Koala Habitat Rehabilitation Monitoring Report

ORU 8th Monitoring Period Yarrabilba

EPBC Number:	2013/6791
Project Name:	Yarrabilba
Proponent's ACN:	103 578 436
Prepared for:	Lendlease
Prepared by:	Dr M.N. Runkovski, K. Leopold & K. Richardt
Date:	10 December 2021

Proposed Action: To construct the Yarrabilba residential development and associated infrastructure approximately 40 kilometres south east of Brisbane, Queensland (see EPBC Act referral 3013/6791 and request to vary proposal dated 5 August 2013)

Natura Pacific – Document Control Sheet

Project	
Title:	**Habitat Rehabilitation Management Report – Offset Area 8th Monitoring Period**
Authors:	**Dr M.N. Runkovski, K Leopold and K Richardt**
Mapping:	**Dr M.N. Runkovski**
File reference:	**NCO11-0011_Yarrabilba**
Project leader	**K. Richardt**
Phone:	**+(61) 7 557 65568, +(61) 4 1541 3408**
Email:	**kieran@natura-pacific.com**
Client:	**Lendlease**
Client contact:	**Graeme Knox**
Contact:	**Graeme.Knox@lendlease.com**
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NATURA PACIFIC
PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
info@natura-pacific.com www.natura-pacific.com

Contents

List of Figures

List of Tables

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1 Executive summary

Natura Pacific has developed this *Habitat Rehabilitation Monitoring Report* as the 8th monitoring report after: initial baseline, 6 month, 2nd, 3rd, 4th, 5th, 6th and 7th monitoring period reports for rehabilitation within the Yarrabilba offset requirement areas as prescribed in the *Habitat Rehabilitation and Management Plan* (Natura Consulting, March 2015) and the Approval Conditions set out under the *Environmental Protection and Biodiversity Conservation Act 1999* dated 13 November 2014.

The intent of this report is to provide monitoring information to direct the rehabilitation works associated with Koala habitat within the Fauna Corridor, Greenspace Corridor and Environmental Protection Zones of the Yarrabilba Priority Development Area (PDA). Pine tree removal and assisted natural regeneration commenced six months prior to the 2nd monitoring period and has been ongoing in response to successive monitoring reports. The areas to be rehabilitated are offset requirement areas, ensuring that Koala habitat is specifically maintained within the 195 ha offset area. This report provides the 8th monitoring period data for the rehabilitation of the offset areas, with 59 sites, consistent with the 7th monitoring period, all monitored within an area of 198.2 ha in the Yarrabilba footprint. Each monitoring site is located within an offset area rehabilitation unit (ORU1 to ORU23) including road crossing rehabilitation units (CRU8, CRU11 and CU15), with the pre-clearing Regional Ecosystem (RE), management type and corridor type tabulated.

Each rehabilitation unit is to be rehabilitated to a vegetation structure and species composition that is in line with that of the pre-existing (pre-clearing) Regional Ecosystems (REs). This is derived from the vegetation structure and species composition of the appropriate pre-clearing RE. The final benchmark for rehabilitation is derived from the definition of remnant vegetation under the *Vegetation Management Act 1999* (canopy is 70% of the height, 50% of the cover and similar species composition of the appropriate pre-clearing RE). Interim benchmarks are also provided whereby an assessment at regular intervals will be made on the progress of the rehabilitation / revegetation efforts towards achieving this plan's outcomes. For interim benchmark years 1 to 10, vegetation structure has been quantified from a cumulative growth curve (CGC). The reference benchmark, interim benchmarks and final benchmarks have been tabulated for each RE, with the relevant rehabilitation unit also identified.

Contingency measures and corrective actions have also been provided to account for instances of when interim benchmarks are not being met. 'As constructed' data and surveyed boundaries will also be provided for each rehabilitation unit to test and demonstrate compliance within the offset area (195 ha) requirement.

The monitoring methodology that is applied has been detailed, where a minimum of two monitoring sites per rehabilitation unit has been surveyed in order to document and assess rehabilitation through time. The final locations of the 59 monitoring sites have been mapped. Monitoring includes photo point monitoring, transect and quadrat monitoring to monitor changes in species richness, percentage foliage cover for the ground layer, shrub and canopy, woody strata average height and weed cover.

An assessment of site species richness and structure was undertaken to determine the 8th monitoring period condition against previous monitoring and benchmark values. With seven monitoring periods now undertaken, it will be possible to observe trends in the data, however, the analyses made within this report are relatively basic, to identify high priority areas and guide management recommendations for different ORU and CRU based on a number of variables and RE benchmark indicators. Regardless of results in this report, ongoing passive and active management, weed control and maintenance of fencing is required to ensure restoration practices are effective within the offset areas.

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Overall, compared to the 7th monitoring period, improvements in general ecological health remained varied across offset sites, with a trend for improvement indicating continued recovery following on from extremely dry seasonal conditions experienced in the 6th monitoring period. There was a continued significant increase in the number of sites that improved for species richness, supporting the findings of overall improvement. This was also reflected by a 15.3% increase in the number of sites meeting the final benchmark for species richness. There was an overall trend for improvement in canopy cover (16 sites improved), shrub height (28 sites improved) and native ground cover (25 sites improved). Variables with most notable declines were shrub cover (27 sites declined) and contrastingly, shrub height (10 sites declined). The remaining variables had remained relatively stable since the 7th monitoring period. Overall the changes observed in this monitoring period may be attributed to continued recovery of the ground layer following return of more favourable climate conditions, recruitment of lower order structural layers into higher order structural layers (i.e. movement of shrubs into T2-T3 layers) and flourishing of weed species due to favourable conditions.

Of the 59 sites, a total of 34 sites meet a benchmark for T1 canopy tree cover, 34 sites meet a benchmark for T1 canopy tree height, 58 sites meet a benchmark for T2-T3 small tree cover and 57 sites meet a benchmark for T2-T3 small tree height, 42 sites meet a benchmark for shrub cover, 57 sites meet a benchmark for shrub height, 55 sites meet a benchmark for ground cover and 31 sites meet a benchmark for weed cover of the ground layer.

In summary, this assessment reveals that rehabilitation needs to continue, with a focus on **5 top priority Rehabilitation Units within four precincts**, determined from sites that are in poorest condition, have made the least improvements or fail to meet the weed cover benchmark in accordance with IMO-3 benchmark targets for this 3 year, 8th monitoring period (see Table 11). **An additional 6 'least improved' or 'greatest decline' Rehabilitation Units are recommended for management (lower priority)** to reduce weed cover and carry out infill planting to continue benchmark improvements in one or more areas. Recommendations aim to assist natural regeneration and prevent weed spread and incursion, particularly in sensitive precinct areas adjacent to the Plunkett Conservation Reserve through targeted weed control including the most abundant weed species - *Lantana camara* (woody shrub), *Andropogon virginicus* (graminoid), *Passiflora suberosa* (vine), *Ageratum houstonianum* (herb), *Setaria sphacelata* (graminoid) and *Lantana montevidensis* (herb) as well as targeted removal of *Pinus elliotti* from upper strata layers where present. In addition, infill planting is to be considered during favourable seasonal conditions to support long term benchmark goals and continue improving benchmark results within appropriate strata, with suitable species as recommended in previous rehabilitation monitoring reports (incl. shrubs) that will support the primary focus of assisted natural regeneration.

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2 Introduction

2.1 Background

The Yarrabilba development site is located on the eastern side of Waterford - Tamborine Road and to the south of Logan Village (refer to Figure 1). It is bounded by rural residential areas to the north, Plunkett Road to the south and the Plunkett Conservation Park to the east. The site consists of approximately 2,200 ha, of which 1,931 ha is controlled by Lendlease Communities (Yarrabilba) Pty Ltd. The land has been historically used for pine forestry, a military training camp in WWII and for livestock grazing, when first cleared. Yarrabilba is predominately vegetated with areas of regrowth native vegetation, regenerating pines and exotic grasslands. Some limited areas of native remnant and regrowth vegetation exist but they are mostly confined to creeks, drainage channels and wetlands.

The site is currently in the early stages of development with the growth of Yarrabilba projected to span approximately 30 years. The long-term master-planned development incorporates an extensive network of dedicated open space (in excess of 25% of the site). A significant component of the open space is dedicated to the conservation of habitat for Koalas (*Phascolarctos cinereus*).

Habitat rehabilitation is intended to improve Koala habitat quality within the site in order to significantly increase the site's carrying capacity in the medium to long term. In addition, the configuration of key elements of the open space system (Fauna Corridor, Greenspace Corridor and Environmental Protection Zone) will enhance the site's contribution to Koala movement opportunities within the context of larger areas of Koala habitat to the east and west of the site (Austecology 2012). Under the development of Yarrabilba, the majority of existing fragments of remnant vegetation which have value for koalas will be earmarked to be retained (approximately 5.4% of the total site area) (Austecology 2012). The rehabilitation of the Fauna Corridor, Greenspace Corridor and Environmental Protection Zone will significantly expand on these values by providing additional Koala habitat (Natura Consulting 2011).

This report provides the 8th monitoring data for the rehabilitation of offset areas in the development site, based on the 59 sites monitored.

2.2 Objectives

The intent of this report is to provide data with which to assess the rehabilitation of Koala habitat within the Offset Requirement area, which includes Fauna Corridor, Greenspace Corridor and Environmental Protection Zone.

This report is consistent with the *Habitat Rehabilitation and Management Plan* (Natura Consulting 2015), *Offset Management Plan* (Austecology 2015), *Koala Management Plan* (Austecology 2012) and *Fauna Corridor Infrastructure Master Plan* (Natura Consulting 2011). In particular the objectives of this report are to:

- describe the rehabilitation areas and provide clear and concise rehabilitation outcomes and performance indicators against which achievement of the rehabilitation will be measured
- identify contingency measures and appropriate corrective actions that will be undertaken if the performance indicators or outcomes are not being met
- outline the monitoring methodology including monitoring site locations
- assess whether rehabilitation is on-track to meet the next interim performance indicator

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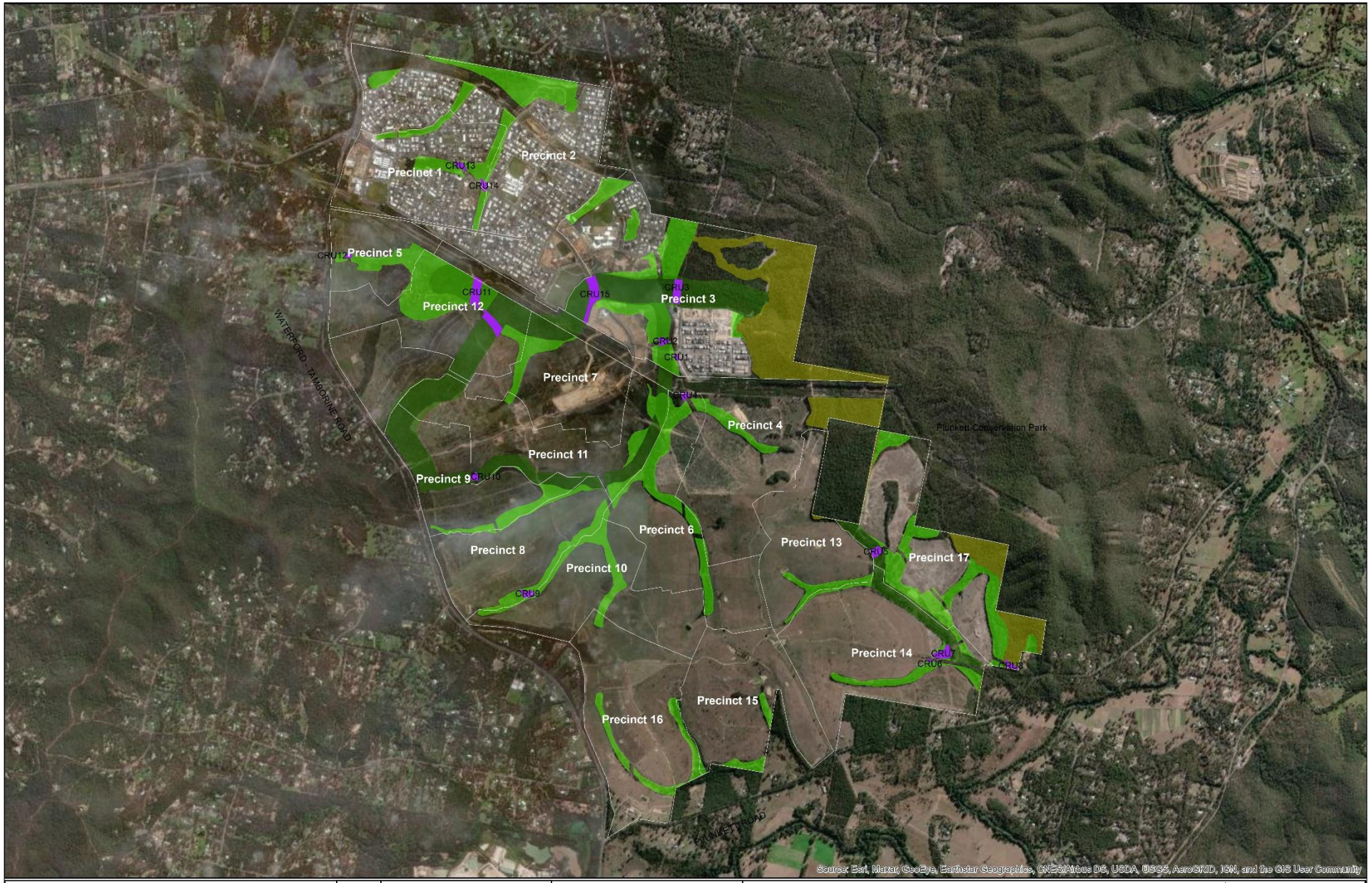
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Precinct 15
Precinct 16
Precinct 17
CRU1
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CRU5
CRU6
CRU7
CRU8
CRU9
CRU10
CRU11
CRU12
CRU13
CRU14
CRU15
WATERFORD - TAMBORINE ROAD
PLUNKETT ROAD
Plunkett Conservation Park
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Meters
Yarrabilba PDA Precincts
Conservation Areas
Fauna Corridor
Greenspace Corridor
Road Crossing Rehab Unit
Figure 1:
Yarrabilba Layout

3 Rehabilitation areas

3.1 Purpose of habitat rehabilitation

Koala habitat rehabilitation is to be undertaken within "Existing Assessable Koala Habitat to be protected and managed" and "Offset Areas" within Fauna Corridors, Greenspace Corridors and Environmental Protection Zones. This totals an area of 1,981,771 m^2 (198.2 ha) in the offset areas and an additional 754,657 m^2 (75.5 ha) within existing assessable Koala habitat areas outside of offset areas, comprising a combined area of 2,736,428 m^2 (273.6 ha) to be rehabilitated.

