly Windmill Grass (*Enteropogon acicularis*), Blue Trumpet (*Brunoniella australis*) and Ridged Sida (*Sida cunninghamiana*). There were no exotic species present in this community during the survey.

The monitoring plot data, along with the benchmarks for this vegetation type (DECC 2008), are shown in Table 3.4 and 3.5. Plates 5 to 8 show the photo assessment points during Year 3 and Year 4 surveys. Species richness (which is the number of native species, shown in Table 3.4 as 'Native Spp. #') is above the benchmark for both plots, and above the baseline (NGH 2014) for M04. Overstorey cover is above the benchmark and slightly higher than last year. Similarly, mid-storey cover is above the benchmark and slightly higher than last year. Grass cover was substantially higher than last year's survey and within the benchmark range for the first time since Year 1 monitoring but is still well below the baseline level. Groundcover shrub cover was within the benchmark range and slightly increased compared to last year but is also below baseline values for the community. Other native ground cover such as forbs, saw a very large increase compared to last year, and exceeded the benchmark range and baseline values, in both plots, for this community. Groundcover increase is evident when comparing the photo monitoring points from the Year 3 survey with the current survey (Plates 5 to 8). The increase in groundcover vegetation is most likely due to four months of above average rainfall throughout 2020. Whilst HBTs occur within the wider area of this community, none were recorded in the monitoring plot, which is below the benchmark and baseline (NGH 2014) for this community. The values for fallen timber in the monitoring plot were like last year, higher than the benchmark and similar to the baseline (NGH 2014).

Overall, the White Cypress Pine – Poplar Box Woodland community is in moderate condition and has improved considerably on last year's values. It now exceeds a number of the benchmarks, especially native groundcover - other, and it has experienced a substantial increase in native species diversity.

Table 3.4 Benchmark and monitoring plot data comparison for White Cypress Pine – Poplar Box Woodland – plot M03

	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	3%	22%	0%	30%	5%	30%	2%	10%	2%	30%	0.1	20
Baseline (NGH 2014)	24	29%		0%		32%		6%		10%		2	35
Yr 1 M03	31	39%		0%		18%		0%		56%		0	7
Yr 2 M03	12	32%		2%		0%		2%		18%		0	36
Yr 3 M03	4	30%		2%		0%		2%		7%		0	35
Yr 4 M03	21	32%		4%		10%		4%		45%		0	36

Table 3.5 Benchmark and monitoring plot data comparison for White Cypress Pine – Poplar Box Woodland – plot M04

	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	3%	22%	0%	30%	5%	30%	2%	10%	2%	30%	0.1	20
Baseline (NGH 2014)	21	22%		0%		18%		10%		6%		1	36

	Native Spp. #	Native Cover				Native Groundcover						HBTs	Logs
		Overstorey		Mid-storey		Grasses		Shrubs		Other			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Yr 1 M04	36	28%		0%		8%		0%		28%		0	2
Yr 2 M04	19	25%		0%		2%		0%		8%		0	38
Yr 3 M04	7	25%		0%		0%		3%		5%		0	38
Yr 4 M04	24	27%		2%		15%		4%		50%		0	38

Plate 5 White Cypress Pine – Poplar Box Woodland - Plot M03 Year 3

Plate 6 White Cypress Pine – Poplar Box Woodland - Plot M03 Year 4

Plate 7 White Cypress Pine – Poplar Box Woodland - Plot M04 Year 3

Plate 8 White Cypress Pine – Poplar Box Woodland - Plot M04 Year 4

3.2 Monitoring survey results summary and discussion

The observed changes in the vegetation of the offset site are summarised and discussed below.

3.2.1 Native species richness

Native species richness (labelled Native Spp. # in tables above) was above benchmark levels for all plots (see Figure 3.1). The groundcover grass and forb component of the vegetation seems to have been the most increased, with many previously recorded annual and short-lived perennial species reappearing. Refer to Appendix A for the full list of native species in each plot.

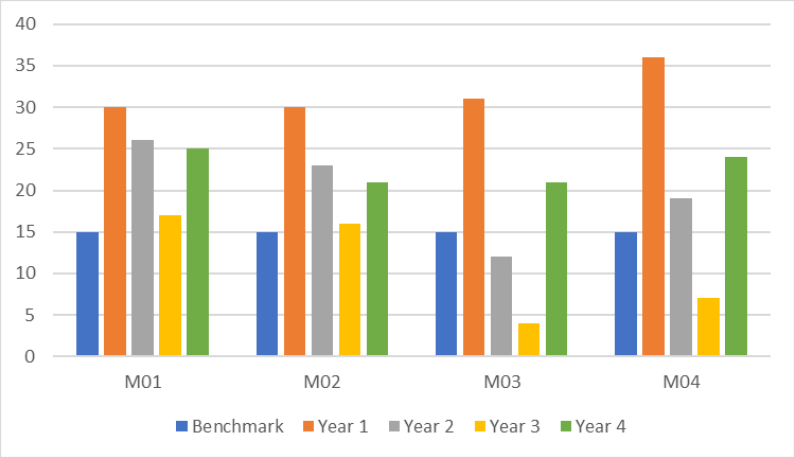

Figure 3.1: Changes in native species richness assessed against benchmark levels

3.2.2 Cover of native and exotic vegetation

The cover scores for native and exotic vegetation have increased for all categories in comparison with last year, apart from in groundcover shrub. Noticeably, groundcover grasses demonstrated the most substantial increase in Year 4 compared to Years 2 and 3. There has also been an increase in the abundance of exotic species when compared with data from Years 2 and 3 (see Figure 3.2). This change is likely to be attributable to an increase in favorable rainfall conditions compared with Years 2 and 3.

