Koala Habitat Rehabilitation Monitoring Report ORU 6th 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: 20 July 2020
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 6th Monitoring Period**
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Revision History

Version:	**Purpose:**	**Issued by:**	**Date**	**Reviewer:**	**Date:**
Draft	Peer Review	K. Leopold	12/07/2020	M.N. Runkovski	15/07/2020
1.0	Quality Assurance	M.N. Runkovski	15/07/2020	D. Coburn	20/07/2020

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1 Executive summary

Natura Pacific has developed this *Habitat Rehabilitation Monitoring Report* as the 6th monitoring report after: initial baseline, 6 month, 2nd, 3rd, 4th and 5th 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 6th monitoring period data for the rehabilitation of the offset areas, with 59 sites, consistent with the 5th 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 6th monitoring period condition against the baseline and benchmark values. With six 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 5th monitoring period, improvements in general ecological health remained varied across offset sites, with a trend for improvement despite some losses to ground and shrub cover, attributed to extremely dry seasonal conditions. There was a slight decline in the number of sites that improved for species richness, with a significant number of sites declining in this area due to species loss in the ground layer, also attributed to the dry conditions. This resulted in a 32% decrease in the number of sites meeting the final benchmark for species richness. Other variables with most notable declines were native ground cover (24 sites declined) and shrub cover (15 sites declined). There was an overall trend for improvement in small tree height (25 sites improved); shrub height (32 sites improved) and weed cover (13 sites improved). The remaining variables had remained relatively stable since the 5th monitoring period. Overall the changes observed in this monitoring period may be attributed to extremely dry climate conditions, recruitment of lower order structural layers into higher order structural layers (i.e. movement of shrubs into T2-T3 layers) and rehabilitation actions including continued control of exotic weeds and decreased grazing due to adequate maintenance of exclusion fencing. A slight adjustment to the methods to give better RE representation in benchmark evaluations may have also impacted results slightly in the ground and shrub layers.

Of the 59 sites, a total of 28 sites meet a benchmark for T1 canopy tree cover, 27 sites meet a benchmark for T1 canopy tree height, 56 sites meet a benchmark for T2-T3 small tree cover, 58 sites meet a benchmark for T2-T3 small tree height, 41 sites meet a benchmark for shrub cover, 58 sites meet a benchmark for shrub height, 53 sites meet a benchmark for ground cover and 41 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 seven priority areas, 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 (6th) monitoring period (see Table 9). **Recommendations include targeted weed control for the exotic graminoids *Andropogon virginicus* and *Setaria sphacelata,* exotic shrubs / vines including *Lantana camara* and *Passiflora suberosa,* as well as the exotic tree species *Pinus elliotti,*** to assist natural regeneration and prevent weed spread and incursion, particularly in areas adjacent to the Plunkett Conservation Reserve. **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. **Furthermore, thinning out of dominant *Acacia* species such as *A. leiocalyx* and *A. disparrima* or native ground cover species such as *Imperata cylindrica* and *Pteridium esculentum*** to improve species diversity over time may also be considered.

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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, all existing fragments of remnant vegetation which have value for koalas will 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 6th 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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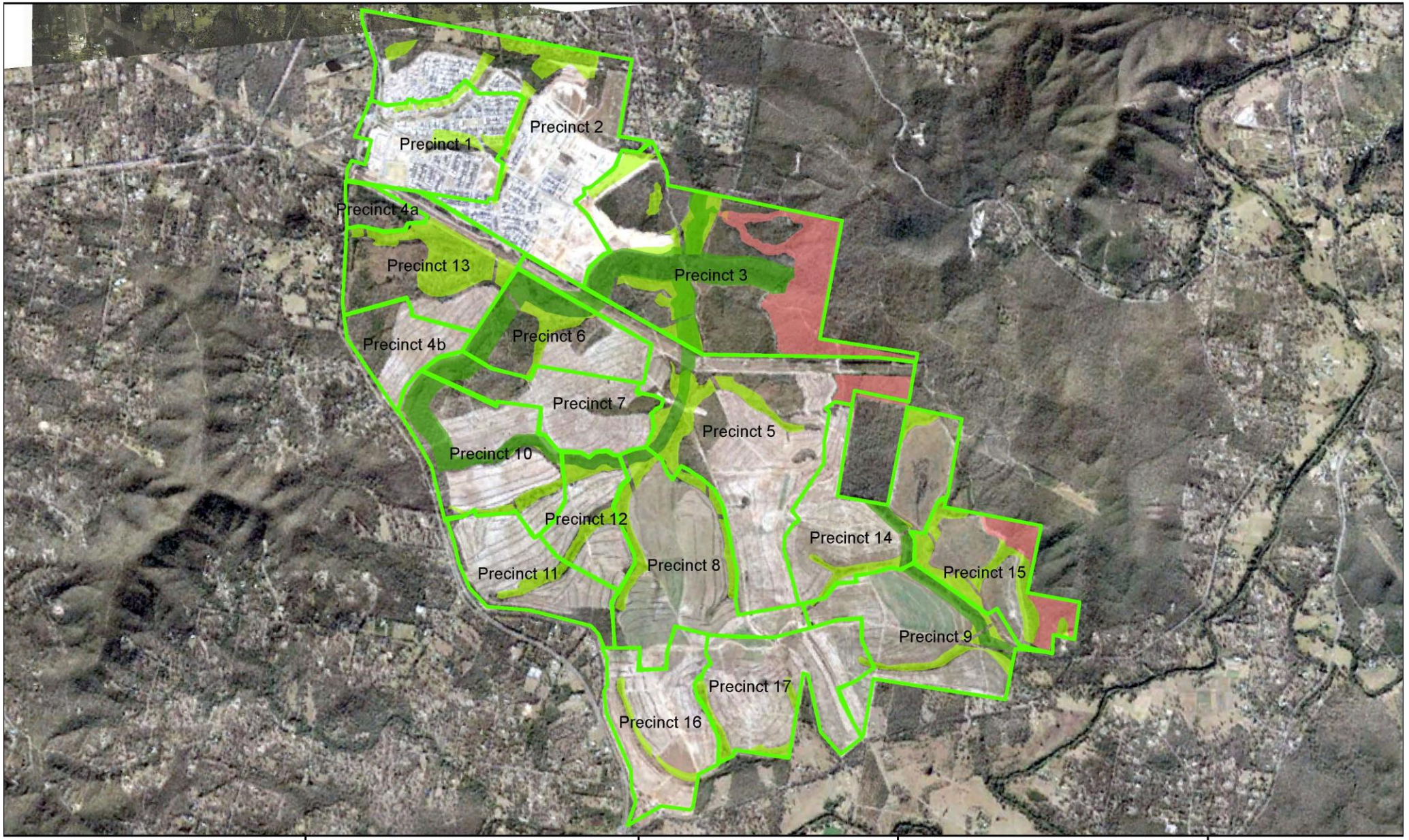