The Koala habitat rehabilitation area has been divided into offset rehabilitation and habitat rehabilitation units and crossing rehabilitation units. This report is relevant to the offset and crossing rehabilitation units only.

3.2 Offset rehabilitation units (ORU)

Koala habitat rehabilitation is to occur within offset rehabilitation units as shown in Figure 2. Each rehabilitation unit (ORU1 to ORU23) is a mapped polygon, where the polygon boundaries are the mapped Pre-Clearing Regional Ecosystems. The Regional Ecosystem (RE) code applicable to each unit was determined by overlapping Pre-Clearing Regional Ecosystem mapping (Queensland Government 2015b) with Offset Requirement area mapping within the Fauna Corridors, Greenspace Corridors and Environmental Protection Zones.

The Table 1 presents a summary of rehabilitation unit attributes, including:

- the area of the rehabilitation unit in square metres
- the corridor within which the rehabilitation unit is located
- the RE code for pre-clearing vegetation within the rehabilitation unit and the landzone / geology of the rehabilitation unit

It is noted that the minimum rehabilitation unit size is ~2,500 m^2 to reflect the mapping limitation of the Pre-Clearing Regional Ecosystems mapping dataset (Queensland Government 2015a).

3.3 Crossing rehabilitation units (CRU)

Rehabilitation and monitoring will also be undertaken where road and infrastructure is proposed to traverse an Offset Requirement area. Crossing rehabilitation units have been identified by overlaying the proposed internal road network (currently under review) with the Pre-Clearing Regional Ecosystem mapping (Queensland Government 2015a) and Offset Requirement area mapping. Each crossing rehabilitation unit (CRU1 to CRU15) is a mapped polygon overlayed over offset rehabilitation units. It is noted that these locations are indicative and may change with the final alignment of roads. Table 2 presents a summary of the crossing rehabilitation units, which are subject to rehabilitation actions outlined in this report.

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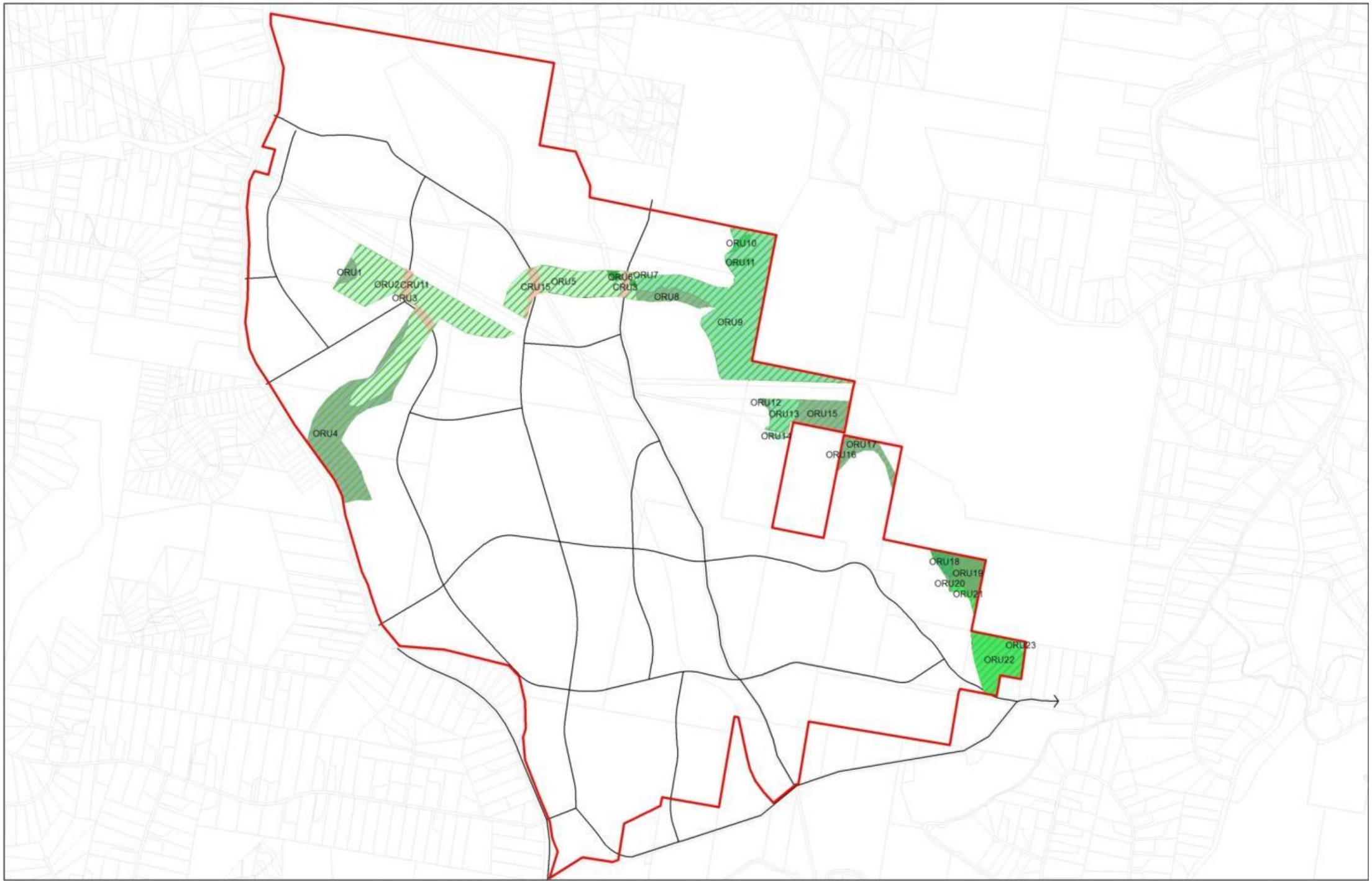

Figure 2 Rehabilitation Units within Offset Requirement areas (OR1-OR23) and road crossings (CRU3, CRU11 and CRU15)

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Table 1 Offset rehabilitation units (ORU) within the corridor network

Rehab. Unit	Area (m^2)	Corridor Type	RE Code(s)	Landzone / Geology
ORU1	16,933	Greenspace Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU2	439,297	Fauna Corridor / GreenSpace Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU3	1,451	Fauna Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks - undulating country on fine grained sedimentary rocks
ORU4	269,317	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7 12.9-10.17 / 12.9-10.2	Recent quaternary alluvial systems – alluvial river and creek flats and Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU5	201,530	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU6	10,205	Fauna Corridor	12.3.11 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU7	7,264	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU8	46,711	Fauna Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU9	513,080	Environmental Protection / Fauna Corridor	12.9-10.17 / 12.9-10.19	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU10	8, 777	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU11	8,324	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU12	46,711	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU13	49,644	Environmental Protection	12.9-10.17 / 12.9-10.19 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU14	4,286	Environmental Protection	12.9-10.17 / 12.9-10.19 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU15	80,800	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks

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Rehab. Unit	Area (m^2)	Corridor Type	RE Code(s)	Landzone / Geology
ORU16	4,708	Environmental Protection	12.9-10.17 / 12.9-10.19	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU17	47,475	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU18	24,352	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU19	59,917	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU20	3,154	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks - undulating country on fine grained sedimentary rocks
ORU21	13,374	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU22	118,260	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU23	6,201	Environmental Protection	12.11.5	Recent quaternary alluvial systems – alluvial river and creek flats
Area	**1,981,771**			

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Table 2 Road and infrastructure crossing rehabilitation units (CRU) traversing offset rehabilitation units (ORU)

Crossing Rehab. Unit	Area (m^2)	Traversing ORU	Corridor Type	RE Code(s)	Landzone / Geology
CRU3	12,578	ORU5, ORU6, ORU7, ORU9	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
CRU11	31,324	ORU2	Fauna Corridor	12.3.11 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
CRU15	22,138	ORU5	Greenspace Corridor / Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
Area	**66,040**				

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3.4 Pre-clearing Regional Ecosystems rehabilitation units

A short description of the pre-clearing Regional Ecosystems (RE) identified in the offset rehabilitation units and crossing rehabilitation units is provided in Table 3.

Table 3 Summary of pre-clearing Regional Ecosystems (RE) within offset rehabilitation units and crossing rehabilitation units

RE Code	RE short description (extract from Qld Herbarium RE Description Database)	*Vegetation Management Act* Class	Biodiversity Status
12.3.6	*Eucalyptus tereticornis, Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland	Least concern	No concern at present
12.3.7	*Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens* open forest on coastal alluvial plains	Least concern	No concern at present
12.3.11	*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia, Corymbia intermedia* open forest on alluvial plains	Of concern	Of concern
12.9-10.2	*Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks	Least concern	No concern at present
12.9-10.4	*Eucalyptus racemosa* subsp. *racemosa* woodland on sedimentary rocks	Least concern	No concern at present
12.9-10.12	*Eucalyptus seeana, Corymbia intermedia, Angophora leiocarpa* woodland on sedimentary rocks	Endangered	Endangered
12.9-10.17	*Eucalyptus acmenoides, E. major, E. siderophloia* +/- *Corymbia citriodora* subsp. *variegata* woodland on sedimentary rocks	Least concern	No concern at present
12.9-10.19	*Eucalyptus fibrosa* subsp. *fibrosa* woodland on sedimentary rocks	Least concern	No concern at present
12.11.3	*Eucalyptus siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics	Least concern	No concern at present
12.11.5	*Corymbia citriodora* subsp. *variegata*, *Eucalyptus siderophloia, E. major* open forest on metamorphics +/- interbedded volcanics	Least concern	No concern at present

(Source: QLD Government 2015a)

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4 Rehabilitation performance indicators

In accordance with the *EPBC Act 1999* decision notice, the Koala Habitat Rehabilitation Management Plan (Natura Consulting 2015) has been formulated reflecting the onsite rehabilitation requirements of Fauna and Green Space Corridors, Regional Ecosystems, drainage lines and post development fauna movement pathways within Offset Areas on the site. This plan identifies Koala habitat rehabilitation benchmarks and determines restoration actions to meet these benchmarks.

Each rehabilitation unit is to be rehabilitated to a vegetation structure and species composition that is in line with that of the appropriate pre-clearing RE (Table 4). The reference benchmark for rehabilitation of each rehabilitation unit is derived from the vegetation structure and species composition of the appropriate pre-clearing Regional Ecosystem (RE) (Table 4). These benchmarks quantify average canopy cover, shrub cover, ground cover, species richness and average height of the canopy and have been sourced from the Queensland Herbarium (Queensland Government 2015a). These technical descriptions are a compilation of data from multiple sites for canopy cover, shrub cover, and average stem density for each strata, groundcover and average species richness (Queensland Government 2015a). Through establishing these benchmarks, a reasonable comparison can be made between the floristic composition and vegetation structure of a given rehabilitation unit and the appropriate pre-clearing RE.

4.1 Performance indicators

The final benchmark for rehabilitation is derived from the definition of remnant vegetation under the *Vegetation Management Act 1999.* Vegetation can be mapped as remnant vegetation and associated essential habitat for Koalas if the canopy is 70% of the height, 50% of the cover and similar species composition of the appropriate pre-clearing RE (Queensland Government 2015a). Therefore, the final benchmark for rehabilitation is 50% of the reference benchmark cover (for canopy, shrub and ground-layer) and 70% of the reference benchmark height (for canopy and shrub layer) of the appropriate RE.