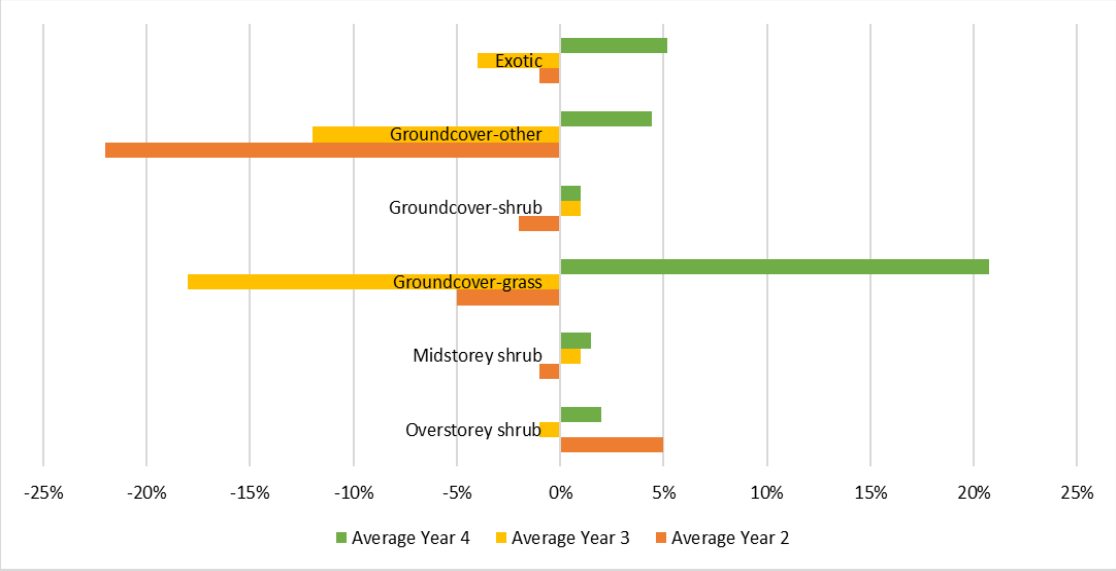

Figure 3.2: Changes in the cover of native and exotic vegetation

The native groundcover-other cover for M03 and M04 exceeded the benchmark maximum during Year 4. Furthermore, M01 and M02 were within the benchmark range (see Figure 3.3).

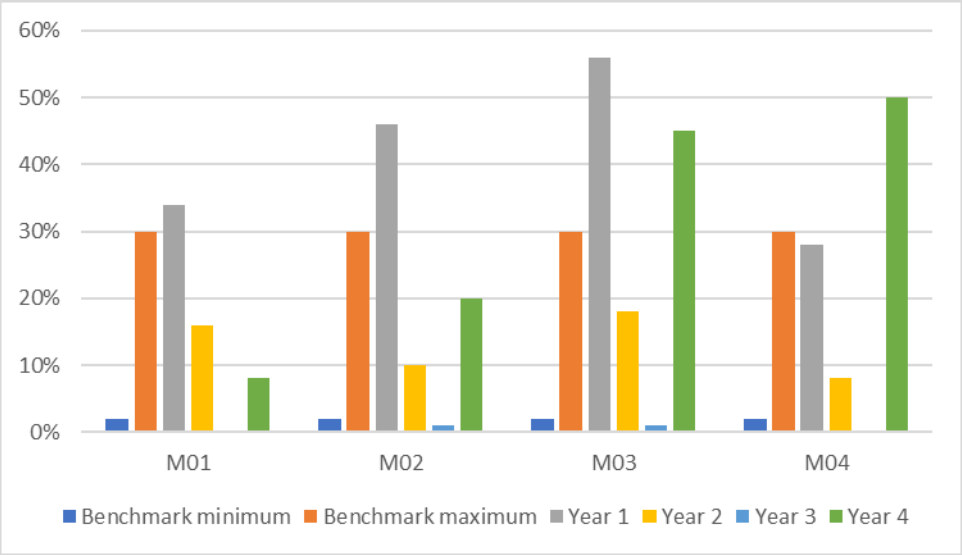

Figure 3.3: Native groundcover – other (percentage cover)

Likewise, Figure 3.4 demonstrates the native groundcover-grass layer exceeded the benchmark maximum for M01 and M02 for Year 4. Additionally, the native groundcover-grass layer increased for M03 and M04 in comparison to Year 2 and Year 3 and remained within the benchmark range (see Figure 3.4).

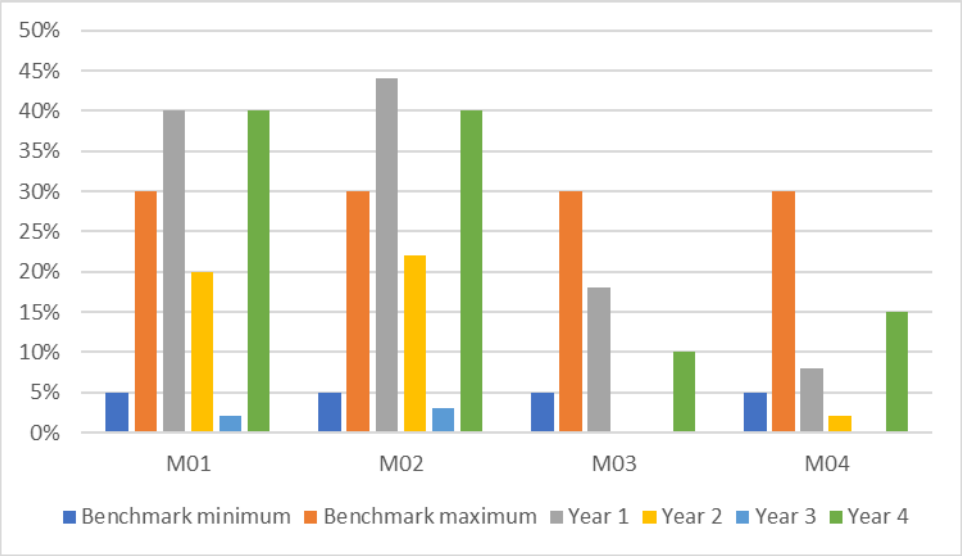

Figure 3.4: Native groundcover - grass (percentage cover)

In relation to native groundcover-shrubs (Figure 3.5), the benchmark levels were met for all of M01, M02, M03, M04 and generally increased compared to Year 2 and Year 3.