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Source: Corridor Areas/Conservation: Lend Lease 2016
Development Layout: Lend Lease 2016

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: Yarrabilba
Date: 21/09/2016

N

0 145 290 580 870 1,160 1,450
Meters

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

Legend

- Ongoing Conservation Areas
- Ongoing Fauna Corridor
- Ongoing Greenspace Corridor
- Precinct Boundaries (as of 22.03.17)

Figure 1
Yarrabilba site location

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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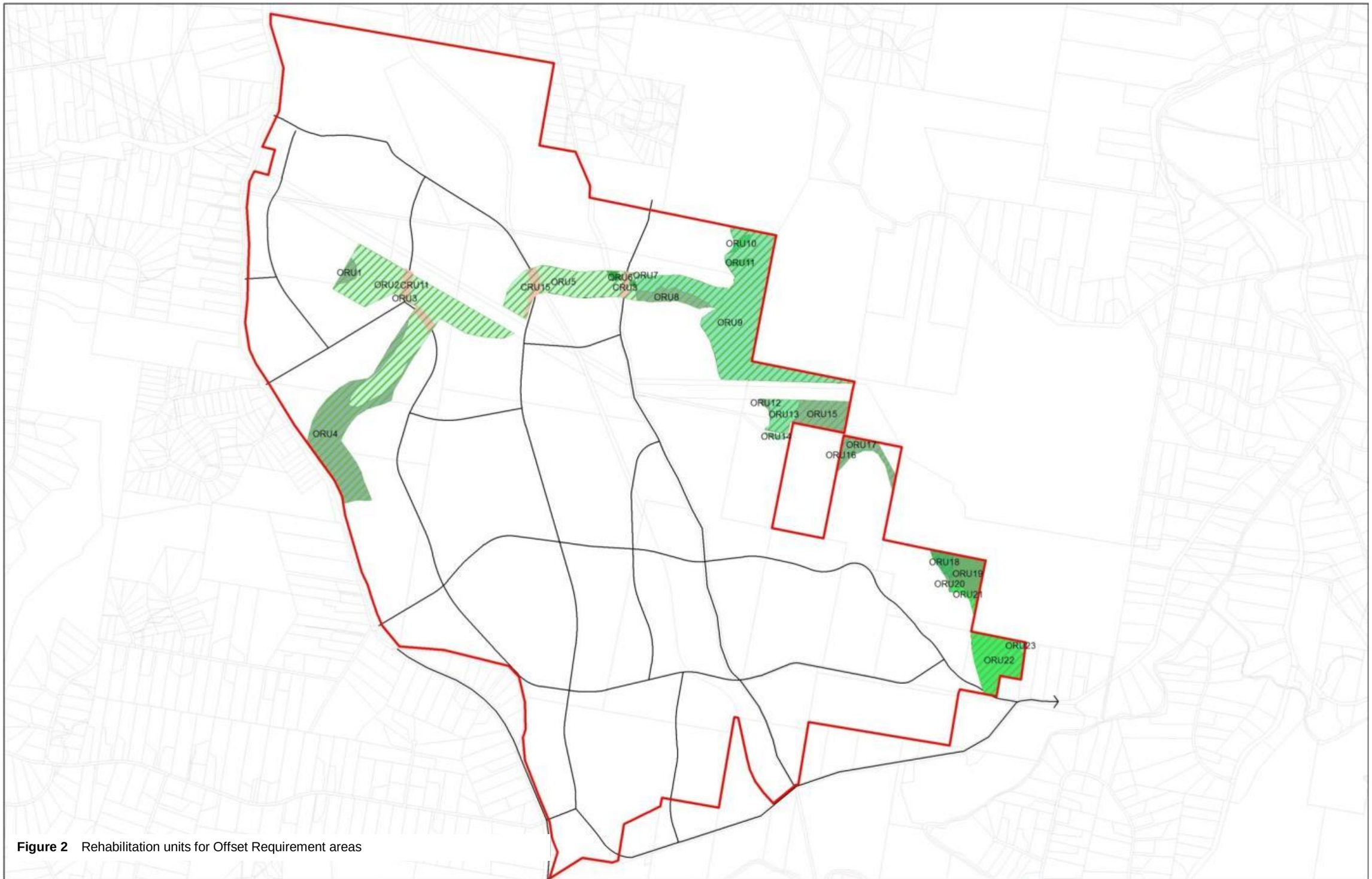

Figure 2 Rehabilitation units for Offset Requirement areas

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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 numerous exotic pine trees exist. 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**

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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			
12.3.11	***Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open-forest on alluvial plains**	Of concern	Of concern	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				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*,**	Least	No concern	ORU1, ORU3, ORU4, ORU8, ORU9, ORU10, ORU11,	

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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 major, Eucalyptus siderophloia* +/- *Corymbia citriodora subsp. variegata* woodland on sedimentary rocks**	concern	at present	ORU12, ORU13, ORU14, ORU15, ORU16, ORU17, 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,***	Least	No concern	ORU19, ORU21, ORU22							

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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**			
	***E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics**	concern	at present	**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	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 6th 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.