Six rehabilitation performance indicators were selected:

1) average canopy cover
2) average height of canopy
3) dominant canopy species
4) average shrub cover
5) average groundcover
6) species richness
7) weed cover

Weed cover needs to be considered for rehabilitation benchmarks for this site, particularly in the canopy where mature exotic pine trees remain. Throughout the life of the development a weed cover of ≤5% is to be reached, and then maintained.

The reference and final benchmark vegetation structure and species composition for each of the pre-clearing RE's identified within the mapped rehabilitation units is identified in Table 4. Note that exotic species identified in Table 4 are to assist with identification purposes only and are to be controlled and managed, not planted or assisted.

Rehabilitation units are to be managed and restored until they reach the final benchmark condition as identified in Table 4 and objectives of the Habitat Rehabilitation and Management Plan. The objectives of this plan are long term and are likely to require more than 15 years to be achieved, within each rehabilitation unit, after commencement of implementation.

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Interim benchmarks are also provided whereby an assessment at regular intervals can be made on the progress of the rehabilitation / revegetation efforts towards achieving this plan's outcomes. Given this, adaptive management approaches can also be employed to redirect restoration approaches, in the event that interim benchmarks are not being met. Table 4 provides a summary of the timeframe to achieve the interim and final benchmarks.

For Interim Benchmark years 1 to 10, vegetation structure has been quantified from a cumulative growth curve (CGC), which for biological organisms including trees and shrubs, is sigmoidal. As the reference benchmarks applied for this report are at the Regional Ecosystem level and site data and long term tree and shrub growth curves are not available for Yarrabilba, we have derived general growth curves for each Regional Ecosystem. This is based on a sigmoidal growth curve, the average reference benchmark height of the stratum, the minimum height at which regrowth vegetation is considered to be of equivalent height as the RE (50% of reference benchmark height), and the average height of tubestock (20 cm) that is predominately used for revegetation in southeast Queensland.

The final benchmark at year 15 is 70% of the reference benchmark cover (for canopy, shrub and ground-layer) and 50% of the reference benchmark height (for canopy and shrub layer) of the appropriate pre-clearing RE.

4.2 Contingency measures and corrective actions

4.2.1 Meeting benchmarks

During the course of monitoring, if interim benchmarks are not being met, the timeframes to achieve the final benchmarks will be reviewed and extended, whereby Lendlease will continue to undertake rehabilitation works with continued monitoring until the final benchmarks are met. The review of the success of meeting interim benchmarks will be undertaken at each monitoring event and reported on. Where the extension of rehabilitation works is required for particular rehabilitation units, discussions will be undertaken with the Department of Environment, to ensure that any additional requirements are also highlighted and addressed.

4.2.2 As constructed data

Constructed data and surveyed boundaries will be provided for each rehabilitation unit, within three months of completion of earthworks. This will be undertaken to test and demonstrate compliance within the offset area (195 ha) requirement.

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Table 4 Reference, interim and final benchmark vegetation structure for each pre-clearing RE detailed for rehabilitation units (ORU and HRU) and crossing rehabilitation units (CRU)

Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)											
RE Code	**Name**	**Status (VMA)**	**Biodiversity Status**	**Offset Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
12.3.6	***Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens* open forest on coastal alluvial plains**	Least concern	No concern at present	ORU2, ORU4, ORU5, ORU7				CRU3, CRU15			
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				10.0	1.5			1.5	0.5	6.0	
Interim Benchmark by 2 years				14.0	3.0			2.0	0.8	10.0	
Interim Benchmark by 3 years				16.0	4.0			2.5	1.2	15.0	
Interim Benchmark by 5 years				22.0	6.0			3.0	1.4	20.0	
Interim Benchmark by 10 years				28.0	9.2			4.0	1.5	25.0	
Final Benchmark by 15 years				**30.5**	**10.7**			**4.5**	**1.6**	**29.2**	**-**
Reference Benchmark (Pre-Clearing RE)				**60.9**	**15.3**			**8.9**	**2.3**	**58.4**	**33.3 +/- 10.5**
12.3.7	***Eucalyptus tereticornis*, *Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland**	Least concern	No concern at present	ORU2, ORU4, ORU5, ORU6, ORU7				CRU3, CRU11, CRU15			
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				5.5	1.6	2.0	0.8	2.5	0.5	6.0	
Interim Benchmark by 2 years				6.0	2.9	3.0	2.7	3.0	0.8	7.0	
Interim Benchmark by 3 years				7.0	4.1	4.0	3.7	3.5	1.2	8.0	
Interim Benchmark by 5 years				9.0	6.2	5.9	5.2	4.0	1.4	10.0	
Interim Benchmark by 10 years				12.0	10.1	9.3	7.3	6.0	1.5	12.0	
Final Benchmark by 15 years				**13.3**	**13.6**	**11.5**	**8.2**	**6.6**	**1.6**	**14.4**	**-**
Reference Benchmark (Pre-Clearing RE)				**26.6**	**19.4**	**15.3**	**9.0**	**13.2**	**2.3**	**28.7**	**52.8 +/- 7.5**
12.3.11	***Eucalyptus tereticornis* +/-**	Of concern	Of concern	ORU2, ORU4, ORU5, ORU6, ORU7				CRU3, CRU11, CRU15			

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PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
info@natura-pacific.com www.natura-pacific.com

Benchmark Condition
(where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)

RE Code	Name	Status (VMA)	Biodiversity Status	Offset Rehabilitation Unit				Crossing Rehabilitation Unit			
	***Eucalyptus siderophloia*, *Corymbia intermedia* open-forest on alluvial plains**			**Average Canopy Cover (%)**	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				7.0	1.6	2.0	0.8	2.0	0.4	1.5	
Interim Benchmark by 2 years				10.0	3.0	3.0	2.8	4.0	0.7	2.0	
Interim Benchmark by 3 years				12.0	4.2	4.2	3.8	5.0	1.1	3.0	
Interim Benchmark by 5 years				18.0	6.4	6.4	5.5	7.0	1.3	4.5	
Interim Benchmark by 10 years				22.0	10.7	10.7	8.2	9.0	1.5	7.0	
Final Benchmark by 15 years				**25.6**	**16.7**	**13.9**	**9.6**	**10.9**	**1.9**	**8.5**	**-**
Reference Benchmark (Pre-Clearing RE)				**51.1**	**23.8**	**23.9**	**11.3**	**21.7**	**2.7**	**17**	**40.6 +/- 8.5**

12.9-10.2	***Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks**	Least concern	No concern at present	ORU1, ORU3, ORU4, ORU8, ORU12, ORU13, ORU14, ORU15, ORU17, ORU20							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				6.0	1.6	2.0	0.8	6.0	0.4	6.0	3.0
Interim Benchmark by 2 years				10.0	2.9	2.9	2.8	6.5	0.7	7.0	4.0
Interim Benchmark by 3 years				12.0	4.2	4.0	3.8	7.0	1.1	12.0	5.0
Interim Benchmark by 5 years				18.0	6.3	6.0	5.3	8.5	1.3	18.0	7.0
Interim Benchmark by 10 years				22.0	10.5	9.6	7.7	11.4	1.5	22.0	9.0
Final Benchmark by 15 years				**26.8**	**15.5**	**11.9**	**8.9**	**15.1**	**1.8**	**23.6**	**10.8**
Reference Benchmark (Pre-Clearing RE)				**53.5**	**22.2**	**16.5**	**10.1**	**21.6**	**2.5**	**47.2**	**21.6**

12.9-10.17	***Eucalyptus acmenoides, Eucalyptus major,***	Least concern	No concern at present	ORU1, ORU3, ORU4, ORU8, ORU9, ORU10, ORU11, ORU12, ORU13, ORU14, ORU15, ORU16, ORU17,	

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PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
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Benchmark Condition
(where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)

RE Code	Name	Status (VMA)	Biodiversity Status	Offset Rehabilitation Unit				Crossing Rehabilitation Unit			
	***Eucalyptus siderophloia* +/- *Corymbia citriodora subsp. variegata* woodland on sedimentary rocks**			ORU18, ORU20							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				6.0	1.6	2.0	0.8	6.0	0.6	10.0	
Interim Benchmark by 2 years				10.0	3.0	3.0	2.8	7.0	1.0	20.0	
Interim Benchmark by 3 years				12.0	4.2	4.3	3.9	10.0	1.5	25.0	
Interim Benchmark by 5 years				18.0	6.4	6.5	5.7	14.0	1.8	30.0	
Interim Benchmark by 10 years				22.0	10.9	11.3	8.9	16.0	2.2	35.0	
Final Benchmark by 15 years				**27.2**	**18.2**	**15.0**	**10.4**	**20.0**	**2.8**	**43.9**	-
Reference Benchmark (Pre-Clearing RE)				**54.3**	**26.0**	**30.5**	**12.9**	**40.0**	**4.0**	**87.8**	**36.5 +/- 15.1**

12.9-10.19	***Eucalyptus fibrosa subsp. fibrosa* woodland on sedimentary rocks**	Least concern	No concern at present	ORU9, ORU14, ORU16							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				6.0	1.6	2.0	0.8	2.5	0.4	2.5	
Interim Benchmark by 2 years				7.0	3.0	2.9	2.7	4.0	0.7	3.0	
Interim Benchmark by 3 years				9.0	4.2	4.0	3.7	5.0	1.1	4.0	
Interim Benchmark by 5 years				12.0	6.3	6.0	5.2	7.0	1.3	6.0	
Interim Benchmark by 10 years				15.0	10.5	9.6	7.3	9.0	1.5	8.0	
Final Benchmark by 15 years				**20.9**	**15.8**	**11.9**	**8.2**	**9.6**	**1.7**	**8.2**	-
Reference Benchmark (Pre-Clearing RE)				**41.8**	**22.5**	**16.4**	**9.0**	**19.1**	**2.4**	**16.4**	**30.1 +/- 4.6**

12.11.3	***Eucalyptus siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon***	Least concern	No concern at present	ORU19, ORU21, ORU22							
				Average T1 Canopy	**Average T1 Canopy**	**Average T2-T3**	**Average T2-T3**	**Average Shrub**	**Average Shrub**	**Average Ground**	**Species Richness**

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Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)											
RE Code	**Name**	**Status (VMA)**	**Biodiversity Status**	**Offset Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
	***confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics**			**Cover (%)**	**Height (m)**	**Canopy Cover (%)**	**Canopy Height (m)**	**Cover (%)**	**Height (m)**	**cover (%)**	**(av. +/- SD)**
Interim Benchmark by 1 year				6.0	1.6	1.6	1.0	1.5	0.4	3.0	
Interim Benchmark by 2 years				10.0	3.0	3.0	2.7	2.0	0.7	5.0	
Interim Benchmark by 3 years				14.0	4.2	4.2	3.6	2.5	1.1	7.0	
Interim Benchmark by 5 years				20.0	6.4	6.5	4.9	4.0	1.3	10.0	
Interim Benchmark by 10 years				25.0	10.8	11.2	6.8	4.5	1.5	12.0	
Final Benchmark by 15 years				**31.1**	**17.6**	**14.9**	**7.5**	**5.3**	**1.7**	**15.4**	-
Reference Benchmark (Pre-Clearing RE)				**62.1**	**25.2**	**30.0**	**8.0**	**10.5**	**2.4**	**30.8**	**55.1 +/ 15.4**

12.11.5	***Corymbia citriodora* subsp. *variegata*, *Eucalyptus siderophloia*, *E. major* open forest on metamorphics +/- interbedded volcanics**	Least concern	No concern at present	ORU19, ORU21, ORU22, ORU23							
				Average T1 Canopy Cover (%)	**Average T1 Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
Interim Benchmark by 1 year				6.0	1.6	1.6	1.0	0.5	0.4	8.0	
Interim Benchmark by 2 years				9.0	3.0	2.8	2.7	1	0.7	10.0	
Interim Benchmark by 3 years				12.0	4.2	3.8	3.7	1.5	1.1	14.0	
Interim Benchmark by 5 years				15.0	6.4	5.4	5.3	2	1.3	18.0	
Interim Benchmark by 10 years				18.0	10.8	7.9	7.7	2.5	1.5	20.0	
Final Benchmark by 15 years				**21.8**	**15.8**	**9.2**	**8.7**	**2.9**	**1.6**	**23.0**	-
Reference Benchmark (Pre-Clearing RE)				**43.5**	**22.5**	**10.6**	**9.9**	**5.8**	**2.3**	**46.0**	**48.0 +/ 12.3**

Adapted from Queensland Government (2015a) * No pre-defined benchmarks for this RE are provided within the RE technical descriptions (Queensland Government 2015) and therefore, these numbers have been based on data collected in the field from previous assessments and reference sites within this RE type.