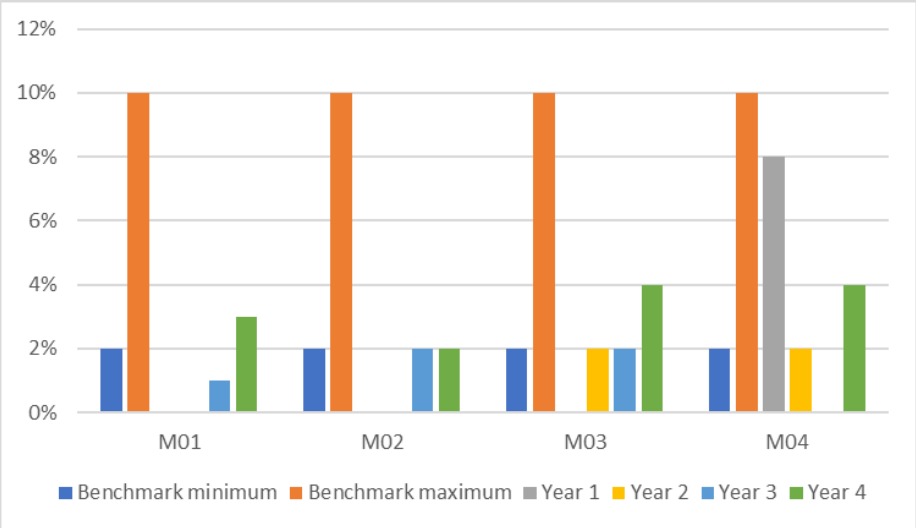

Figure 3.5: Native Groundcover – shrubs (percentage cover)

3.2.3 Discussion

The observed growth and recovery in species richness and native vegetation cover observed at the site in 2020 is most likely a result of the above average rainfall events at the offset site throughout 2020 compared to the previous two years. The annual and short-lived perennial groundcover species are likely to naturally fluctuate in abundance, as a response to rainfall, and are likely to persist on the site in the form of a soil-stored seedbank during unfavourable conditions. These data show the resilience and recovery potential of the community and species present in response to environmental conditions.

Grazing pressure on grasses and herbs by kangaroo and sheep seem to have decreased since last year as a result of increased biomass available to grazers. An extended return to average or higher rainfall will likely see a return of annual and short-lived perennial groundcover species and recovery of the foliage cover of grasses across all monitoring plots.

The Year 4 monitoring has shown an improvement in the diversity and abundance of native plants and the overall condition of native vegetation on the offset site. This change is likely to be caused primarily by increased rainfall events as well as lower levels of grazing by goats.

3.3 Weeds, disturbance and pests

Overall weed infestation across the site was low. The only weed species identified within monitoring plots was *Conyza bonariensis*. None of the weeds identified within the site are declared as state or regional priority weeds under the *Biosecurity Act 2015* or the Western Regional Strategic Weed Management Plan 2017-2022 (LLS 2017).

As noted in previous monitoring reports, historic clearing (prior to AGL acquiring the offset site) was evident across the offset site, with several stumps and stags remaining.

No new damage or other signs of recent pig activity was observed in the Year 4 monitoring. Predation, habitat degradation, competition and diseases transmission by feral pigs is listed as a 'key threatening process' under Schedule 4 of the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999). A threat abatement plan exists for this process (DEH 2005) and has two broad goals:

- To protect nationally listed threatened species and ecological communities from predation, habitat degradation, competition and disease transmission by feral pigs; and

- To prevent further species and ecological communities from becoming nationally threatened or extinct due to predation, habitat degradation, competition and disease transmission by feral pigs (DEH 2005).

The plan outlines the environmental impacts caused by feral pigs, control techniques and the roles and responsibilities of landowners, communities and authorities in managing the pest. Table 5.1 offset site management measures in the BOMP (NGH 2014) list the exclusion of feral pigs as a management action. If pigs are found on the site in future, they should be managed through trapping in the first instance, as recommended by the Central West Local Land Services (Mr G Grahame 2018, pers. comm., 30 January). Further details for this management action have been included in Table 5.1 of this report (see Section 5).

3.4 Fauna Habitats

Habitat within the offset site comprises of fallen logs, standing dead trees (stags), hollow bearing trees and grassy/forb groundcover (see Plate 9 to12). The higher density woodland areas along the southern and western boundaries of the site are abundant in fallen timber and the overstorey provides nesting and roosting habitat for a range of woodland birds. Mature Poplar Box and Gum-barked Coolabah trees provide hollows of various sizes as mapped by NGH (2014). Tree hollows provide potential habitat for a wide range of bats, woodland birds, owls and arboreal mammals such as gliders.

Searches were undertaken for Grey-crowned babbler nests whilst undertaking monitoring of plots M03 and M04 within the White Cypress Pine – Polar Box Woodland community and whilst traversing the offset site. No nests were observed. No Grey-crowned Babblers were observed within the offset site. As described by NGH (2014) the presence of the aggressive Noisy Miner within the White Cypress Pine – Polar Box Woodland areas and less commonly in the Open White Cypress Pine Woodland community may be a significant factor in the absence of this species.

The greater area across the centre of the offset site comprises of very few scattered trees and is a mix of bare ground and a grassy/forb groundcover. Scattered fallen timber and small stags also provide habitat in this area. Numerous common species of woodland birds were observed foraging within the grassy groundcover and perching on small trees and stags. Eastern Grey Kangaroos including juveniles were observed within the site.

Overall, the habitats within the offset site appeared to be consistent with those described by NGH (2014). The installation of fencing approximately three years prior to the current survey is likely to be effective in excluding goats, pigs and any livestock from the site, which may assist in the natural regeneration of the site and hence improve the vegetative habitats.

Plate 9 Open grass habitat with patches of bare ground and occasional tree or stag

Plate 10 A large log, one of many providing habitat for reptiles

Plate 11 Wooded areas along the southern and western boundaries of the offset site provide an abundance of fallen log habitat

Plate 12 Hollow bearing tree – *Eucalyptus populnea* subsp. *bimbil*

3.5 Fence maintenance

Stock proof fences, approximately 1200 mm high, were installed around the entire perimeter of the offset site in January 2018. The fences appeared well maintained and in near new condition. Fencing comprises of a ring lock style, (and originally included) a single strand of barbed wire along the top (see Plate 13). Kangaroos were observed within the offset site and exiting the site by jumping the fence.

The top barbed-wire strand of the fencing was removed in 2019 as recommended by Jacobs (2019, Year 2 Survey) to minimise the risk of kangaroo entrapment and mortality. No kangaroo carcasses were observed entangled in the boundary fences in the Year 4 survey.

Gaps under the fence identified in the Year 3 survey were repaired / filled by AGL as per previous recommendation. Any future animal diggings are to be filled in as soon as possible to prevent entry of goats and sheep.

Plate 13 Ring-lock fencing along the southern boundary of the offset site. This style of fencing surrounds the entire perimeter of the offset site.

3.6 Recommended future management actions

The following management actions are recommended for the offset site. These actions are also included in Section 5 of this report.