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. 6th mon.)
- date

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Figure 3 Offset Area monitoring locations

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 90 180 360 540 720 Meters

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

- Koala Offset Sites - End Posts
- Koala Offset Sites - Start Posts
- Road Crossing Rehab Unit
- Conservation Areas
- Fauna Corridor
- Greenspace Corridor
- Precinct Boundaries

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 replicaton 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 (current monitoring period) and will continue at 6 monthly intervals until significant progress has been achieved towards RE benchmark values at which point monitoring can be reduced to annual events. 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)

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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 vegetation varies from mixed native grasses such as *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 evidence of *Lantana camara* infestations, including sites 18, 132, 137, 138 and mostly heavily infested site 139, although a significant decrease in cover and density is visually evident at these sites and others (e.g. sites 32, 49, 55, 103, 111, 135 and 143) and this is attributed primarily to the dry conditions, which is also evidenced by extensive browning off and dieback of *I. cylindrica* and *P. esculentum.* 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, which do not appear to have advanced since the 5th monitoring period (e.g. sites 23, 24, 26, 57, 60 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 19, 27, 44, 47 and 58), however the density and cover of *Acacia* spp. appears to have decreased slightly at these sites.

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Table 7 Photo monitoring images

Site 18 – 22/10/2019

Site 19 – 22/10/2019

Site 23 – 23/10/2019

Site 24 – 23/10/2019

Site 25 – 23/10/2019

Site 26 – 24/10/2019

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Site 27 – 23/10/2019

Site 28 – 23/10/2019

Site 29 – 23/10/2019

Site 30 – 24/10/2019

Site 31 – 23/10/2019

Site 32 – 24/10/2019

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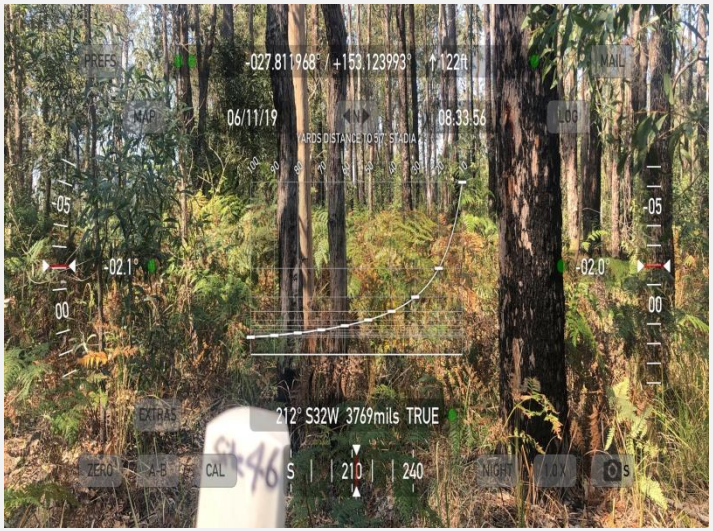
Site 33 – 24/10/2019

Site 44 – 29/10/2019

Site 45 – 29/10/2019

Site 46 – 07/11/2019 (photo date incorrect)



Site 47 – 25/10/2019

Site 49 – 29/10/2019

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Site 54 – 25/10/2019

Site 55 – 30/10/2019

Site 56 – Photo not recorded

Site 57 – 29/10/2019

Site 58 – 30/10/2019

Site 59 – 25/10/2019

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Site 60 – 29/10/2019

Site 61 – 30/10/2019

Site 62 – 12/11/2019

Site 63 – 12/11/2019

Site 64 – 12/11/2019

Site 65 – 12/11/2019

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Site 66 – 08/11/2019

Site 67 – 30/10/2019

Site 68 – 12/11/2019

Site 69 – 30/10/2019

Site 102 – 07/11/2019

Site 103 – 05/11/2019

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Site 104 – 07/11/2019

Site 109 – 05/11/2019

Site 110 – 08/11/2019

Site 111 – 07/11/2019

Site 112 – 07/11/2019

Site 113 – 07/11/2019

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Site 115 – 08/11/2019

Site 123 – 01/11/2019

Site 124 – 01/11/2019

Site 127 – 01/11/2019

Site 128 – 01/11/2019

Site 129 – 01/11/2019

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Site 130 – 31/10/2019

Site 131 – 01/11/2019

Site 132 – 31/10/2019

Site 133 – 08/11/2019

Site 134 – 31/10/2019

Site 135 – 31/10/2019

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Site 136 – 05/11/2019

Site 137 – 05/11/2019

Site 138 – 05/11/2019

Site 142 – 31/10/2019

Site 143 – 31/10/2019

Site 144 – 31/10/2019

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6.2 Transect and quadrat monitoring

6.2.1 Species richness

During the 6th monitoring period in Oct-Nov 2019, a total of **285 species** were recorded within different strata at the 59 monitoring sites in the Offset Area. This is a decrease of 37 species from the 5th monitoring period. Species richness within sites ranged from 8 to 40 native species (minus weeds), with 21 species per site observed on average. There was **a 6.4% decrease in average native species richness** since the 5th monitoring period.