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5 Monitoring methodology

The following monitoring program was implemented to capture baseline data prior to rehabilitation treatments being applied. Adaptive management strategies will be used where a rehabilitation treatment does not produce the desired result. When this occurs, the treatment will be identified and/or modified.

For this monitoring program, a minimum of two monitoring sites per rehabilitation unit is sufficient to identify any major changes and to provide a 'snap-shot' of ecological conditions. Monitoring in this way will allow the ongoing collection of information to demonstrate the effectiveness of habitat rehabilitation efforts, and the frequency of monitoring activities will enable management prescriptions to be adjusted to bring about any necessary changes and corrective actions (adaptive management).

5.1 Sites

Vegetation monitoring for the 8th monitoring period occurred in a network of 59 monitoring sites (refer to Tables 1 and 2). The final location of each monitoring site within its representative rehabilitation unit was identified by GPS coordinates and direction (compass bearing). Monitoring site locations are identified in Figure 3.

Site locations have been permanently marked by two steel pickets with yellow safety caps placed 50 m apart, measured using a 50 m stringline and marked at 10 m intervals with wooden stakes to ensure consistent replication. Each picket is clearly labelled identifying the site number.

Due to the vegetation clearing for road construction being undertaken in the Precinct 3 road corridor, two sites (site 55 and 58) were lost and needed to be relocated. Another two sites were able to be retained, with start points moved outside of the clearing footprint and new end points established respectively. This may not have an impact over the long-term goals of restoring sites to original RE, however the new sites selected appear to be highly degraded, potentially resulting in lower benchmark values.

The following methodology will be applied to monitor at each site.

5.2 Photo point monitoring

For each site, a permanently marked photo point has been established at the first marker picket. In previous monitoring rounds, a second marker picket at 10 m along the relevant compass bearing was used to assist with photo direction. This methodology has changed slightly with no difference in outcome observed - marker pickets were removed and all photos were taken such that the 0 m picket was located in the bottom left hand corner of the photo with the site number visible.

The photos were saved with the following information recorded for each file:

- site number
- survey (i.e. 8th mon.)
- date

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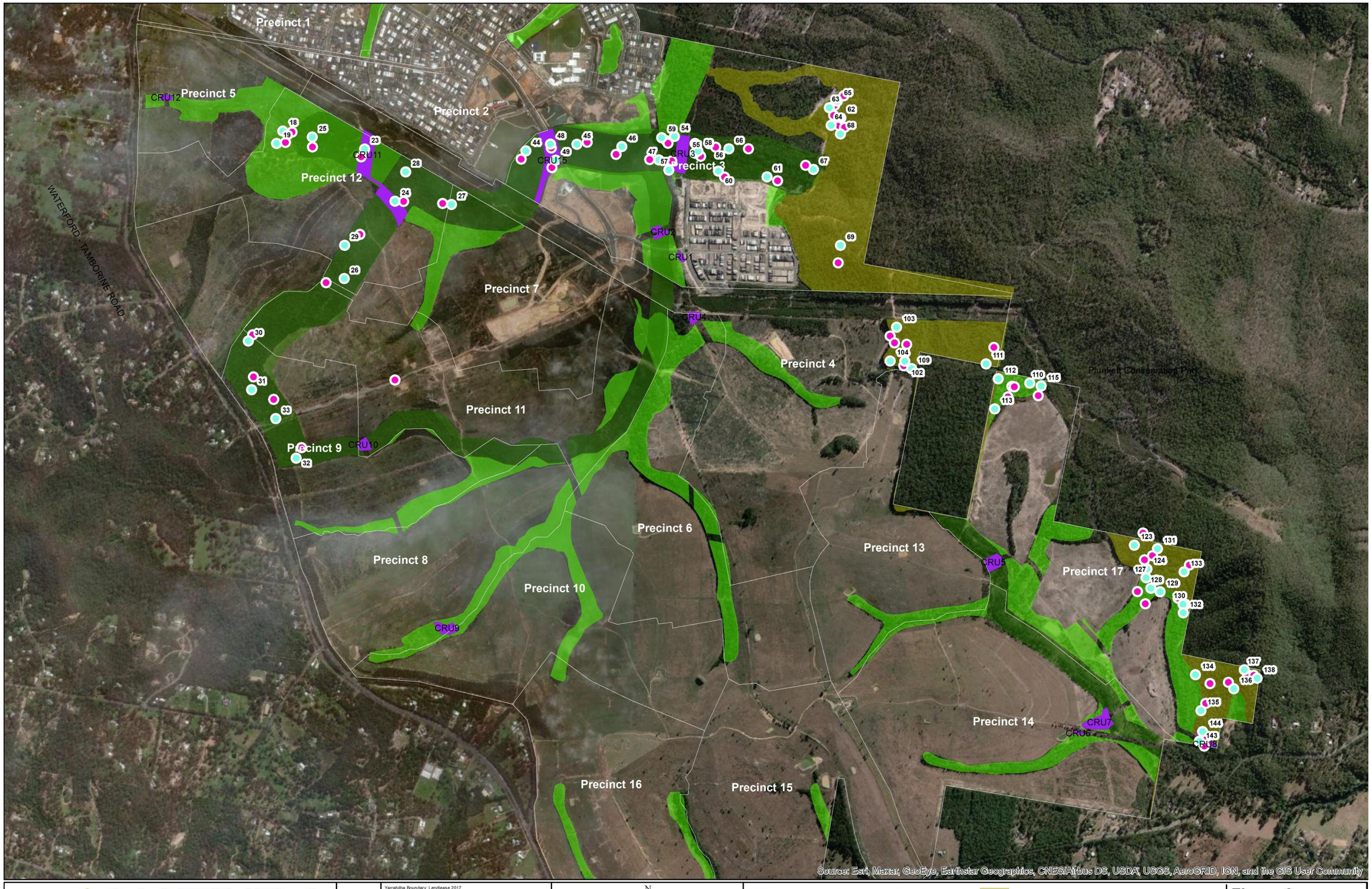

Source:	Yarrabilba Boundary: Lendlease 2017 Offset Areas: Lendlease 2015 Rehabilitation Units: Natura Consulting 2015 Aerial Imagery: ESRI ArcMap 2020
Desclaimer:	No warranty is given in relation the data (including accuracy, reliability, completeness, currency of suitability) and no liability is accepted (including without limitation liability in negligence) for any loss, damage or costs (including subsequent damage) relating to any use of the data. Data must not be used for direct marketing purposes or be used in breach of privacy laws.
File/Date:	Koala Offset Sites Date: 22/07/2020

N

0 105 210 420 630 840 Meters

Coordinate System: WGS 1984 Zone 56S Projection: Transerve Mercator

- Koala Offset Monitoring Sites (Start Posts)
- Koala Offset Monitoring Sites (End Posts)
- Yarrabilba PDA Precincts
- Conservation Areas
- Fauna Corridor
- Greenspace Corridor
- Road Crossing Rehab Unit

Figure 3: Koala Offset Area Monitoring Locations

5.3 Transect and quadrat monitoring

Quantitative site data, including the attributes of species richness, percentage foliage cover for the ground layer, shrub and canopy layers, canopy height, and weed cover are to be collected from field transects and quadrats established at each of the monitoring sites:

- A 50 m transect was placed between the 0 m and 50 m metal pickets. Ten metre intervals were marked permanently with wooden stakes that had flagging tape attached for high visibility.

- Quadrats were placed along the transect:
    - 50 x 10 m plot positioned at the transect starting at 0 m on the right hand side of the transect
    - 1 x 1 m subplots positioned at staked intervals 0 m, 10 m, 20 m, 30 m and 40 m. Adjustments were made for each subplot if its positioning was placed over a trunk, fallen tree or roots. Installation of permanent stakes ensures consistent sampling and adequate replication for data collection in future monitoring periods.

- When recording data, reference height ranges were used for allocating vegetation to different strata layers according to dominant pre-clearing RE allocated for the different rehabilitation units (ORU and HRU) and crossing rehabilitation units (CRU) (Table 5).

Table 5 Example reference height ranges used for classifying RE vegetation to respective strata layers

RE Type	Pre clearing height ranges (m)			
	Canopy (T1)	Small trees (T2-T3)	Shrub layer (S1)	Ground Layer (G1)
12.3.11	>19.1	5.1-19	1.26-5	<1.25
12.9-10.17	>13.1	6.1-13	0.76-6	<0.75
12.11.5	>17.5	4.6-17.5	1.2-4.5	<1.1

Given the above, each monitoring site had the information collected, as detailed in (Table 6). This benchmark monitoring process has also been undertaken at 1 year, 18 months, 2 years, 2.5 years, 3 years, 3.5 years, and 4 years (current monitoring period) post commencement and will continue at yearly intervals from this report, until significant progress has been achieved towards RE benchmark values. Reporting from each of the monitoring events shall be provided to the Department of Environment within 4 weeks of completion of monitoring.

Table 6 Data collected at monitoring sites

Method of collection	Data collected
50 m x 10 m quadrat (plot)	Species richness, tubestock survival, height of each canopy species
50 m transect	Canopy species cover (% Foliage Projected Cover (FPC)) and height, shrub cover (% FPC) and height
Five 1 x 1 m quadrats (subplot)	Percentage cover in ground layer (including regenerating native canopy cohorts)

Percent Foliage Projected Cover calculation:

$$\% \, FPC = \frac{total \; cover \; (m)}{transect \; length \; (m)} \times 100$$

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6 Results

6.1 Photo-point monitoring

Photo monitoring results for all surveyed sites, are reported in Table 7, indicating the variety of vegetation types and condition. This photo sample was considered representative of the entire transect in most cases, with the vegetation type and structure remaining fairly consistent throughout individual sites. Many of the sites are typically at an advanced state of natural regeneration with common canopy tree sized eucalypts and mixed Acacia species. In congruence with previous monitoring periods, the ground cover vegetation varies from mixed native grasses such as Bladey Grass (*Imperata cylindrica)* and Bracken Fern (*Pteridium esculentum),* mixed with exotic grass pasture in the understorey with sparse regenerating shrubs and trees to established woodland eucalypt forest with intact structure and diverse species composition.

A number of sites continue to show photographic evidence of *Lantana camara* infestations, with increased growth noticeable at sites 49, 29, 132, 135, 137 and 138, potentially attributable to favourable growth conditions following dry periods and fire observed in the 6th monitoring period. Felled and fallen trees can be seen within many of the photo monitoring points. A number of these are exotic pine (*Pinus elliottii*) which have been hand felled as part of the ongoing weed management process. There are several sites also containing immature *Pinus elliottii* in the understorey and shrub layers, including sites 23, 24, 26 and 115. A number of sites continue to be moderately vegetated with regrowth of mixed Acacia species, predominantly *Acacia leiocalyx* and *A. disparrima* (e.g. sites 44 and 47), however the density and cover of *Acacia* spp. appears to have continued decreasing at these sites. Site 66 is continuing to recover from fire experienced in the 6th monitoring period.

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PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
info@natura-pacific.com www.natura-pacific.com

Table 7 Photo monitoring images

Site 18 – taken 08/07/2020 (photo from prev. mon.)

Site 19 – taken 08/07/2020 (photo from prev. mon.)

Site 23 – 08/07/2021

Site 24 – 08/07/2021

Site 25 – 12/08/2021

Site 26 – 09/02/2021

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Site 27 – 08/07/2021

Site 28 – 08/07/2021

Site 29 – 17/08/2021

Site 30 – 09/02/2021

Site 31 – 09/02/2021

Site 32 – 09/02/2021

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Site 33 – 09/02/2021

Site 44 – 03/06/2021

Site 45 – 03/06/2021

Site 46 – 06/07/2021

Site 47 – 01/07/2021

Site 49 – 03/06/2021

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Site 54 – 28/07/2021

Site 55 – 02/06/2021: new start point, moved due to clearing for road corridor

Site 56 – 01/07/2021: new location, moved due to clearing for road corridor

Site 57 – 01/07/2021: new location, moved due to clearing for road corridor

Site 58 – 02/06/2021: new start point, moved due to clearing for road corridor

Site 59 – 28/07/2021

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Site 60 – 04/02/2021

Site 61 – 04/02/2021

Site 62 – 09/06/2021

Site 63 – 04/02/2021

Site 64 – 04/02/2021

Site 65 – 04/02/2021

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Site 66 – 02/06/2021

Site 67 – 04/02/2021

Site 68 – 01/07/2020 (photo from prev. mon.)