- Monitoring and spot-spraying of re-emerging weeds in early spring 2021. (In growth season, in suitable low wind conditions to prevent spray drift reaching other native species)
- Ongoing fence monitoring and repair of any damage observed.

4. Solar Plant revegetation area

4.1 Overview and monitoring methodology

It was a condition of approval (COA B18, October 2011) for the Nyngan Solar Plant that visual screening be provided along the southern boundary of the solar plant site to reduce visual impacts. As per section 6 of the OMP, the provision of visual screening was to be incorporated with habitat restoration of approximately five hectares of land at the solar plant site as an additional compensatory environmental measure. In the long-term, this is expected to provide additional habitat for the Grey-crowned Babbler in the immediate area where habitat has been removed and where the species is known to occur and breed.

A Landscape Plan was prepared for the revegetation area by First Solar (2013) and planting of the revegetation area was undertaken in accordance with this plan. Measures, additional to the Landscape Plan, that have the objective of enhancing habitat for the Grey-crowned Babbler were outlined in the BOMP (NGH 2014) and include:

- Where possible, tubestock and seed used for revegetation would be of local provenance.
- Stock would be excluded from the revegetation area for the life of the solar plant.
- Groundcover revegetation would be conducted focusing on establishing a grassy understorey suitable for foraging by the Grey-crowned Babbler. It is proposed to utilise grass species that are known to occur on the site and are considered suitable for revegetation as outlined in Table 6-2 of the BOMP (NGH 2014).
- Larger logs that are cleared from other activities within the development site would be placed within the revegetation area to provide additional habitat features.
- Ongoing weed control within the revegetation area would be carried out as described for the development site in the project Operational Environmental Management Plan.

The revegetation area at the solar plant (see Figure 4.1) is divided into two areas, the eastern and western revegetation areas (see Plates 15 and 16), by a patch of remnant vegetation retained within the site. Revegetation occurred in July 2017, and each area has been fenced in its entirety. One monitoring transect (50m x 20m) was established within the larger, eastern revegetation area to identify any natural regeneration diversity and cover in the area. A species list specific to the 20m x 20m monitoring plot within the larger transect area is provided in Appendix A. An overall assessment was also undertaken for the revegetation area to estimate the survival rate of planted tubestock.

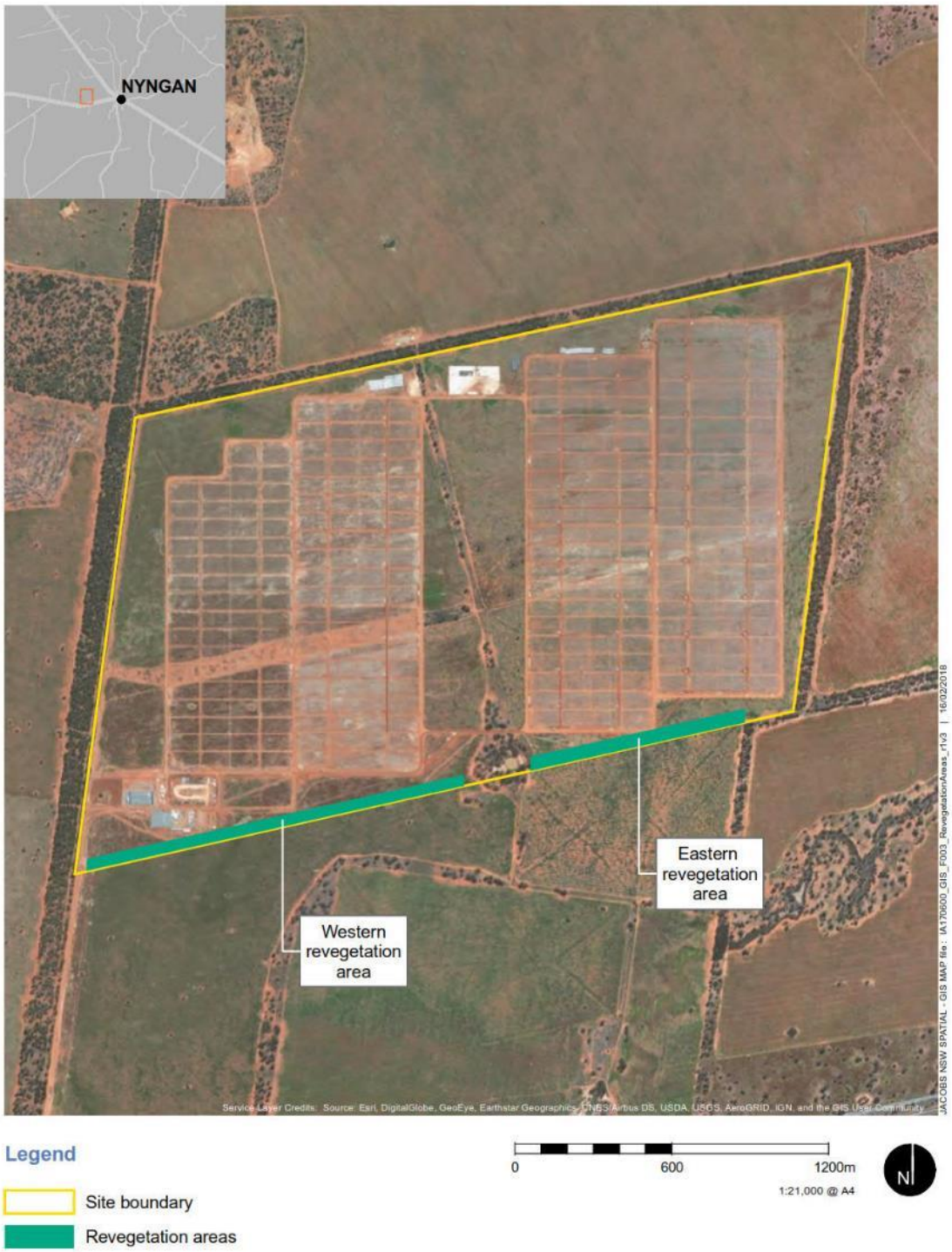

Figure 4.1 | Revegetation areas within the Nyngan solar plant site

Plate 15 Looking west along the western revegetation area (Year 3)

Plate 16 Looking west along the western revegetation area (Year 4)

4.2 Revegetation area condition assessment

Monitoring of the revegetation area within the solar plant site was undertaken on 25 November 2020. The results of the assessment are provided in the following sections along with recommended management actions. Management actions are also outlined in Table 5.1, Section 5.