Canopy tree species (T1 stratum) totalled 19 species (3 species less than 5th monitoring period). Those most common across the offset area remained mostly consistent with 5th monitoring period and included *Corymbia trachyphloia* (11 sites), *Eucalyptus fibrosa* (8 sites), *E. siderophloia* (7 sites), *E. acmenoides* (5 sites) and *E. planchoniana* (5 sites). There was some slight variation in the number of sites for these species since the 5th monitoring period and *Corymbia citriodora* was only recorded at 4 sites (previously 8 sites). This was due to a discrepancy in tree identification, with a number of *C. citriodora* individuals correctly re-identified as *C. henryi* at the other 4 sites (sites 69, 102, 103 and 109).

Small tree species (T2-T3) totalled 35 species (1 species more than 5th monitoring period). The majority of the species most common across the offset area were consistent with the 5th monitoring period, with the addition of *Alphitonia excelsa,* and included *Lophostemon confertus, Acacia disparrima, Eucalyptus siderophloia, L. suaveolens, E. acmenoides* and *A. excelsa* (from highest to lower abundance). *E. tereticornis* had a similar abundance to the 5th monitoring period, however the addition of new *A. excelsa* individuals which were previously recorded in the shrub layer at a number of sites, saw this species included in the top 6 (recorded in the T2-T3 layer at 17 sites this monitoring period, 9 more sites than 5th monitoring period). This is a good indication that the species have increased in height overall since the previous monitoring period, despite the dry conditions.

Shrub species (S1 stratum) totalled 60 species (4 species more than 5th monitoring period). Those that were most commonly represented across the offset area included *Alphitonia excelsa, Lantana camara, Acacia disparrima, Acacia leiocalyx, A. maidenii, Davesia umbellulata* and *Leptospermum polygalifolium* (from highest to lower abundance), with *Melaleuca linarifolia* and *Ozothamnus diosmifolius* no longer amongst those most commonly recorded.

In the ground layer, a total of 171 species were recorded (39 less than 5th monitoring period). The huge decrease in the number of species recorded was attributed to 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 included *Entolasia stricta, Lomandra longifolia, Imperata cylindrica, L. multiflora* and *Cymbopogon refractus* (from highest to lower abundance).

Of all the species recorded, 46 were exotic weeds (16% of total and 12 less species than 5th monitoring period). ***Pinus elliotti* was no longer present in the T1 layer yet remained in the lower strata (T2-T3, shrub and ground layers) at a number of sites.** Additional T2-T3 weed species included *Cinnamomum camphora*. Additional weed species in the shrub layer included *Lantana camara, Cinnamomum camphora* (recruiting), and *Baccharis halmifolia* (from highest to lowest number of sites), with *Triumphetta rhomboidea* no longer present. The ground layer contained 40 weed species (87% of weed species recorded across sites and 11 less than the 5th monitoring period), with 29 herbaceous species (1 less than 5th monitoring period) and 8 graminoids (6 less than 5th monitoring period). Five of these had the highest representation across the development area, being present at more than 10 monitoring sites (three less than 5th monitoring period). This includes *Andropogon virginicus* (24 sites, 1 more than 5th monitoring period), *Passiflora suberosa* (15 sites, 13

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sites less than 5th monitoring period), *Lantana camara* (14 sites, 22 less than 5th monitoring period), *Ageratum houstonianum* (14 sites, 1 more than 5th monitoring period) and *Lantana montevidensis* (13 sites, 5 less than 5th monitoring period). **Overall the results demonstrate a significant decline in the representation of a number of prevalent weed species** including *L. camara, L. montevidensis* and *P. suberosa*, with other previously high occurence species such as *Richardia brasiliensis, Digitaria didactyla* and *Megathyrsus maximus* represented at less than 10 sites in this monitoring period. This has been largely attributed to seasonal variation, with the extreme dry climate providing unfavourable conditions for some of the exotic herb and graminoid species. Proactive management may also account for some of the decline in weed species across sites.

6.2.2 Tree canopy cover and height (T1)

Of the sites with canopy trees present (T1 stratum), tree canopy FPC varied from 2% to 47.5% overlapping cover, with **average total canopy cover of 19.3% (same as 5th monitoring period)** (Table 8). Canopy species with high canopy cover were *Eucalyptus fibrosa, Corymbia trachyphloia, E. siderophloia, C. intermedia* and *E. planchoniana* (in order of highest to lower FPC). *Eucalyptus acmenoides* had a much lower cover and was no longer represented among the highest.

Thirty two of the sites (54.2%, same as 5th monitoring period) did not have any canopy trees present, including sites 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 44, 45, 47, 49, 54, 56, 57, 58, 59, 60, 61, 110, 111, 112, 113, 129, 130, 132, 134, 135 and 144. There was slight variation in which sites did not have canopy trees present, with sites 18 and 133 containing canopy trees this monitoring period and no T1 species recorded in sites 111 and 129. This may be due to a slight adjustment in height specifications for determining the RE benchmark values.

Of the sites with canopy trees present within the T1 stratum, tree height varied from 14 m to 22 m, with the **average tree height 17.6 m (1 m higher than 5th monitoring period)** (Table 8). Canopy species with high average canopy height were *Corymbia trachyphloia. Eucalyptus siderophloia, E. fibrosa, C. intermedia* and *E. planchoniana* (in order of highest to lower). *C. citriodora* and *E. acmenoides* were not amongst the highest in this monitoring period.

Total weed crown cover remained absent from the T1 layer. This was following management activities that were undertaken for treatment of *Pinus elliottii* and *Cinnamomum camphora* in response to recommendations made in the 1st koala offset monitoring report.