Site 69 – 09/06/2021

Site 102 – 09/06/2021

Site 103 – 09/06/2021

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Site 104 – 09/06/2021

Site 109 – 09/06/2021

Site 110 – 20/07/2021

Site 111 – 16/06/2021

Site 112 – 20/07/2021

Site 113 – 15/06/2021

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Site 115 – 15/06/2021

Site 123 – 08/06/2021

Site 124 – 08/06/2021

Site 127 – 08/06/2021

Site 128 – 08/06/2021

Site 129 – 01/06/2021

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Site 130 – 21/07/2021

Site 131 – 08/06/2021

Site 132 – 20/07/2021

Site 133 – 08/06/2021

Site 134 – 01/06/2021

Site 135 – 01/06/2021

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Site 136 – 08/06/2021

Site 137 – 16/06/2021

Site 138 – 16/06/2021

Site 143 – 01/06/2021

Site 144 – 01/06/2021

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6.2 Transect and quadrat monitoring

6.2.1 Native species richness

During the 8th monitoring period undertaken between February to July 2021, a total of **314 species** were recorded within different strata at the 59 monitoring sites in the Offset Area. This is an increase of 38 species from the 7th monitoring period. Species richness within sites ranged from 13 to 59 native species (minus weeds), with 30.7 species per site observed on average. There was **a 5.9% increase in average native species richness** since the 7th monitoring period. Site 127 continued to have the highest overall native species richness this monitoring period.

Canopy tree species (T1 stratum) totalled 18 species (1 species more than 7th monitoring period). Those most common across the offset area remained mostly consistent with 7th monitoring period and included *Eucalyptus siderophloia* (11 sites), *E. acmenoides* (10 sites), *E. resinifera* (6 sites) and *C. intermedia* (5 sites).

Small tree species (T2-T3) totalled 34 species (2 species more than 7th monitoring period). The most common species included *Lophostemon confertus, Acacia disparrima, L. suaveolens* and *E. siderophloia* (from highest to lower abundance).

Shrub species (S1 stratum) totalled 51 species (3 species more than 7th monitoring period). The most common native species included *Acacia leiocalyx, Alphitonia excelsa, A. disparrima, Lophostemon confertus,* and *L. suaveolens* (from highest to lower abundance). These were also among species most commonly represented in the 7th monitoring period. The exotic weed *Lantana camara* was also among the most common species recorded at sites.

In the ground layer, a total of 211 species were recorded (32 more than 7th monitoring period). The increase indicates continued recovery from the extreme dry conditions in the lead up to and during field visits for the 6th monitoring period. Species most commonly represented in the ground layer were typically consistent with the 7th monitoring period, with the addition of two ground cover species. These included *Lomandra longifolia, Lobelia purpurascens, Entolasia stricta, Cymbopogon refractus, Glycine clandestina, L. multiflora, Imperata cylindrica* and *Paspalidium distans* (from highest to lower abundance).

6.2.2 Weed species richness

Of all the species recorded, 54 were exotic weeds (13 more species than 7th monitoring period). Most of these were recorded in the ground layer with a single occurrence of *Pinus elliotti* in the T2 layer and four weed species recorded in the shrub layer. **At a number of sites, *Pinus elliotti* remained in the shrub layer (4 sites) and ground layer (12 sites).**

Weed species in the shrub layer included *Lantana camara, Cinnamomum camphora* (recruiting), *Pinus elliotti,* and *Passiflora suberosa* (from highest to lowest number of sites).

The ground layer contained 49 weed species (91% of all weed species recorded), including a combination of graminoids, herbs and woody weeds. The most common weed species in the ground layer had increased in the number of sites at which they were recorded since the 7th monitoring period. Moreover, the most common weeds were identical to those recorded in the 7th monitoring period. These included *Lantana camara* (42 sites, 1 more than 7th monitoring period), *Passiflora suberosa* (27 sites, 3 more than 7th monitoring period), *Andropogon virginicus* (24 sites, 2 more than 7th monitoring period), *Ageratum houstonianum* (24 sites, 7 more than 7th monitoring period), *Emilia sonchifolia* (23 sites, 6 more than 7th monitoring period), and *Lantana montevidensis* (21 sites, 5 more

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than 7th monitoring period) (from highest to lower abundance). The presence of *Lantana camara* had steadied after the sharp increased experienced between the 5th and 6th monitoring periods.

6.2.3 Tree canopy cover and height (T1)

Twenty four of the sites did not have any canopy trees present (41%, 1% less than 7th monitoring period. There is a continued trend of gradual decline in the number of sites with trees absent in the T1 layer, which is a positive result (Table 8).

Of the sites with canopy trees present in the T1 stratum, **tree canopy FPC** varied from 2% to 47.5% overlapping cover, with **average total canopy cover of 21.8% (3% more than 7th monitoring period)** (Table 8). Canopy species with high canopy cover were *Eucalyptus fibrosa, Corymbia trachyphloia, E. siderophloia, C. intermedia, E. moluccana* and *E. resinifera* (in order of highest to lower FPC). *Corymbia citriodora* had a slight decrease in cover and was no longer represented among the highest.

Of the sites with canopy trees present in the T1 stratum, **tree height** varied from 13.1 m to 23 m, with the **average tree height being 17.9 m (same as 7th monitoring period)** (Table 8). Canopy species with high average canopy height were *Corymbia trachyphloia. Eucalyptus siderophloia, E. fibrosa, E. resinifera, C. intermedia* and *E. acmenoides* (in order of highest to lower). *C. citriodora* had a lower cover than in the 7th monitoring round yet was not amongst the highest in this monitoring period.

Whilst total weed crown cover was absent from the T1 layer in the 7th monitoring period. In this monitoring period, *Pinus elliotti* was recorded in the T1 layer at two sites (110 and 132), **and it is recommended that these trees are removed.**

Table 8 8th Monitoring round sites with canopy absent for current and three previous monitoring rounds

Site and Rehabilitation Unit	5th mon	6th mon	7th mon	8th mon
19 (ORU1)	x	x		
23 (CRU11)	x	x	x	x
24 (CRU11)	x	x	x	x
25 (ORU2)	x	x		
26 (ORU2)	x	x	x	x
27 (ORU2)	x	x	x	x
28 (ORU2)	x	x	x	x
29				x
32 (ORU4)	x	x	x	x
33 (ORU4)	x	x	x	x
44 (ORU5)	x	x	x	x
47 (ORU5)	x	x	x	x
49 (CRU15)	x	x	x	x
54 (ORU6)	x	x	x	x
56 (CRU3)	x	x	x	x
57 (CRU3)	x	x	x	x
58 (ORU7)	x	x	x	x
59 (ORU7)	x	x	x	
60 (ORU8)	x	x	x	x

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Site and Rehabilitation Unit	5th mon	6th mon	7th mon	8th mon
61 (ORU8)	x	x	x	x
66				x
110 (ORU15)	x	x	x	
111 (ORU15)		x	x	
112 (ORU16)	x	x	x	x
113 (ORU16)	x	x	x	x
123				x
124 (ORU18)	x			
129 (ORU21)		x	x	
130 (ORU21)	x			
132 (ORU19)	x			x
134 (ORU22)	x	x	x	x
135 (ORU22)	x	x	x	
143 (CRU8)	x			
144 (CRU8)		x	x	x
TOTAL	**28**	**27**	**25**	**24**

6.2.4 Small tree cover and height (T2-T3)

Two sites (site 29 and 56) did not have any small trees (T2-T3 strata) present. Site 69, which had previously no small trees recorded had improved. In review of the T2/T3 layer, weed crown cover was recorded at 5 sites for the presence of *Pinus elliottii* including sites 23, 110, 128, 129 and 132. **Continued removal of *P. elliotti* from the T2/T3 layer is also recommended.**

Table 9 Sites containing *Pinus elliotti* in the small tree layer this monitoring round and previous two monitoring rounds

Site and Rehabilitation Unit	× = *Pinus elliotti* present in small tree layer			
	5th mon	6th mon	7th mon	8th mon
23 (CRU11)	×		×	×
57 (CRU3)		×		
110 (ORU15)	×	×	×	×
128 (ORU20)	×	×	×	×
129 (ORU21)	×	×	×	×
132 (ORU19)	×	×	×	×
TOTAL	**5**	**5**	**5**	**5**

T2/T3 foliage projected cover ranged from 2% to 82%, and there was a slight increase in **average total FPC (25%, 0.5% higher than in the 7th monitoring period)**. Small tree species with high average cover were mostly consistent with the 7th monitoring period yet varied in order. These included *Acacia disparrima, Lophostemon confertus, A. leiocalyx, L. suaveolens, E. acmenoides* and *E. siderophloia* (from highest to lower FPC).

Of the sites with small trees present in the T2-T3 stratum, the **minimum tree height continued to increase,** varying from 6.5 m to 13.8 m, with the average tree height 9.4 m (0.2 m more than 7th monitoring period (not a significant difference)) (Table 10). Small tree species with high average canopy height were *Eucalyptus siderophloia, L. suaveolens, Acacia disparrima, E. acmenoides, L.*

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confertus and *Corymbia trachyphloia* (in order of highest to lower). *E. tereticornis* was no longer amongst the highest small trees in this monitoring period.

6.2.5 Shrub cover and height (S1)

Shrub cover was recorded at all sites in this monitoring period, Site 66, which previously had no cover recorded, had an FPC of 5%. Sites containing shrub cover ranged from 0.5% to 29.5% shrub FPC. **Average total cover decreased slightly to 9.9% (3.1% less than 7th monitoring period).** Shrub species with highest average FPC were similar to the 7th monitoring period and included *Acacia leiocalyx, Lantana camara* (a weed)*, Lophostemon confertus, Alphitonia excelsa, A. disparrima* and *Leptospermum polygalifolium* (from highest to lower FPC)*.*

Average shrub height ranged from 1.4 m to 5.3 m. **Average height increased slightly at 2.9 m (0.5 m more than 7th monitoring period)**. Shrub species with high average height were similar to those recorded in the 7th monitoring period, including *Acacia leiocalyx, Alphitonia excelsa, A. disparrima, L. suaveolens, L. confertus* and *Lantana camara* (a weed) (in order of highest to lower FPC).

6.2.6 Ground cover (G1)

Consistent with previous monitoring periods, **a living native ground cover layer was recorded at all sites**, ranging from 4% to 71.6%. Average ground cover increased to 31.5% (5.9% increase since 7th monitoring period). This indicates continued overall improvement from previous declines that were attributed to extremely dry conditions.

Consistent with the previous 3 monitoring periods**, the native grass species *Imperata cylindrica* continued to have the highest native ground cover overall**, followed by *Lomandra longifolia Entolasia stricta, Pteridium esculentum, Cymbopogon refractus* and *L. multiflora.* Three weed species are important to mention as they were also amongst overall species with highest ground cover, including *Lantana camara, Andropogon virginicus* and *Passiflora suberosa* (in order of highest to lower cover).

6.2.7 Weed incursion

Weeds in the ground layer were present at 49 sites (83%, 2 sites more than the 7th monitoring period), ranging from 0.4% to 46.8% with an average weed cover of 12.3% (3.5% increase in weed cover since the 7th monitoring period). **Overall, weed cover in the ground layer increased at 35 sites (59% of sites, 1 site less than 7th monitoring period)**. Weed cover in the ground layer had decreased at 9 sites (15% of sites, 3 sites less than 7th monitoring period).

There was some variation in sites with highest weed cover, which included **sites 59** (46.8%, 3% increase since 7th monitoring period), **site 137** (45.2%, 19.2% increase), **site 110** (43.2%, 9.2% increase), **site 138** (42%), **site 129** (37.2%, 10.2% increase) and **site 143** (34.8%). High cover was recorded again at sites 26 and 115, however they were not among the highest. These sites are located within the Precinct 3 Fauna Corridor area to the north (site 59), or within Greenspace Corridors (sites 110, and 129) and the Conservation Areas adjoining the Plunkett Conservation Area to the east and south east (sites 137, 138 and 143) in Precincts 9, 14 and 15 (Figure 3).