4.2.1 Vegetation monitoring

The return to favourable weather conditions has meant that the declines in cover of native vegetation recorded during the drought (2017-2019) has been reversed. The loss of planted trees from the revegetation area due to drought means that the vegetation cover is still low, however the plants that have survived appear to be in good health and have grown considerably in the last year. Cover of native grasses, shrubs and herbs (other) has increased considerably (see photo 16). Species richness across the monitoring plot has increased from 10 species to 16 species – showing that natural regeneration is also occurring. Whilst vegetation cover is still low and near the minimum benchmarks for the desired vegetation community, there has been improvement since 2019 (see figure 4.2 below).

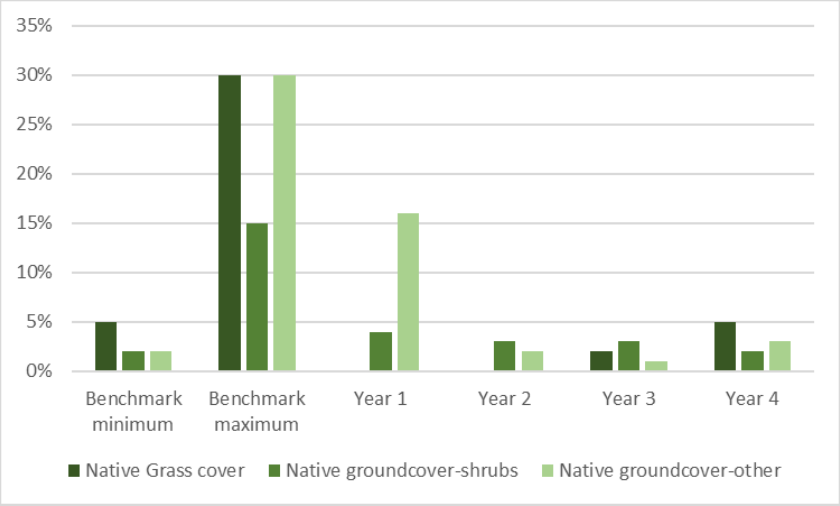

Figure 4.2 Changes in vegetation cover (%) of groundcover types - Revegetation Area

4.2.2 Tubestock survival rate

Tubestock was planted within the revegetation area in July 2017 (see Figure 4.1). The estimated survival of tubestock in Year 3 survey was 10%. There appears to be no further losses of tubestock this year compared to last year's survey. The survivors are predominately *Eucalypt spp.* and some shrub species such as *Acacia spp.* and hardier species such as the shrub *Bursaria spinosa*. Some of these specimens have put on significant growth since being planted, such as *Brachychiton populneus* (see Plates 17 and 18). Substantial growth since last year was noted in some species such as *Acacia spp.* and this can be attributed to the months of above average rainfall in 2020.

Plate 17 *Brachychiton populneus* planted within the revegetation area with recently installed jute matting and plant protector (Year 2)

Plate 18 Surviving *Brachychiton populneus* In Year 4

4.2.3 Natural regeneration

A significant amount of natural regeneration occurring within the ground layer of the revegetation area was observed in the Year 1 monitoring. With the subsequent dry conditions many of the species that were previously apparent were not detected during the Year 2 survey. Year 3 survey found a further decline in species with ten native species identified within a 20m x 20m plot in the eastern revegetation area, which is considered likely to be representative of the entire revegetation area.

This year saw a rebound in species richness and cover, with many species appearing that were not present in the last two years. A full species list and cover abundance score using the modified Braun Blanquet scale are provided in Appendix A. The increased diversity and number of native plants naturally regenerating within the ground layer of the revegetation area since last year can be attributed to improved rainfall conditions.

4.2.4 Fencing

Fences were installed around the entirety of the revegetation area in March 2017 and were in good condition at the time of this survey.

4.2.5 Weed infestation

Weed infestation within the revegetation area was low to moderate. There were six species present, comprising of *Carthamus lanatus, Conyza bonariensis, Sonchus oleraceus, Citrullus colocynthis, Medicago laciniata var. laciniata* and *Avena* sp.

4.2.6 Habitat evaluation

The revegetation area currently does not provide suitable habitat for the target species, Grey-crowned Babbler. As the ground layer cover improves and planted shrub species and overstorey Eucalypts grow this may improve. It is likely to take at least 10 years before the overstorey is a suitable height for nesting habitat. The bare ground and emerging groundcover may provide some areas of open foraging habitat for birds.

4.3 Recommended future management actions

The following management actions are recommended for the revegetation area within the solar plant. These actions are also included in Section 5 of this report.

- Replacement planting is recommended at a low rate (approximately 200 plants per revegetation area) and in clusters along the revegetation areas using the species of plants that were previously planted and have survived (see table 4-1).
  - Clustering of a low number of plants may allow for a concentrated effort in watering and hence a greater likelihood of plant survival. Further clusters may be added in the future should this method prove to be more successful.
  - Tubestock is to be used and tree guards provided around each. Supplementary planting is recommended to be undertaken when weather conditions are still warm but cooler in Autumn but only after a return to average or higher monthly rainfall over several successive months. Intensive watering in of tubestock at the time of planting as well as subsequent watering following planting is required.
  - A suitably experienced contractor is required to advise on species and watering frequency.
- Targeted spot spraying of weeds is recommended in late winter or early spring 2021, to allow for continued improvement in the natural regeneration of the areas and greater growth in the surviving tubestock species.
- Brush matting – collection of native seed from local provenance placed within the revegetation area on branches scattered along the original planting rip lines. It is recommended this to be undertaken in early spring after suitable withholding periods post targeted weed spraying.
  - Branches should be left with seed *in-situ*, allowing seeds to disperse naturally and lay dormant within the ground layer until favourable weather conditions activate germination.