6.2.3 Small tree cover and height (T2-T3)

Of the sites with small trees present (T2 – T3 stratum), the variation in foliage projected cover (FPC) increased since the 5th monitoring period, ranging from 0.5% to 70%, with **average total FPC of 23.4% (1% lower than in the 5th monitoring period)**. Small tree species with high average cover were mostly consistent with the 4th monitoring period and included *Acacia disparrima, Lophostemon confertus, L. suaveolens, E. acmenoides* and *E. siderophloia* (from highest to lower FPC). *C. trachyphloia* was no longer amongst those with highest cover.

Of the sites surveyed, only one site (site 69, 1%, 9 sites less than 5th monitoring period) did not have any small trees (T2-T3 strata) present. **Sites which had previously no small trees recorded continued to improve,** including sites 103 and 115, which had no small tree cover in the 5th monitoring period.

Of the sites with small trees present within the T2-T3 stratum, **tree height continued to improve,** varying from 4.9 m to 13.5 m, with the average tree height 9.6 m (0.5 m higher than 5th monitoring period) (Table 8). Small tree species with high average canopy height were *Eucalyptus siderophloia,*

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E. acmenoides, C. trachyphloia, L. suaveolens and *L. confertus* (in order of highest to lower). *Acacia disparrima* was no longer amongst the highest small trees in this monitoring period.

6.2.4 Shrub cover and height (S1)

Shrub cover was present at all sites in this monitoring round. Shrub cover varied from 0.2% to 32.5% FPC, with **average total cover in slight decline at 10.2% (0.2% less than 5th monitoring period).** Shrub species with highest average FPC included *Acacia leiocalyx, Lantana camara, A. disparrima, Alphitonia excelsa* and *Lophostemon confertus* (from highest to lower FPC).

Average shrub height varied from 1.2 m to 5.2 m with an **average height at a slight decrease of 2.8 m (0.4 m less than 5th monitoring period)**. Shrub species with high average height were similar to those recorded in the 5th monitoring period, including *Acacia leiocalyx, A. disparrima, Alphitonia excels, L. suaveolens* and *L. confertus* (in order of highest to lower FPC). *Lantana camara* was no longer amongst the highest shrubs in this monitoring period.

6.2.5 Ground cover (G1)

Consistent with all previous monitoring periods, **all sites had living ground cover layer**. Ground % cover ranged from 1.2% to 61.6%, with an average of 24.9% (7.4% decrease since 5th monitoring period). This difference was mainly attributed to the extremely dry conditions, with a notable decrease in ground layer cover observed visually in the field. It may also be partly due to the slight adjustment to specifications used for ground cover height according to the RE benchmark recommendations, for more accurate reporting.

Consistent with the 5th monitoring period**, the native grass species *Imperata cylindrica* had the highest ground cover overall** and was present at 35 sites (59% of sites, 4 sites less than 5th monitoring period), which was a continuation in positive change from the weed grass *Andropogon virginicus,* which had been dominant in the ground layer in the 3rd and 4th monitoring periods. Other ground cover species with high % cover within sites included *A. virginicus, Entolasia stricta, Lomandra longifolia, Cymbopogon refractus,* the weed shrub *Lantana camara* and *L. multiflora* (in order of highest to lower % cover).

6.2.6 Weed incursion

Weeds in the ground layer were present at 41 sites (69%, 8 sites less than the 5th monitoring period), ranging from 0.4% to 34% with an average weed cover of 9.9% (2.2% decrease in weed cover since the 5th monitoring period). **Overall, weed cover in the ground layer had increased at only 5 sites (8% of sites, 12 sites less than 5th monitoring period) including sites 55, 57, 110, 111 and 115**. Interestingly, all of these sites, with the exception of 110, had decreased in cover in the 5th monitoring round. Weed cover in the ground layer had decreased at 43 sites decreased at 31 sites (73% of sites, 12 sites less than 5th monitoring period), including sites 18-54, 56, 58-61, 66, 67, 103, 109, 112, 113, 124-133, 135 and 137-144. A number of these sites had continued to decline in weed cover since the 5th monitoring period, however many of these sites, with the exception of site 110, had previously been recorded as increasing. This is therefore a positive result that is primarily attributed to a combination of effective weed management and reduced prevalence due to the dry conditions.

There was some variation in sites with highest weed cover, which included **sites 24** (34%, 2.4% decrease since 5th monitoring period), **site 59** (32%, 15.6% decrease since 5th monitoring period), **site 60** (31.6%, 2.4% decrease since 5th monitoring period), **site 111** (31%, 1.6% increase since 5th monitoring period) and **site 26** (24%, 14 decrease since 5th monitoring period) (from highest to lower % ground cover). These sites are located either within the Precinct 3 Fauna Corridor area to the north

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(sites 59 and 60), P6 Fauna Corridor area to the north-west, below the power easement (site 24 and 26) or within the Conservation Area to the east in Precinct 5 (site 111) (Figure 3).

Weed species in the ground layer with highest overall cover were consistent with the 5th monitoring period, with slight variation in the order of highest to lower abundance, including *Andropogon virginicus*, *Lantana camara*, *Setaria sphacelata,* immature *Pinus elliotti* and *Passiflora suberosa.* A number of these were also amongst those that had the highest representation across sites (*A. virginicus*, *L. camara* and *S. sphacelata*).