Weed species in the ground layer with highest overall cover were similar to the 7th monitoring period, including *Lantana camara*, *Andropogon virginicus*, *Passiflora suberosa, Ageratum houstonianum, Setaria sphacelata* and *Lantana montevidensis* (from highest to lower abundance)*.*

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Table 10 8th Koala Offset monitoring period species richness, average canopy height within the canopy (T1), sub-canopy (T2-T3) and shrub layer (S1) and average total cover within the canopy (T1), sub-canopy (T2-T3), shrub layer (S1) and ground layer (G1)

Site	Species Richness (incl. weeds)					Height (m)			Overlapping Crown Cover (%)					Av. Ground Cover (%)	
	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Ground Layer (G1)	Total (excl. weeds)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Total Weed Crown Cover	Total Crown Cover	Total Ground Layer	Total Weed Ground Layer
18	2	4	4	24	34	17.8	7.2	3.6	25.0	15.5	15.5	0.0	56.0	24.0	12.8
19	1	3	5	25	34	20.3	10.1	4.5	22.0	21.5	8.0	0.0	51.5	27.2	7.6
23	0	6	2	26	34	0.0	8.1	3.8	0.0	20.5	8.5	5.0	24.0	30.0	2.4
24	0	3	2	23	28	0.0	8.7	3.8	0.0	16.5	5.5	0.0	22.0	46.8	26.0
25	1	2	7	40	38	20.0	12.2	3.0	14.0	40.5	5.8	0.0	60.3	32.0	6.4
26	0	3	5	35	43	0.0	8.6	2.6	0.0	19.5	20.5	0.0	40.0	60.4	32.4
27	0	5	2	18	25	0.0	7.7	2.9	0.0	16.5	19.5	0.0	36.0	12.4	5.2
28	0	3	2	27	32	0.0	6.6	3.0	0.0	7.0	6.0	0.0	13.0	49.6	11.6
29	0	0	4	45	34	14.8	9.1	3.8	11.0	32.0	11.0	0.0	54.0	58.4	18.8
30	3	3	2	68	76	17.5	10.5	2.5	47.0	9.5	1.0	0.0	57.5	43.2	4.0
31	1	4	3	27	35	15.0	10.1	2.8	6.0	24.0	5.5	0.0	35.5	4.0	1.2
32	0	7	3	34	44	0.0	8.1	1.8	0.0	24.0	4.5	0.0	28.5	4.0	4.0
33	0	5	3	26	34	0.0	8.6	4.4	0.0	29.0	24.5	0.0	53.5	12.0	7.2
44	0	5	4	33	42	0.0	7.3	3.1	0.0	20.0	27.0	0.0	47.0	15.2	3.6
45	1	5	9	27	42	21.3	12.2	2.9	22.5	36.0	6.5	0.0	65.0	57.6	20.0
46	1	2	4	31	38	20.0	13.8	2.8	17.0	25.0	8.0	0.0	50.0	33.2	6.0
47	0	2	3	10	15	0.0	7.8	3.6	0.0	15.5	24.0	0.0	39.5	9.2	0.0
49	0	7	7	32	46	0.0	9.3	2.8	0.0	14.0	29.0	0.0	43.0	34.8	3.2
54	0	4	7	30	41	0.0	9.0	3.0	0.0	10.0	23.0	0.0	33.0	46.8	6.4
55	1	10	6	21	38	23.0	10.1	2.3	14.0	54.0	18.5	0.0	86.5	52.0	4.8
56	0	0	1	15	16	0.0	10.2	3.5	0.0	31.0	0.5	0.0	31.5	19.2	3.2
57	0	2	3	24	29	0.0	9.0	2.0	0.0	4.0	0.5	0.0	4.5	16.0	1.2
58	0	5	2	35	42	0.0	9.1	3.5	0.0	28.5	10.0	0.0	38.5	12.8	0.4
59	1	3	5	19	28	0.0	7.5	1.8	0.0	16.5	6.0	0.0	22.5	71.6	46.8
60	0	4	3	29	36	0.0	7.1	5.0	0.0	8.0	1.0	0.0	9.0	31.2	8.4
61	0	1	3	42	46	0.0	7.4	3.2	0.0	17.5	14.0	0.0	31.5	33.2	4.0
62	3	4	3	20	30	20.7	10.5	2.1	15.0	21.5	4.0	0.0	40.5	22.8	0.4
63	2	5	5	21	33	21.6	7.7	2.6	27.0	15.0	16.5	0.0	58.5	25.2	0.0
64	3	2	6	17	28	17.7	10.0	2.2	25.0	11.5	4.5	0.0	41.0	14.8	0.0
65	2	4	9	27	42	17.5	10.3	2.7	30.0	13.5	7.5	0.0	51.0	33.2	0.0
66	0	5	4	55	64	17.5	9.2	2.2	2.0	15.0	5.0	0.0	22.0	49.2	2.8
67	2	3	6	31	42	16.3	7.4	2.4	36.0	13.0	9.5	0.0	58.5	24.4	0.0
68	2	3	9	17	31	13.1	9.8	2.1	15.0	21.0	8.0	0.0	44.0	26.8	0.0
69	1	1	6	16	24	16.0	0.0	1.6	22.0	0.0	8.5	0.0	30.5	17.6	0.0
102	3	2	2	23	30	17.9	9.7	2.6	40.5	17.0	3.0	0.0	60.5	4.8	0.0
103	3	2	8	35	48	17.6	9.8	1.5	35.5	2.0	5.0	0.0	42.5	12.8	1.2
104	2	4	4	16	26	18.4	11.9	2.1	22.5	19.0	4.5	0.0	46.0	20.8	0.0
109	2	5	4	26	37	18.6	8.2	2.7	23.0	9.5	6.5	0.0	39.0	9.2	0.8
110	1	4	3	20	28	15.0	6.5	1.5	3.0	2.2	5.0	3.0	7.2	58.4	43.2

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Site	Species Richness (incl. weeds)					Height (m)			Overlapping Crown Cover (%)					Av. Ground Cover (%)	
	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Ground Layer (G1)	Total (excl. weeds)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Total Weed Crown Cover	Total Crown Cover	Total Ground Layer	Total Weed Ground Layer
111	1	6	4	28	32	15.0	9.1	2.5	2.0	30.5	18.5	0.0	51.0	20.0	12.8
112	0	4	3	29	23	0.0	8.4	5.3	0.0	40.2	3.0	0.0	43.2	56.0	24.0
113	0	2	5	24	25	0.0	7.6	2.8	0.0	19.0	11.5	0.0	30.5	43.2	19.2
115	1	2	3	21	18	16.0	6.5	2.8	4.0	10.0	9.5	0.0	23.5	51.2	25.2
123	0	1	3	20	24	16.8	10.0	2.7	37.0	24.0	7.0	0.0	68.0	13.2	0.0
124	2	3	4	22	29	16.2	9.2	4.0	43.0	16.0	5.5	0.0	64.5	15.2	0.4
127	3	4	9	43	59	16.0	10.3	2.3	28.0	18.5	1.5	0.0	48.0	27.2	0.8
128	5	7	6	33	45	17.2	10.1	2.9	43.0	19.5	5.0	4.0	63.5	34.0	11.6
129	1	6	6	34	35	18.0	8.7	2.3	10.0	19.0	29.5	8.5	58.5	46.4	37.2
130	3	6	3	32	41	16.7	11.2	3.5	16.0	57.5	5.0	0.0	78.5	22.8	7.6
131	1	5	4	27	34	21.2	11.0	4.4	14.0	40.0	3.0	0.0	57.0	20.0	1.6
132	0	6	11	27	38	17.5	12.9	2.8	16.0	41.5	4.5	17.0	45.0	26.2	5.0
133	3	6	5	27	35	19.8	10.2	3.8	22.0	40.0	11.5	0.0	73.5	21.2	5.6
134	0	6	2	26	31	0.0	8.4	2.9	0.0	54.0	7.0	0.0	61.0	28.4	1.2
135	3	20	13	27	28	17.0	10.6	2.1	11.0	68.5	5.5	0.0	85.0	43.2	16.0
136	2	6	5	22	31	19.4	10.4	3.5	39.0	82.0	19.5	0.0	140.5	10.8	2.0
137	3	6	2	35	36	19.0	10.6	3.0	32.0	27.0	11.5	0.0	70.5	54.8	45.2
138	2	5	3	22	22	18.5	12.2	2.8	18.5	31.0	22.0	0.0	71.5	53.6	42.0
143	2	4	4	34	37	18.3	11.2	1.6	18.5	41.5	6.0	0.0	66.0	59.2	34.8
144	0	6	2	27	28	0.0	11.7	1.4	0.0	56.5	3.5	0.0	60.0	55.2	2.8
Averages*	**2.0 (+0.2)****	**4.3 (+0.1)****	**4.5 (-0.8)**	**28.0 (+6.2)**	**30.7 (+4.0)**	**17.9 (0)****	**9.4 (+0.2)****	**2.9 (+0.5)****	**21.8 (+3.0)**	**25.0 (+0.5)**	**9.9 -3.1)**	**7.3 (-0.1)****	**46.5 (+1.2)**	**31.5 (+5.9)**	**12.3 (+3.5)**

*Note: values in parentheses indicate the percent or actual change in averages since 7th monitoring period
** Within the margin of error (+/- 0.4%) for this type of assessment and is otherwise identified as 'no change' between two subsequent monitoring periods. Analysis of results from additional monitoring periods will provide a basis for more accurate conclusions.

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6.3 Normalised Difference Vegetation Index (NDVI) monitoring

Although the last three Koala Offset reports presented results for normalised difference vegetation index (NDVI) monitoring across the site, this form of monitoring has been temporarily suspended due to delays and then as a result of restrictions relating to the COVID-19 pandemic. This monitoring is planned to recommence once these restrictions have eased.

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7 Discussion

An assessment of site species richness and structure was undertaken to compare the 8th monitoring period condition against the 7th monitoring period and to measure against target benchmark parameters, in order to identify priority management areas and guide recommendations for management. The 8th offset monitoring period was undertaken in year 3 of monitoring. Therefore, sites will ideally have attained a minimum of IMO-3 for the benchmark variables as per the 6th and 7th monitoring periods. There were 56 sites that met a FINAL benchmark in at least one benchmark variable, same as 7th monitoring period). Upon closer review, it can also be seen that a high number of sites are approaching or have already attained the goal of reaching their original RE conditions across multiple variables and are recovering naturally, or with some assisted natural regeneration (Table 11).

7.1 Benchmark overview – trends within parameters

Whilst recovery is not consistent across all variables, there is a general trend of improvement for native species richness, T1 canopy cover, small tree cover and height, shrub height and native ground cover. The greatest declines were observed in shrub cover and weed cover whilst remaining variables were regarded as 'same'.

There was a significant increase in average species richness and an overall increase in the total number of species, perhaps due to favourable seasonal conditions. This was reflected in the overall trend of increase in benchmark results. A total of **32 sites met the FINAL benchmark for species richness, (54.2%, 15.3% increase since 7th monitoring period).**

The slight **increase in average T1 canopy cover was congruent with the benchmark results, which had an overall trend of 'improving'**. A total of 34 sites met a benchmark for T1 canopy cover (57.6%, an 11.2% increase since 7th monitoring period). The results for **average T1 canopy height and total meeting a benchmark remained consistent with those in the 7th monitoring period**, with 34 sites having met a benchmark for T1 canopy height (57.6%).

The slight **increase in T2-T3 small tree cover was not reflected in the benchmark results, which had an overall trend of 'same'**. A total of 58 sites met a benchmark for T2-T3 small tree cover (98.3%, 1.7% decrease since 7th monitoring period). The slight **increase in T2-T3 small tree height was not reflected in the benchmark results, which also had an overall trend of 'no change'**. A total of 57 sites also met the benchmark for T2-T3 small tree height (96.6%, same as 7th monitoring period).

The significant decrease in overall average shrub cover was reflected in the benchmark results, which had an overall trend of 'declining'. A total of 42 sites met a benchmark for shrub cover (71.1%, 10.2% decrease since 7th monitoring period), with 27 sites declining. In contrast, there was a slight increase in shrub height, therefore declines in cover may be attributed to some individuals migrating into the T2-T3 layer, or redistribution of cover across the centre line due to patterns of shrub growth. Despite the **slight increase in average shrub height, there was an overall trend of 'same'** with 57 sites meeting the benchmark for shrub height (96.6%, same as 7th monitoring period).

The significant **increase in average ground cover was reflected in the benchmark results, which had an overall trend of 'improving'**. A total of 55 sites met a benchmark for ground cover (93.2%, 3.4% increase since 7th monitoring period), with 25 sites improving (6 more than 7th monitoring period).

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The significant **increase in average weed cover was coupled with an overall trend of 'declining' in benchmark values.** This is due to the lower number of sites (31 sites) meeting the <5% cover benchmark (52.5%, 10.2% decrease since 7th monitoring period), coupled with a low number of sites improving and an increase in the number of sites declining. The increase in weed cover is most likely attributable to the continuation of favourable seasonal conditions following the extreme dry period.

7.2 Benchmark overview – site comparison

Within individual sites, there were 20 sites that did not experience any variables that were 'declining' (33.8%, 15.2% increase since 7th monitoring period), thereby exhibiting a trend of improvement (condition 'improving' or 'same'). Their associated ORU were considered amongst those in best condition and therefore not prioritised for active management at this time. Sites with no declining variables included sites 23 (CRU11), 26 (ORU2), 29-31 (ORU4), 49 (CRU15), 54 (ORU6), 60 and 61 (ORU8), 65 (ORU9), 66 (ORU10), 102 (ORU13), 113 (ORU16), 115 (ORU17), 131 (ORU19), 134 and 136 (ORU22), 137 and 138 (ORU23). A number of these sites were also among those with no declining variables in the 7th monitoring period.

Despite some declines in species richness and foliage cover, the number of variables meeting any benchmarks within sites continued to improve since the 6th monitoring period. Two sites (sites 110 and 112) met only four benchmark variables, however the remaining **97% of sites now meet at least 5 benchmarks across variables indicating a trend of improvement overall.** Furthermore, **there is a continued increase in the number of IMO-3 benchmarks met within sites, with 98% of sites meeting a minimum of four IMO-3 benchmarks** (with the exception of site 110). Furthermore, 54 sites (91%, 1% more than 7th monitoring period) reached the benchmark of IMO-3 or greater for at least 5 benchmark variables supporting an overall trend of improvement.