Table 4-1 Recommended species for planting

Stratum	Suitable Species	Suggested planting density
Trees and tall shrubs	*Acacia excelsa* *Acacia melvillei* *Callitris glaucophylla* *Eremophila mitchellii* *Geijera parviflora* *Hakea tephrosperma* *Eucalyptus populnea ssp bimbil*	Approximately 3m spacing in rows spaced a minimum of approximately 3m apart. Trees and tall shrubs would be alternated with shrubs and sub-shrubs
Shrubs and sub-shrubs	*Dodonaea viscosa subsp. mucronata* *Eremophila longifolia*	

Stratum	Suitable Species	Suggested planting density
	Senna form taxon 'zygophylla'	

Note: The above species are a selection of the original planting list detailed in the 2013 Biodiversity Offset Management Plan by NGH Environmental. These species are usually tolerant of dry conditions and are likely to persist in the revegetation area or surrounding environment. Other species which were also planted in the revegetation area in 2017 such as Kurrajong (*Brachychiton populneus*), Deane's Wattle (*Acacia deanei*) and Old-man Saltbush (*Atriplex nummularia*) were found to have survived recent dry conditions and should be included in replanting if available.

5. Management Actions

The management measures outlined in the BOMP (NGH 2014) are listed in Table 5.1 below. Additionally, Table 5.1 provides an evaluation of the need for each management action, based on observation during the monitoring works, the timing, and who is required to undertake the action. Management actions relate to the Nyngan Offset Site (Figure 2.2) and the Nyngan Solar Plant revegetation area (Figure 4.1).

Table 5.1 Management Actions for the Nyngan offset site and Nyngan Solar Plant revegetation area

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
Management Measures of the BOMP (Note: the text in blue is text added to the original BOMP text where required)							
Exclusion of stock	To prevent overgrazing and encourage regeneration of native vegetation	Install stock proof fencing around the perimeter of the offset site.	At establishment of the offset site.	n/a Fence installed around the offset site.	n/a	n/a	n/a
			Ongoing repairs as required.	The perimeter fence and the presence of grazing animals was checked by a Contractor in September 2020 and November 2020.	No	n/a	n/a
Weed control	To minimise the occurrence of weeds within the offset site particularly	Survey to identify target locations for weed control. Weed control using appropriate methodologies considering target species and landscape context.	Ongoing as required.	Targeted weed spraying was conducted at the offset site in November 2020.	Yes	Nyngan offset site Nyngan Solar Plant revegetation area	Monitoring and spot-spraying of re-emerging weeds in early spring 2021. (In growth season, in suitable low wind

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
	Weeds of National Significance (WoNS) and listed noxious weeds.			Targeted weed spraying was conducted at the solar plant revegetation area in July 2020.			conditions to prevent spray drift reaching other native species)
Exclusion of feral pigs	To exclude feral pigs. To improve natural regeneration of vegetation, prevent soil disturbance which may lead to erosion and to prevent potential harm to and competition with native fauna.	Install and maintain preventative fencing suitable for the target species. Remove pigs (by trapping or other means) if detected within the offset site.	Ongoing as required. Possibly required if any pigs manage to get into the site due to future fence damage.	The perimeter fence and the presence of grazing animals was checked by a Contractor in September 2020 and November 2020. No evidence of feral pigs.	Yes	Nyngan offset site.	Fence monitoring and repair of any damage observed.
Cat and/or fox control	To minimise the presence of cats and foxes within	Monitor for presence of cats and foxes. Conduct baiting or trapping if cats or foxes are detected within the offset area. Where possible, coordinate baiting or trapping with adjacent landowners to maximise effects	Consideration given to action on the basis of monitoring results.	n/a	Not required at this stage	n/a.	n/a

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
	the Offset Site. To eliminate feral pests from within the site and improve opportunities for native fauna to inhabit the site						
Rabbit control	To minimise the risk of the Offset Site becoming a refuge for rabbits. To eliminate feral pests from within the site and reduce grazing on native flora	Monitor for presence of rabbits. Conduct baiting or controlled grazing to reduce the ability of the site to act as a refuge to rabbits. Where possible, coordinate baiting with adjacent landowners to maximise effects	Consideration given to action on the basis of monitoring results.	n/a	Not required at this stage	n/a.	n/a
Monitoring	To determine the effectiveness of	Conduct monitoring as detailed in Section 5.3 of the BOMP. Adapt management measures where required.	Annually	n/a	Annual Monitoring	Offset site and Solar Plant	n/a

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
	management measure					revegetation area	
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.	As required	n/a	n/a	n/a	n/a
Additional Management Measures							
Control of Noisy Miners	To reduce Noisy Miners within the offset site to decrease competition with other native woodland birds	None required at this stage. Allow natural regeneration to continue to occur now that the offset site is fenced and re-evaluate in Year 5.	Not required at this stage	-		Nyngan offset site and adjoining lands where possible.	-
Monitoring plot survey	Repeat monitoring plot surveys to evaluate the 'improve or maintain' outcome of biodiversity	Repeat monitoring of all plots within the offset site.	Yes, required late spring 2021	-		Nyngan offset site Nyngan Solar Plant revegetation area	Time monitoring to capture weed control efforts where possible

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
	values at the site						
Monitoring of revegetation area	Repeat monitoring plot survey to evaluate the condition of revegetation areas with regards to planting survival rates and natural regeneration diversity and cover	Repeat monitoring of single plot within the eastern revegetation area.	Yes required late spring 2021	-		Nyngan Solar Plant revegetation area	Time monitoring to capture weed control efforts where possible
Supplementary planting of revegetation area	To enhance the native vegetation, cover in the revegetation areas and replace plants lost	Supplementary planting of approximately 200 plants per revegetation area, using a mixture of *Eucalypt spp., Acacia spp.* and other hardy shrub species that were previously planted and have survived. Ecologist to work with a qualified bush regeneration contractor. Tubestock is to be used and tree guards provided around each. Guards are also required around the surviving tubestock from the previous planting. Carton guards are recommended over the plastic tree guards for their ability to more readily break down in the environment and their ease of installation. Intensive watering in of tubestock at the time of planting as well as subsequent watering following planting is paramount. A qualified Bush Regeneration contractor is required to advise on	Yes required, when the weather is warm but not hot and following several months of average or higher rainfall. Subject to suitable weather conditions in the locality.	During 2020, AGL contacted numerous contractors about the possibility of planting and watering work. The remote location of and lack of suitable contractors provides significant		Nyngan Solar Plant revegetation area	Planting to be conducted in 2021 when weather conditions are suitable. Planting time subject to suitable weather conditions in the locality.