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Table 8 6th 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	1	0	20	19	17.0	7.3	3.4	25.0	10	28	0	63.0	32	12
19	2	1	1	14	16	0	9.4	3.3	22.0	10.5	14	0	46.5	26	2.8
23	0	6	3	16	17	0	6.9	3.8	0	16.2	13.7	0	29.9	61.6	2
24	0	3	0	13	8	0	7.6	2.0	0	17.5	1.5	0	19.0	45.2	34
25	0	2	4	17	18	0	13.0	3.1	0	38.5	5	0	43.5	32	1.2
26	0	3	8	22	25	0	11.5	2.6	0	10	19	0	29.0	47.6	24
27	0	9	2	16	22	0	6.7	3.0	0	17.5	24.5	0	42.0	9.2	1.2
28	0	5	1	12	13	0	4.9	3.4	0	4	4	0	8.0	43.6	11.2
29	0	6	4	18	19	14.5	9.0	3.8	6.0	26	2	0	34.0	36.4	14.4
30	4	2	4	26	26	18.4	11.0	2.0	47.5	9.5	1	0	58.0	28.4	1.6
31	0	3	3	10	15	15.0	10.3	2.1	6.0	20	5.7	0	31.7	3.2	0
32	0	6	1	14	15	0	8.3	3.6	0	22.5	11	0	33.5	5.2	2
33	0	5	1	10	11	0	9.3	4.5	0	17.5	28	0	45.5	10.4	3.2
44	0	4	4	20	19	0	6.9	3.0	0	7	32.5	0	39.5	9.6	2.8
45	0	0	8	19	18	21.0	12.4	2.8	13.0	35.5	6	0	54.5	42.8	2.4
46	2	4	5	25	30	20.0	12.8	2.4	13.0	31.5	6.2	0	50.7	43.6	4.4
47	0	4	3	7	11	0	7.9	3.3	0	5	26	0	31.0	19.2	0
49	0	0	6	17	17	0	8.8	2.2	0	11	18	0	29.0	26.8	2
54	0	3	11	13	21	0	8.0	2.7	0	3	18.3	0	21.3	50.4	3.6
55	0	9	8	25	40	22.0	11.3	3.8	14.0	50.5	13.5	0	78.0	18.4	2.8
56	0	4	7	18	26	0	8.4	3.1	0	17	11.4	0	28.4	22	1.2
57	0	8	2	11	17	0	5.7	3.4	0	12.5	14.3	0	26.8	32	22.8
58	0	9	4	10	21	0	9.8	3.7	0	16.5	25	0	41.5	16	5.2
59	0	3	6	23	24	0	7.4	3.6	0	12.5	4.8	0	17.3	58.4	32
60	0	6	4	9	16	0	6.7	3.7	0	7.5	5.3	0	12.8	39.6	31.6
61	0	2	5	17	19	0	6.4	4.4	0	17	5.5	0	22.5	27.2	23.2
62	2	4	4	11	21	17.0	9.8	2.2	23.0	12.5	4	0	39.5	12	0
63	3	2	8	14	27	20.8	9.4	2.2	25.0	7	12.2	0	44.2	32.8	0
64	2	3	5	13	23	17.3	10.7	3.1	25.0	11.5	5.4	0	44.2	13.2	0
65	1	5	8	22	36	15.2	10.1	2.0	31.5	15.5	8.9	0	41.9	20.8	0
66	1	7	3	22	29	17.0	9.0	3.0	2.0	27.5	16.2	0	55.9	23.6	1.2
67	3	2	4	14	23	16.4	10.0	3.1	31.0	11	12.1	0	45.7	22.4	0.4
68	2	2	12	7	23	14.3	10.4	2.8	14.0	19.5	5.8	0	54.1	22.8	0
69	3	0	5	7	15	15.5	11.0	1.3	17.8	0	2	0	39.3	17.2	0
102	3	2	5	8	17	17.2	9.5	2.9	40.5	14.5	5.5	0	60.5	1.2	0
103	5	2	5	10	21	17.1	11.7	1.5	27.5	0.5	2.5	0	30.5	7.6	0
104	2	4	9	11	26	17.3	10.5	2.9	21.0	15.5	2.8	0	39.3	19.2	0
109	2	5	4	14	24	16.6	8.8	2.4	13.0	21.5	2.7	0	37.2	6.4	0
110	0	4	3	15	15	0	13.0	2.5	0	2.5	0.2	0	2.7	53.2	16.8
111	0	6	2	9	15	0	9.5	3.4	0	33	15.0	0	48.0	38.4	31.6
112	0	4	4	19	19	0	6.9	5.2	0	17	15.2	0	32.2	34.4	13.6

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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*
113	0	1	7	17	20	0	7.5	3.1	0	3	15.8	0	18.8	41.6	16.8
115	1	3	4	19	19	14.0	6.5	3.1	3.0	1	1.87	0	5.9	44	19.2
123	3	1	5	7	16	15.4	9.2	2.4	29.0	22.5	2.2	0	53.7	15.6	0
124	3	2	3	11	19	16.3	9.9	2.9	40.5	20.5	7.7	0	68.7	11.2	0
127	3	1	10	16	27	15.1	9.5	1.4	29.5	15.5	1.7	0	46.7	15.2	0
128	6	4	2	23	30	17.3	10.1	2.9	39.0	28	7.3	0	74.3	17.6	4
129	0	7	6	23	31	0	9.9	2.4	0	35.5	23.7	0	59.2	35.6	14.8
130	0	9	5	9	21	19.0	12.5	3.0	0	70	3	0	73.0	8.8	1.6
131	3	6	3	12	24	20.7	11.6	3.0	7.0	47.5	1.5	0	56.0	12.8	0
132	0	8	6	12	21	18.0	11.8	1.5	5.0	44.7	6	0	55.7	14	2
133	3	7	3	11	22	20.3	11.3	2.3	8.0	55	6.3	0	69.3	9.2	2
134	0	5	4	8	16	0	8.7	2.0	0	61.7	3	0	64.7	14.4	0
135	0	10	1	17	23	0	10.9	2.8	0	59.7	2	0	61.7	18	4.4
136	2	6	3	9	18	19.5	10.5	3.7	20.0	56.5	11.4	0	87.9	6	0.4
137	1	7	1	17	20	20.0	10.7	1.5	11.0	34	24	0	69.0	28.8	21.2
138	1	6	2	17	19	20.0	13.5	3.3	7.0	42.5	17.5	0	67.0	15.2	7.2
143	1	6	3	18	24	19.0	12.2	1.7	2.0	52.5	6.2	0	60.7	17.6	4
144	0	7	3	11	17	0	11.1	1.2	0	51.5	3.5	0	55.0	31.6	0
Averages*	**2.4 (-0.1)****	**4.6 (+1.2)****	**4.5 (+0.6)****	**14.8 (-9.7)**	**20.8 (-6.4)**	**17.6 (+1.0)****	**9.6 (+0.5)****	**2.8 (+0.4)****	**19.3 (0.0)****	**23.4 (-1.0)****	**10.2 (-0.2)****	**0 (0)****	**44.1 (-1.3)****	**24.9 (-7.4)**	**9.9 (-2.2)****