Management priorities aim to target the sites that are in poorest condition, and or in greatest decline. The sites that were in **poorest condition** included those that had failed to reach the IMO-3 benchmark target across multiple variables. In this monitoring period, **there were 4 sites that failed to meet this target in 5 or more areas including failure to meet the benchmark of <5% weed cover, making them top priority. These included sites 110 and 111 (ORU15), 112 (ORU16) and 115 (ORU17).** Site 57 (CRU3) had met the benchmark for weed cover, but was below the IMO-3 benchmark for native species richness, T1 and T2-T3 canopy cover and height, potentially making it a candidate for infill plantings to improve the upper strata layers over time.

In the current monitoring round, **there were 6 sites that were in greatest decline, including site 19 (ORU1), 32 (ORU4), 46 (ORU5), 57 (CRU3), 62 (ORU9) and 110 (ORU15).** These sites had all declined in 3 benchmark areas, predominantly T2-T3 cover, shrub cover and shrub height.

Similar to the 7th monitoring period, the overall trend for weed cover benchmark achievement was 'declining', with 50 sites remaining the same (1 more than 7th monitoring period), 8 declining (7 more than 7th monitoring period) and only one improving (same as 7th monitoring period). A total of 28 sites failed to meet the benchmark for weed cover. **It is recommended to concentrate future management towards reducing weed cover at top priority sites, which include those in poorest condition and greatest decline that also fail to meet the benchmark for weed cover (sites 19, 46 and 110).** Other top priority sites are regarded as those that had the highest weed cover recorded (Table 10) and did not meet the benchmark (Table 11), therefore need the most attention in order to bring them into alignment with benchmark targets. These include the following **top 5 priority rehabilitation units and their associated sites as identified in section 6.2.7 (ORU/CRU in italics indicate priority units in 7th monitoring period), *ORU7 (site 59), ORU23 (sites 137 and 138), ORU15 (sites 110 and 111), ORU21 (site 129)* and CRU8 (site 143)** (from highest to lower % weed

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ground cover). It is further recommended to continue investigating additional sites that have not met the benchmark or made improvements and also prioritise weed management tasks within these ORU's, where possible (see table 10).

Another consideration included sites that had the least improvement overall in the 8th monitoring period (sites that had <4 IMO-3 minimum benchmarks achieved across variables, or the lowest number of variables improving overall). Among the least improved sites, some had already met high benchmarks; however they failed to meet any benchmark in 4 or more variables, and were therefore regarded as 'high priority least improved'. **There were 14 'high priority least improved' sites (6 more than 7th monitoring period) including site 24 (CRU11), 26-28 (ORU2), 32 (ORU4), 56 and 57 (CRU3), 59 (ORU7), 60 (ORU8), 110 and 111 (ORU15), 112 and 113 (ORU16) and 115 (ORU17). These sites failed to meet the benchmark in 4 or more variables, primarily native species richness, T1 canopy cover; T1 canopy height and % weed cover. It is recommended that rehabilitation efforts within these sites are focussed on assisted natural regeneration of the ground and shrub layers with potential planting of T1 canopy and T2-T3 small tree species where possible.**

7.3 Priority weed management in Precincts

In this monitoring period, the results indicate a decline in the number of sites meeting the benchmark for % weed cover, and a significant increase in overall average weed cover. This may be attributed to seasonal changes providing favourable conditions for the growth of herbaceous weeds and graminoids in the ground layer. It is recommended that **rehabilitation continues to prioritise weed control in ORU/CRU containing sites that fail to meet the <5% weed cover benchmark as prescribed above, particularly those in ongoing sensitive areas such as those within or adjacent to conservation areas and greenspace areas adjoining Plunkett Conservation Reserve. These include Precincts 14 (ORU15, ORU16 and ORU17) and 15 (CRU8, ORU21, ORU23).** There are a total of 16 sites in these ORU's, with 10 of these failing to meet the ≤5% benchmark for weed cover (sites 110 and 111 (ORU15); 112 and 113 (ORU16); 115 (ORU17); 129 and 130 (ORU21); 137 and 138 (ORU23) and 143 (CRU8). Priority species for weed control are mostly consistent with the 7th monitoring period and include the most abundant species recorded - ***Lantana camara*** **(woody shrub),** ***Andropogon virginicus*** **(graminoid),** ***Passiflora suberosa*** **(vine),** ***Ageratum houstonianum*** **(herb),** ***Setaria sphacelata*** **(graminoid) and** ***Lantana montevidensis*** **(herb).**

7.4 Conclusions and recommendations

In conclusion, the results for benchmark indicators and weed cover were used to determine highest priority sites for rehabilitation based on poorest overall condition, least improved, weed benchmark condition and precinct proximity to sensitive areas. **It was determined that there are 5 priority Rehabilitation Units within four precincts to be considered highest priority action, including ORU15 (Precinct 14), ORU16 (Precinct 14), ORU17 (Precinct 14), ORU21 (Precinct 15) and ORU23 (Precinct 15) and CRU8 (Precinct 15) from highest to lower priority. The recommended treatment for these sites includes weed control in the ground and shrub layer including removal of *P. elliotti* from the upper strata layers where present (primarily sites 110 and 129). Additionally, infill planting of T1 canopy and T2-T3 strata species in these ORUs is recommended in order to achieve benchmark targets in the long term.**

An additional 6 'least improved' or 'greatest decline' Rehabilitation Units are recommended for management to reduce weed cover and carry out infill planting to continue benchmark improvements in one or more areas including ORU7 and ORU8 (Precinct 3); ORU2 and CRU11

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(Precinct 6) ORU1 (Precinct 13) and ORU5 (Precinct 3). Review Table 11 to determine layers of strata that require infill plantings within these ORU – this will include layers that have not yet achieved the IMO-3 or greater benchmark for a particular site.

Additional measures:

- Targeted removal of *P. elliotti* from the T1 canopy and T2-T3 small tree layers is recommended where present at sites 23, 110, 128, 129 and 132.

- Where appropriate, rehabilitation efforts are to also incorporate ongoing maintenance of stock exclusion fencing.

- Continued strategic rehabilitation of the shrub layer may be required in priority areas to continue boosting the layer to meet or improve benchmarks, and also to help ensure that weeds are outcompeted and shaded out, thereby reducing the need for reactive management over time.

- Seasonal variation should be taken into account when considering any infill planting, which is not recommended during extreme dry conditions.

- Thinning of the ground layer in sites that are dominated by *Imperata cylindrica* or exotic ground cover species may also be considered, in order to provide opportunity for the natural seed bank to propagate and help improve species richness.

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Table 11 8th Koala Offset monitoring period species richness, canopy height within the canopy (T1), sub-canopy (T2-T3) and shrub layer (S1) and cover within the canopy (T1), sub-canopy (T2-T3), shrub layer (S1) and ground layer (G1) measured against benchmarks for each respective RE

Site	Rehab Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Cover (T2-T3)	Small Tree Height (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (<5%?)
18	ORU1	12.9-10.17/12.9-10.2	FINAL (S)	IMO-10 (S)	IMO-10 (S)	FMO-15 (I)	IMO-5 (S)	IMO-5 (D)	FMO-15 (I)	IMO-2 (I)	X (S)
19	ORU1	12.9-10.17/12.9-10.2	FINAL (S)	IMO-10 (D)	FMO-15 (S)	FMO-15 (I)	IMO-10 (I)	IMO-2 (D)	FINAL (I)	IMO-3 (I)	X (D)
23	CRU11	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	IMO-10 (I)	IMO-5 (S)	FINAL (S)	FINAL (S)	FINAL (S)
24	CRU11	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	FMO-15 (I)	IMO-3 (D)	FINAL (S)	FINAL (S)	X (S)
25	ORU2	12.3.11/12.3.6/12.3.7	FINAL (I)	IMO-3 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	IMO-3 (D)	FINAL (I)	FINAL (S)	X (D)
26	ORU2	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (I)	FMO-15 (S)	FMO-15 (S)	FMO-15 (S)	FINAL (S)	X (S)
27	ORU2	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	IMO-10 (I)	FMO-15 (D)	FINAL (I)	FMO-15 (S)	X (D)
28	ORU2	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (I)	IMO-5 (S)	IMO-3 (D)	FINAL (I)	FINAL (S)	X (D)
29	ORU4	12.9-10.17/12.9-10.2	FINAL (S)	IMO-2 (I)	IMO-10 (S)	FINAL (I)	IMO-10 (I)	IMO-3 (I)	FMO-15 (I)	FMO-15 (I)	X (S)
30	ORU4	12.9-10.17/12.9-10.2	FINAL (S)	FMO-15 (S)	IMO-10 (S)	IMO-5 (S)	FMO-15 (S)	X (S)	IMO-10 (S)	IMO-10 (I)	FINAL (S)
31	ORU4	12.9-10.17/12.9-10.2	FINAL (I)	IMO-1 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (S)	X (S)	IMO-10 (I)	X (S)	FINAL (S)
32	ORU4	12.9-10.17/12.9-10.2	FINAL (S)	X (S)	X (S)	FMO-15 (S)	IMO-5 (S)	X (D)	IMO-5 (D)	X (D)	FINAL (S)
33	ORU4	12.9-10.17/12.9-10.2	FINAL (I)	X (S)	X (S)	FMO-15 (D)	IMO-5 (S)	FMO-15 (I)	FINAL (I)	IMO-1 (I)	X (D)
44	ORU5	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (I)	IMO-5 (S)	FINAL (S)	FINAL (I)	FMO-15 (S)	FINAL (D)
45	ORU5	12.3.11/12.3.6/12.3.7	X (D)	IMO-10 (I)	FMO-15 (S)	FINAL (S)	FMO-15 (S)	IMO-1 (D)	FINAL (I)	FMO-15 (S)	X (S)
46	ORU5	12.3.11/12.3.6/12.3.7	X (D)	IMO-3 (S)	FMO-15 (S)	FMO-15 (D)	FINAL (S)	IMO-2 (D)	FINAL (S)	IMO-5 (S)	X (S)
47	ORU5	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (I)	IMO-5 (S)	FINAL (S)	FINAL (I)	FMO-15 (D)	FINAL (S)
49	CRU15	12.3.11/12.3.6/12.3.7	FINAL (S)	X (S)	X (S)	FMO-15 (I)	IMO-10 (S)	FINAL (S)	FINAL (I)	FINAL (S)	FINAL (S)
54	ORU6	12.3.11/12.3.7	FINAL (I)	X (S)	X (S)	IMO-5 (S)	IMO-10 (S)	FINAL (S)	FINAL (I)	FINAL (S)	X (S)
55	ORU6	12.3.11/12.3.7	FINAL (S)	IMO-3 (S)	FMO-15 (S)	FINAL (S)	FMO-15 (D)	FMO-15 (S)	FMO-15 (S)	FINAL (S)	FINAL (S)
56	CRU3	12.3.11/12.3.7	X (D)	X (S)	X (S)	FINAL (I)	FMO-15 (I)	X (D)	FINAL (I)	FINAL (S)	FINAL (S)
57	CRU3	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-2 (D)	IMO-10 (I)	X (D)	FMO-15 (D)	FMO-15 (I)	FINAL (S)
58	ORU7	12.3.11/12.3.6/12.3.7	FINAL (I)	X (S)	X (S)	FINAL (S)	IMO-10 (S)	IMO-10 (D)	FINAL (S)	FMO-15 (D)	FINAL (I)
59	ORU7	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	IMO-5 (S)	IMO-3 (D)	IMO-10 (D)	FINAL (S)	X (S)
60	ORU8	12.9-10.17/12.9-10.2	FINAL (I)	X (S)	X (S)	IMO-5 (S)	IMO-5 (S)	X (S)	FINAL (I)	IMO-5 (I)	X (S)