Management measure	Objective	Action	Timing	Actions undertaken by AGL	Actions required in 2021	Location where required	Adaptive measures / recommended actions for 2021 / Timing
		watering frequency and as such a degree of flexibility should be allowed for in any quotation for these services. Larger logs that are cleared from other activities within the development site would be placed within the revegetation area to provide additional habitat features		challenges for implementing this scope of work. AGL hopes to be able to organise this for 2021 when conditions are suitable.			
Brush-matting of revegetation area	To enhance the natural regeneration of the revegetation area	Collection of native seed from local provenance placed within the revegetation area on branches scattered along the original planting rip lines. Branches should be left with seed in-situ, allowing seeds to disperse naturally and lay dormant within the ground layer until favourable weather conditions activate germination. To be undertaken in early spring after suitable withholding periods post targeted weed spraying.	Yes, required in early spring 2021 after suitable withholding periods post targeted weed spraying.	-		Nyngan Solar Plant revegetation area	Plan to undertake this action in 2021 if better conditions arise, subject to local seed availability.
Fence modification	To prevent kangaroos and other native wildlife from being injured or killed by fences	Monitoring should be undertaken to determine whether kangaroos and other animals continue to become entangled in fencing. Monitoring should also determine whether the modified fence continues to be effective in excluding large non-native herbivores.	As soon as possible	The perimeter fence and the presence of grazing animals was checked by a Contractor in September 2020 and November 2020.		Boundaries of the offset site with the exception of any boundaries with neighbouring properties.	Additional measures may be required in 2021 to either further reduce the risk to wildlife and/or to inhibit non-native herbivores from entering the site.

Notes: Feral pigs may potentially be in low numbers in the offset site. If they are seen in the offset site, the recommended action in the first instance is trapping and use of firearm to kill any caught pigs. The specific process for the trapping procedure, killing of any caught pigs and disposal of carcases are outlined on the NSW Department of Primary Industries (DPI) web page: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/feral-pigs/feral-pig-control Central West Local Land Services have an office based at Nyngan and a trap readily available for loan to assist in this process. Liaison with the landowner to undertake this process is required.

6. Conclusions

As per the requirements of the MCoA for the Nyngan Solar Plant, the offset site is required to be monitored annually and the results reported to NSW DPIE. Condition C5(b) specifically states that the biodiversity outcome to be achieved must 'improve or maintain' the biodiversity values of the offset site. This report outlines the results of the fourth monitoring survey for the offset site since the baseline study recorded in the BOMP by NGH (2014).

In addition, this report provides a condition assessment for the revegetation area at the Nyngan Solar Plant, which was required by the condition of approval (CoA B18, October 2011). The revegetation area was to provide both visual screening along the southern boundary of the solar plant, as well as future compensatory habitat for the Grey-crowned Babbler in the immediate area where habitat has been removed and where the species is known to occur and breed.

6.1 Conditions at the offset site

The recent monitoring results demonstrate that the vegetation and habitat across the offset site have considerably improved with regards to floristic diversity, and in some measures of cover and condition when compared to the vegetation community benchmarks (DECC 2008) and compared to previous monitoring events.

The notable change in native grass and other groundcover condition is likely attributed to improved rainfall conditions in 2020 which appear to have promoted the growth of grass and forb species. It is likely that seed stock lay dormant within the ground. Continued adequate rainfall would further increase the species diversity at the site. The management actions outlined in Table 5.1 (see section 5) are expected to further assist the natural regeneration of the offset site over the next twelve months.

Stock proof fencing around the offset site has been present since early 2018 and it is likely that with the fencing in place the biodiversity values of the offset site will improve through the exclusion of some feral pests and any livestock, allowing further opportunities for natural regeneration to occur once suitable rainfall conditions persist. While the fence is in good condition around the perimeter of the site, ongoing inspections and management actions need to be taken to prevent feral herbivores from accessing the site in the future.

Fauna habitats across the offset site are in moderate to good condition and have been maintained, with an increase in grassy habitat due to recent wetter conditions.

Weed infestations across the offset site are generally low and can be maintained by spot treatment as outlined in the management actions.

6.2 Conditions at the solar plant revegetation area

Overall, the solar plant revegetation area has maintained a similar plant survival rate since 2019 and condition of surviving plants has improved due to higher rainfall in 2020. There has also been significant growth of native grasses and groundcovers due to recent favourable weather conditions. At the time of writing, favourable weather conditions are continuing and the proposed planting of more tubestock (to account for losses during 2018/2019) should be conducted in the first half of 2021 (assuming weather conditions and projections remain suitable).

7. References

Benson J.S. (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains, Cunninghamia 9(3): 383-450, Botanic Gardens Trust, Sydney

DECC (2008) Vegetation Benchmarks Database. Department of Environment and Climate Change NSW.http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm

DECC (2009) BioBanking Assessment Methodology and Credit Calculator Operational Manual. NSW Department of Environment and Climate Change, Sydney

DEH (2005) Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs Department of the Environment and Heritage (Commonwealth of Australia)

First Solar (2013) Nyngan Solar Plant Landscape Plan30

Jacobs, 2018 Nyngan Solar Plant Biodiversity Offset Site: Annual Ecological Monitoring Report Year 1 – 2017/18. Report to AGL

Jacobs, 2019 Nyngan Solar Plant Biodiversity Offset Site: Annual Ecological Monitoring Report Year 2 – 2018/19. Report to AGL

Jacobs, 2020. Nyngan Solar Plant Biodiversity Offset Site: Annual Ecological Monitoring Report Year 3 – 2019/20. Report to AGL

LLS (2017) Western Regional Strategic Weed Management Plan 2017 – 2022. New South Wales Local Land Services Western Region http://western.lls.nsw.gov.au/__data/assets/pdf_file/0006/722391/Western-RSWMP-web.pdf

NGH (2014) Biodiversity Offset Management Plan (BOMP), Nyngan Solar Plant, NGH Environmental

OEH (2012) Vegetation types database. Office of Environment and Heritage NSW http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm

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	Genus	Species	N or E	M01	M02	M03	M04	Reveg area
Asteraceae	*Carthamus*	*lanatus**	E					2
Asteraceae	*Conyza*	*bonariensis**	E	1				2
Asteraceae	*Lactuca*	*serriola f. serriola**	E					
Asteraceae	*Sonchus*	*oleraceus*	E					1
Cucurbitaceae	*Citrullus*	*colocynthis**	E					2
Fabaceae - Faboideae	*Medicago*	*laciniata var. laciniata**	E					1
Poaceae	*Avena*	*sp.**	E					2
Polygonaceae	*Emex*	*australis**	E					
Verbenaceae	*Glandularia*	*aristigera*	E					
Acanthaceae	*Brunoniella*	*australis*	N			2	2	
Acanthaceae	*Rostellularia*	*adscendens var. adscendens*	N					
Amaranthaceae	*Alternanthera*	*sp. A Flora of New South (M.Gray 5187)*	N					
Amaranthaceae	*Ptilotus*	*obovatus*	N		1	2	1	
Amaranthaceae	*Ptilotus*	*polystachyus*	N	2	2		2	
Apocynaceae	*Marsdenia*	*australis*	N				1	
Apocynaceae	*Parsonsia*	*eucalyptophylla*	N					
Apocynaceae	*Rhyncharrhena*	*linearis*	N					
Asteraceae	*Calotis*	*cuneifolia*	N					
Asteraceae	*Calotis*	*lappulacea*	N	2	2	2	2	2
Asteraceae	*Chrysocephalum*	*apiculatum*	N	2	2	2	1	
Asteraceae	*Glossocardia*	*bidens*	N					
Asteraceae	*Stuartina*	*muelleri*	N					
Asteraceae	*Vittadinia*	*dissecta var. hirta*	N					
Asteraceae	*Vittadinia*	*cuneata var. cuneata*	N	2				
Asteraceae	*Vittadinia*	*sulcata*	N			3		
Asteraceae	*Vittadinia*	*gracilis*	N					
Asteraceae	*Xerochrysum*	*viscosum*	N					
Boraginaceae	*Heliotropium*	*europaeum**	N					
Campanulaceae	*Wahlenbergia*	*sp.*	N		2			

Family	Genus	Species	N or E	M01	M02	M03	M04	Reveg area
Campanulaceae	*Wahlenbergia*	*gracilis*	N					2
Chenopodiaceae	*Atriplex*	*sp.*	N			2		
Chenopodiaceae	*Dysphania*	*pumilio*	N		2			
Chenopodiaceae	*Einadia*	*nutans subsp. nutans*	N				2	
Chenopodiaceae	*Einadia*	*nutans subsp. linifolia*	N	1			3	
Chenopodiaceae	*Enchylaena*	*tomentosa*	N			2		
Chenopodiaceae	*Maireana*	*villosa*	N		1			
Chenopodiaceae	*Maireana*	*microphylla*	N				1	
Chenopodiaceae	*Maireana*	*enchylaenoides*	N	2	1		1	
Chenopodiaceae	*Rhagodia*	*spinescens*	N				2	
Chenopodiaceae	*Salsola*	*australis*	N	1		2		2
Chenopodiaceae	*Sclerolaena*	*birchii*	N		2	2	2	
Chenopodiaceae	*Sclerolaena*	*bicornis var. bicornis*	N	2			2	
Chenopodiaceae	*Sclerolaena*	*sp.*	N			2		
Convolvulaceae	*Convolvulus*	*recurvatus subsp. recurvatus*	N	2	2		1	2
Cupressaceae	*Callitris*	*glaucophylla*	N	2	3	4	3	
Euphorbiaceae	*Euphorbia*	*drummondii*	N	1	1		1	2
Fabaceae - Mimosoideae	*Acacia*	*deanei subsp. deanei*	N					1
Geraniaceae	*Erodium*	*crinitum*	N					
Goodeniaceae	*Goodenia*	*cycloptera*	N	2				
Lamiaceae	*Teucrium*	*racemosum*	N	2				
Lomandraceae	*Lomandra*	*effusa*	N					
Malvaceae	*Abutilon*	*oxycarpum*	N				1	
Malvaceae	*Abutilon*	*halophilum*	N	2	2	2		2
Malvaceae	*Brachychiton*	*populneus subsp. trilobus*	N					
Malvaceae	*Sida*	*cunninghamii*	N	2	2	2	2	2
Malvaceae	*Sida*	*corrugata*	N			1	1	
Myrtaceae	*Eucalyptus*	*populnea subsp. bimbil*	N	1		2	3	
Nyctaginaceae	*Boerhavia*	*dominii*	N					
Oxalidaceae	*Oxalis*	*perennans*	N			2		2
Poaceae	*Aristida*	*jerichoensis var. subspinulifera*	N	2	3			

Family	Genus	Species	N or E	M01	M02	M03	M04	Reveg area
Poaceae	*Austrostipa*	*scabra subsp. scabra*	N	2	2	3	2	2
Poaceae	*Dichanthium*	*sericeum*	N					1
Poaceae	*Digitaria*	*brownii*	N			3		
Poaceae	*Digitaria*	*divaricatissima*	N	2				1
Poaceae	*Enneapogon*	*avenaceus*	N					2
Poaceae	*Enteropogon*	*acicularis*	N					
Poaceae	*Panicum*	*decompositum*	N				2	
Poaceae	*Panicum*	*effusum*	N	2	2		1	1
Poaceae	*Paspalidium*	*constrictum*	N					
Poaceae	*Sporobolus*	*contiguus*	N					
Poaceae	*Thyridolepis*	*mitchelliana*	N	2	2			
Poaceae	*Tragus*	*australianus*	N	1	2			
Portulacaceae	*Portulaca*	*oleracea*	N					2
Proteaceae	*Hakea*	*tephrosperma*	N	1				
Pteridaceae	*Cheilanthes*	*sieberi subsp. sieberi*	N					
Rutaceae	*Geijera*	*parviflora*	N			1		
Sapindaceae	*Dodonaea*	*viscosa subsp. mucronata*	N				1	
Scrophulariaceae	*Eremophila*	*longifolia*	N	2	1			
Scrophulariaceae	*Eremophila*	*mitchellii*	N			1		
Solanaceae	*Solanum*	*ellipticum*	N					
Solanaceae	*Solanum*	*eremophilum#*	N					
Solanaceae	*Solanum*	*esuriale*	N	1	1	1		2
Zygophyllaceae	*Tribulus*	*micrococcus*	N					
Zygophyllaceae	*Tribulus*	*minutus*	N					

Key: N = Native, E = Exotic

* 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	*Eolophus roseicapilla*	Galah	Observed in the site
	Cacatua sanguinea	Little Corella	Observed in the site
	Psephotus haemotonotus	Red-rumped Parrot	Observed in the site
	Ptilotula penicillatus	White-plumed Honeyeater	Observed in the site
	Struthidea cinerea	Apostlebird	Observed in the site
	Cracticus tibicen	Australian Magpie	Observed in the site
Mammals	*Macropus giganteus*	Eastern Grey Kangaroo	Observed in the 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.