* Note: values in parentheses indicate the percent or actual change in averages since 5th monitoring period

** Within the margin of error (+/-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 two 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 6th monitoring period condition against the 5th monitoring period and to measure against target benchmark parameters (Table 9). The 6th 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 5th monitoring period. An increasing number of sites **(54 sites, 91.5%, 4 more than 5th monitoring period) already meet the FINAL benchmark for at least one of the benchmark parameters**. This indicates that overall, sites are continuing to attain benchmark goals in some areas before the 15 year time frame, allowing management efforts to be concentrated where they are needed most. Moreover, a high number of sites are approaching or have already attained the goal of reaching their original RE conditions and are recovering naturally, or with some assisted natural regeneration.

From Table 9, it can be seen that within sites, recovery is not consistent across all variables, with individual sites at different stages of improvement, but generally trending towards improvement for small tree cover, shrub height and weed cover, and a decline in species richness (attributed to the loss of species in the ground layer due to the dry conditions), while the remaining variables remained the same.

Within individual sites, the trend of improvement (increase or no change) remained consistent across all variables (therefore no variables declining) at 8 sites (13.5%, an 11.9% decrease since 5th monitoring period). Three of these were consistent with the 5th monitoring period, including sites 31 and 33 (ORU4) and 55 (ORU6), whereas others had previously declined in at least one area. These included sites 27 (ORU2), 32 (ORU4), 59 (ORU7), 102 (ORU13) and 110 (ORU15). These sites are considered amongst those most improved in this monitoring round, despite one site (site 110) also being regarded as amongst those in poorest condition.

In general, there were two variables that were declining (native species richness and ground cover), three that were improving (small tree height, shrub height and weed cover) and four that were remaining the same (canopy cover, canopy height, small tree cover and shrub cover). A decline in at least one of the benchmark variables was recorded at 51 sites (86%, an increase of 12% since 5th monitoring period). The variable that had declined at the least number of sites was small tree height (4 sites declining). **The variable that had declined at the greatest number of sites was native ground cover (24 sites declining),** indicating this is the variable that needs most improvement and has been primarily attributed to the dry seasonal conditions as previously mentioned. A decline in two or more benchmark variables was recorded at 29 sites (1 more than 5th monitoring period). Twelve of these sites were consistent with findings for the 5th monitoring round (in bold), including sites **18, 19,** 26, 46, 47, 54, 57, 60-**62, 64, 67, 69, 111,** 123, **124** and 129, 130, **131,** 132, 133, **134,** 135-138 and **143-144.**

Regarding weed cover, the overall trend was towards improvement, with 44 sites remaining the same (7 less than 4th and 5th monitoring periods), due to a record number of sites improving and further still, meeting the benchmark. A total of 41 sites met a benchmark for weed cover compared to 30 in the 5th monitoring period, with 13 sites improving. **It is recommended to adapt management approach to reducing weed cover at high priority sites and other that have not yet met the <5% benchmark as well as preventing the return of weeds to sites that have met the benchmark, through continued monitoring and feedback.** The high priority sites are regarded as those that had the highest weed cover recorded and did not meet the benchmark, therefore need the most attention in order to bring them into alignment with benchmark targets. These include the following top 5 rehabilitation units and their associated sites and **CRU11 (site 24), ORU7 (site 59), ORU8 (site 60), ORU15 (site 111) and ORU2 (site 26) (from highest to lower % weed ground cover). Also included are additional ORU's according to additional sites that have not yet met the**

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benchmark ORU8 (site 61), CRU3 (site 57), ORU23 (site 137 and 138), ORU17 (site 115), ORU16 (site 113), ORU15 (site 110), ORU21 (site 129), ORU4 (site 29), ORU16 (site 112), ORU1 (site 18), ORU2 (site 28), ORU23 (site 138) and ORU7 (site 58) (in order from higher to lower % weed ground cover). **It is therefore 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.** Management units that have improved since the 5th monitoring period, with all associated sites now meeting the benchmark are no longer considered amongst the highest priority. This includes ORU5 (sites 45-46), CRU15 (site 49), ORU20 (site 128), ORU19 (site 133), ORU22 (site 135) and CRU8 (site 143).

Table 8 (section 6.2) contains the average results for variables within each site and also the overall average for each variable, indicating the variation since the previous (5th) monitoring period. The site with the lowest species richness recorded in the current monitoring period was site 24 (a change from site 47, which had the lowest number of species in the 3rd-5th monitoring periods), with 8 species recorded (16 species (or 66%) less than the 5th monitoring period, excluding weeds), which were predominantly ground cover species. There were no canopy (T1) species or shrubs recorded within the site in this monitoring period and 50% of the total species recorded were weeds. From the photo for site 24 in Table 7, it can be seen that there is a dense cover of browned off *Imperata cylindrica* present, which may be outcompeting other species for space in the ground layer, particularly those vulnerable to hot and dry conditions where there is little canopy cover. The species richness of site 24 should improve with the return of more favourable climatic conditions. **However, if improvement in species richness is required more immediately, natural assisted regeneration is recommended, with limited strategic mosaic removal of *I. cylindrica* to be considered in combination with in-fill planting of a variety of local native shrub and ground cover plants in alignment with recommended native species typical of RE12.3.11.** In-fill planting would ideally take place after sufficient rainfall to ensure their survival and be carried out according to specified density requirements.