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Site	Rehab Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Cover (T2-T3)	Small Tree Height (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (<5%?)
61	ORU8	12.9-10.17/12.9-10.2	FINAL (S)	X (S)	X (S)	FMO-15 (S)	IMO-5 (S)	IMO-5 (I)	FMO-15 (S)	IMO-5 (I)	FINAL (S)
62	ORU9	12.9-10.17/12.9-10.19	FINAL (S)	IMO-3 (D)	FMO-15 (I)	FMO-15 (I)	FMO-15 (I)	X (D)	IMO-5 (D)	IMO-2 (I)	FINAL (S)
63	ORU10	12.9-10.17	FINAL (S)	IMO-10 (S)	FMO-15 (S)	FMO-15 (S)	IMO-5 (D)	IMO-10 (S)	IMO-10 (D)	IMO-3 (I)	FINAL (S)
64	ORU11	12.9-10.17	FINAL (S)	IMO-10 (I)	IMO-10 (S)	IMO-10 (S)	IMO-10 (D)	X (D)	IMO-10 (S)	IMO-1 (S)	FINAL (S)
65	ORU10	12.9-10.17	FINAL (S)	FMO-15 (S)	IMO-10 (S)	IMO-10 (S)	IMO-10 (S)	IMO-2 (I)	IMO-10 (I)	IMO-5 (S)	FINAL (S)
66	ORU9	12.9-10.17/12.9-10.19	FINAL (S)	X (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (S)	X (S)	X (S)	FMO-15 (I)	FINAL (S)
67	ORU9	12.9-10.17/12.9-10.19	FINAL (S)	FMO-15 (S)	IMO-10 (S)	IMO-10 (D)	IMO-5 (S)	IMO-2 (D)	IMO-10 (S)	IMO-2 (S)	FINAL (S)
68	ORU9	12.9-10.17/12.9-10.19	FINAL (S)	IMO-3 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (S)	IMO-2 (D)	IMO-5 (D)	IMO-3 (S)	FINAL (S)
69	ORU9	12.9-10.17/12.9-10.19	FINAL (I)	IMO-10 (I)	IMO-10 (S)	X (S)	X (S)	IMO-2 (D)	IMO-3 (I)	IMO-1 (S)	FINAL (S)
102	ORU13	12.9-10.17/12.9-10.19	X (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (I)	X (S)	IMO-10 (I)	X (S)	FINAL (S)
103	ORU13	12.9-10.17/12.9-10.19	FINAL (I)	FMO-15 (S)	IMO-10 (S)	IMO-1 (I)	IMO-10 (D)	X (S)	IMO-3 (D)	IMO-1 (S)	FINAL (S)
104	ORU13	12.9-10.17/12.9-10.19	X (S)	IMO-10 (S)	FMO-15 (I)	FMO-15 (S)	FMO-15 (I)	X (D)	IMO-10 (S)	IMO-2 (D)	FINAL (S)
109	ORU15	12.9-10.17/12.9-10.2	FINAL (I)	IMO-10 (I)	FMO-15 (I)	IMO-5 (D)	IMO-5 (S)	IMO-1 (I)	IMO-10 (I)	X (S)	FINAL (S)
110	ORU15	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-1 (D)	IMO-5 (D)	X (S)	IMO-3 (D)	FMO-15 (S)	X (S)
111	ORU15	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	FINAL (S)	IMO-10 (S)	IMO-10 (D)	IMO-10 (S)	IMO-2 (S)	X (S)
112	ORU16	12.9-10.17/12.9-10.19	X (S)	X (S)	X (S)	FINAL (S)	IMO-5 (S)	X (D)	FINAL (S)	FMO-15 (I)	X (S)
113	ORU16	12.9-10.17/12.9-10.19	X (S)	X (S)	X (S)	FMO-15 (I)	IMO-5 (S)	IMO-3 (S)	FMO-15 (S)	IMO-10 (S)	X (S)
115	ORU17	12.9-10.17/12.9-10.2	X (S)	X (S)	IMO-10 (S)	IMO-5 (S)	X (S)	IMO-2 (S)	FMO-15 (I)	FMO-15 (S)	X (S)
123	ORU18	12.9-10.17	FINAL (I)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (S)	IMO-2 (I)	IMO-10 (S)	IMO-1 (I)	FINAL (S)
124	ORU18	12.9-10.17	FINAL (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (I)	X (D)	FINAL (I)	IMO-1 (S)	FINAL (S)
127	ORU20	12.9-10.17/12.9-10.2	FINAL (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (D)	X (S)	IMO-10 (I)	IMO-3 (I)	FINAL (S)
128	ORU20	12.9-10.17/12.9-10.2	FINAL (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-10 (S)	X (D)	FMO-15 (I)	IMO-5 (S)	X (S)
129	ORU21	12.11.5/12.11.3	X (D)	IMO-2 (I)	X (S)	FINAL (S)	IMO-10 (D)	FINAL (S)	FINAL (I)	FINAL (I)	X (S)
130	ORU21	12.11.5/12.11.3	FINAL (S)	IMO-5 (I)	IMO-10 (D)	FINAL (S)	FINAL (S)	FMO-15 (D)	FINAL (S)	IMO-10 (I)	X (S)
131	ORU19	12.11.5/12.11.3	X (S)	IMO-3 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FMO-15 (I)	FINAL (I)	IMO-10 (I)	FINAL (S)
132	ORU19	12.11.5/12.11.3	FINAL (I)	IMO-5 (I)	IMO-10 (S)	FINAL (S)	FINAL (S)	FMO-15 (D)	X (S)	FMO-15 (I)	X (D)
133	ORU19	12.11.5/12.11.3	FINAL (S)	X (S)	X (S)	FMO-15 (S)	IMO-5 (S)	IMO-5 (I)	FMO-15 (S)	IMO-5 (I)	FINAL (S)

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Site	Rehab Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Cover (T2-T3)	Small Tree Height (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (<5%?)
134	ORU22	12.11.5/12.11.3	X (S)	X (S)	X (S)	FINAL (S)	IMO-10 (S)	FINAL (S)	FINAL (I)	FMO-15 (I)	FINAL (S)
135	ORU22	12.11.5/12.11.3	X (S)	IMO-2 (I)	X (S)	FINAL (S)	FINAL (S)	FMO-15 (D)	FMO-15 (D)	FMO-15 (S)	X (S)
136	ORU22	12.11.5/12.11.3	X (S)	FMO-15 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (S)	IMO-2 (I)	FINAL (S)
137	ORU23	12.11.5	FINAL (I)	FMO-15 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (I)	FINAL (I)	X (S)
138	ORU23	12.11.5	X (S)	IMO-10 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (I)	X (S)
143	CRU8	12.11.5/12.11.3	FINAL (I)	IMO-10 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (I)	IMO-10 (D)	FINAL (I)	X (S)
144	CRU8	12.11.5/12.11.3	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	FMO-15 (D)	IMO-5 (I)	FINAL (I)	FINAL (S)
Total meeting a benchmark (current mon.)			**32**	**34**	**34**	**58**	**57**	**42**	**57**	**55**	**31**
Total meeting a benchmark (7th mon.)			**23**	**27**	**34**	**57**	**57**	**48**	**57**	**53**	**37**
Total improving (since 7th mon.)			**13**	**16**	**3**	**12**	**11**	**8**	**28**	**25**	**1**
Total declining (since 7th mon.)			**4**	**2**	**1**	**6**	**7**	**27**	**10**	**4**	**8**
Total same (since 7th mon.)			**42**	**41**	**55**	**41**	**41**	**24**	**21**	**30**	**50**
Overall trend			**≥**	**≥**	**=**	**≥**	**≥**	**≤**	**≥**	**≥**	**≤**

Total sites (excl. removed) = 59

Note: the site meets the following benchmarks: IMO- 1 year; IMO- 2 year, IMO-3 year, IMO-5 year, IMO-10 year, FMO-15 year, FINAL Benchmark condition, and X – does not meet any benchmark.
* D = Decrease, S = Same, I = Increase in all values

NATURA PACIFIC
PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
info@natura-pacific.com www.natura-pacific.com

8 Bibliography

Agricultural Management Company (2011) *Interim Land Management Plan, Yarrabilba Stage 2: Business Plan*. Agricultural Management Company, for Lendlease.

Austecology (2012) *Koala Management Plan*. Austecology for Lendlease.

Austecology (2015) *Offset Management Plan*. Austecology for Lendlease.

Batianoff, G.N. and Butler, D.W. (2002) Assessment of invasive naturalised plants of southeast Queensland. *Plant Protection Quarterly* **17**:1.

Big Scrub Rainforest Landcare Group (2000) *Common Weeds of Northern NSW Rainforest: A practical manual on their identification and control.* Big Scrub Rainforest Landcare Group, Bangalow, NSW.

Big Scrub Rainforest Landcare Group (2005) *Subtropical Rainforest Restoration 2nd Edition*. Big Scrub Rainforest Landcare Group, Bangalow, NSW.

Brack, C.L. and Wood, G.B. (1996) *Tree Growth Increment*. Australian National University, Fenner School.
Url: http://fennerschool-associated.anu.edu.au/mensuration/BrackandWood1998/T_GROWTH.HTM. Accessed 24/01/2015.

Brisbane City Council (2010) *Ecological Assessment Guidelines – Appendix 3*. Url: http://www.brisbane.qld.gov.au/documents/building_development/pages%20from%20285065_bcc_eco_guidelines_final.part1.pdf

Buchanan, R.A. (1999) *Bush Regeneration: Recovering Australian Landscapes*. Open Training and Education Network.

Buchanan, R.A. (2009) *Restoring Natural Areas: Open Training and Education Network*. Local College New South Wales and Department of Industry and Investment.

Bushland Protection Systems (2012) *Draft Pre-Development Bushfire Mitigation Concept for the Yarrabilba Site: A Complete Town, A Better Outcome.* Bushland Protection Systems for Lendlease.

Department of Environment and Resource Management (2010) *Wallum Froglet.* Url: http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/az_of_animals/wallum_froglet.html

Department of Infrastructure, Planning and Natural Resources (2004) *Wildlife Corridors.* Url: http://www.environment.nsw.gov.au/resources/nature/landholderNotes15WildlifeCorridors.pdf

Design Flow (2012) *Yarrabilba Stormwater Infrastructure Master Plan.* Design Flow, for Lendlease.

Dight, G.A., Huggins, J.A., Lucy, M.J. and Zerner, G.R. (2003) *Wild Plants of Greater Brisbane*. Queensland Museum.

Environmental Protection Agency (2003) *Regional Ecosystem Map: Based on 2003 Landsat TM Imagery*. Queensland Government, Brisbane.

Franks, A. and Franks, S. (2003) *Nest Boxes for Wildlife, A Practical Guide*. Blooming Books, Melbourne, Australia.

Lendlease (2011) *Yarrabilba Draft Land Management Plan*. Lendlease.

Logan River Branch SGAP (Qld Region) Inc. (2008) *Mangroves to Mountains Revised Edition: A field guide to the native plants of South-east Queensland*. Logan River Branch, Browns Plains Queensland.

NATURA PACIFIC
PO Box 2959, Burleigh BC, QLD 4220 Australia Tel: +61 (0)7 55 765 568 Mob: +61(0)415 413 408
info@natura-pacific.com www.natura-pacific.com

McDonald, M.C. (1996) *Resilience and the Restoration of Damaged Plant Communities: A discussion focusing on Australian Plant Communities*. PhD. Dissertation. University of Western Sydney, Hawkesbury, NSW.

McDonald, R.C., Isbell, R.F., Speight., J.G., Walker J., and Hopkins M.S. (2005) *Australian Soil and Land Survey Handbook*. Department of Agriculture, Fisheries and Forestry, Canberra.

Natura Consulting (2011) *Fauna Corridor Infrastructure Master Plan*. Natura Consulting for Lendlease.

New South Wales Department of Primary Industries (2011) *Noxious and Environmental Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations, Fifth Edition*. DPI NSW.

Parsons, W.T. and Cuthbertson, E.G. (2001) *Noxious Weeds of Australia, Second Edition*. CSIRO Publishing.

Primary Industries Department Queensland (2003) *Weeds of Southern Queensland. 2nd Edition*. Department of Primary Industries Brisbane.

Queensland Government (2009*) Koala Safety Fencing and Measures Guideline: A Guideline for the Draft South East Queensland Koala Conservation State Planning Regulatory Provisions*. Url: http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/Koalas/strategy/pdf/Koalafencingguideline.pdf

Queensland Herbarium (2015a) *Mapping Regional Ecosystems*. Queensland Government. Url: https://www.qld.gov.au/environment/plants-animals/plants/herbarium/mapping-ecosystems/ (Accessed 06/12/2014).

Queensland Government (2015b) *Pre-clearing Broad Vegetation Groups of Queensland*. Queensland Government, Department of Science, Information Technology, Innovation and the Arts. URL: https://data.qld.gov.au/dataset/pre-clearing-broad-vegetation-groups-of-queensland/resource/1d49665c-cbc0-4935-a5b5-380c162ff42b (Accessed: 06/12/2014).

Ross, Y. (1998) *Hollow Bearing Trees in Permanent Plots in Southeast Queensland*. Department of Natural Resources, Natural Sciences Precinct, Indooroopilly, Qld. DNRQ980146/

Transport and Main Roads (TMR) (2002) *Fauna Sensitive Road Design. Volume 1, Past and Existing Practices*. Queensland Department of Main Roads, Planning, Design and Environment Division.

Urban Ecology Australia (2006) *Wildlife Corridors*.
Url: http://www.urbanecology.org.au/topics/wildlifecorridors.html

Urban Land Development Authority (2011a) *Draft ULDA Guideline 14 – Environment and Natural Resources Sustainability*. Urban Land Development Authority.

Urban Land Development Authority (2011b) *ULDA Guideline 17 – Remnant Vegetation and Koala Habitat Obligations in Greater Flagstone and Yarrabilba UDAs*.

Van der Ree, R., Clarkson, D.T., Holland, K., Gulle, N. and Budden M. (2008*) Review of Mitigation Measures used to deal with the Issue of Habitat Fragmentation by Major Linear Infrastructure*. Department of Environment, Water, Heritage and the Arts.

Yurrah (2009) *Yarrabilba Vegetation Management Plan.* Yurrah, for Lendlease.

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info@natura-pacific.com www.natura-pacific.com