The site with the highest species richness in this monitoring period was site 55, with 40 species recorded (excluding weeds) (1 less than the most species rich site (46) in 5th monitoring period). Over 63% of the native species recorded at site 55 were ground cover species. The high native species richness recorded at site 46 in the 5th monitoring period had decreased significantly from 40 species to 30 species during the 6th monitoring period. A total of 10 sites meet a benchmark for species richness, 19 less than the 5th monitoring period. This significant decline is attributed to the dry seasonal conditions.

Where T1 canopy trees were present in the 6th monitoring period they are on average slightly taller than during the 5th monitoring period, (1.0% increase). Weed canopy cover remained at 0% cover across all sites. A total of 28 sites meet a benchmark for T1 canopy cover (47.5%, a 1.6% decrease since 5th monitoring period), whilst 27 sites meet the benchmark for T1 canopy height (45.7%, same as 5th monitoring period). In this respect, the dry conditions were not considered to have affected the T1 canopy layer.

T2-T3 small tree cover decreased to 23.4% (-1% since 5th monitoring period) across sites. Where T2-T3 small trees do occur at sites, they were 9.6 metres high on average (0.5% increase since the 5th monitoring period. In slight variation to the 5th monitoring period, where the T1 or T2 layer or both was absent at site 49, all sites contained T1 or T2 layers (or both) in the current monitoring period.

Average shrub cover decreased slightly to 10.2% (0.2% less then 5th monitoring period). There has also been a decrease in the number of sites meeting a benchmark, with 41 sites (69.5%, a 5% decrease since 5th monitoring period) meeting a benchmark. A total of 58 sites meet the benchmark for shrub height (98.3%, a 5.1% increase in the number of sites). This increase may be attributed to

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the slight adjustment made to correctly align height ranges with specific RE types for more accurate benchmark determination, as described in the methods section.

The abundance of weed ground cover has continued to decline, with an average decrease of 2.2% since the 5th monitoring period. There was a notable increase in the number of sites meeting the benchmark for weed cover, with 41 sites meeting the benchmark in this monitoring period (69.5%, an 18.7% increase in the number of sites since 5th monitoring period). This decline is most likely attributable to impacts of dry seasonal conditions, combined with ongoing weed control efforts in offset management areas, such as exotic pine removal from the ground and shrub layers to allow natural emergence of native species. Successful implementation of management actions between the 2nd-5th monitoring periods may explain the continued overall decline in weed cover.

Despite some declines in species richness and foliage cover, the number of variables meeting benchmarks within sites continued to improve since the 5th monitoring period, with 58 sites meeting at least 4 benchmarks across variables and all sites reaching a minimum of three IMO-3 benchmarks (an increase since the 5th monitoring period, where all sites met a minimum of two IMO-3 benchmarks). Furthermore, 50 sites (84.5% of sites, 3.2% more than 5th monitoring period) reached the benchmark of IMO-3 or greater for at least 5 benchmark variables.

There was a slight increase in number of sites (25 sites, 42.4%, 1.8% more than 5th monitoring period) were still at IMO-1 or IMO-2 benchmark level for one or more variables and this differed within 5 benchmark variables including ground cover (16 sites, with 9 having declined and 7 same as 5th monitoring - sites 33 (ORU4), 62 (ORU9), 64 (ORU11), 67-69 (ORU9), 103-104 (ORU13), 123-124 (ORU18), 127-128 (ORU20), 130 (ORU21) and 131, 133 (ORU19)); shrub cover (7 sites, with 2 having declined, one improved and 2 same as 5th monitoring - **sites 28 (ORU2)**, 45-46 (ORU5), **59 (ORU7)**, 60 (ORU8), 65 (ORU10), 124 (ORU18) and 128 (ORU20); canopy cover (6 sites, with 3 having declined and 3 remaining the same as 5th monitoring - **site 29** and 31 **(ORU4)**, 131, 133 (ORU19), and **137-138 (ORU23)**, small tree cover (2 sites, same as 5th monitoring - **site 28 (ORU2)** and **113 (ORU16)**; and shrub height (1 site, same as 5th monitoring - site 127 (ORU20). Six of these sites (indicated in bold in the above) also failed to meet the benchmark for weed cover (<5% weed cover), (24%, 21.8% less than last monitoring period), **indicating these sites as priority areas for rehabilitation, with a focus on weed control and planting of appropriate strata specific species (when ideal seasonal conditions prevail) to bring the sites into alignment with the IMO-3 targets. Further investigation is recommended in these sites to determine the best approach to planting.**

Sites that had the **poorest condition overall in the previous (5th) monitoring period** (failed to meet the IMO-3 benchmark or higher for at least four variables) included site 28 (ORU2), site 110 (ORU15) and site 113 (ORU16). Site 110 remained the same and has not improved since the 5th monitoring round, whilst site 28 had improved slightly, with 3 variables now meeting IMO-3 or greater, however both of these sites are still amongst the poorest in the 6th monitoring period. These sites are predominantly characterised by a dense ground cover or shrub layer comprised of *Imperata cylindrica* in association with *Pinus elliotti*, or *Pteridium esculentum* or the woody weed *Lantana camara.* Site 113 improved significantly in shrub cover this monitoring period and is no longer among those of poorest condition.

There were three sites that were considered to have the **poorest condition overall in this (6th) monitoring period**. **In addition to sites 28 and 110, site 115 (ORU17) had failed to meet at least four benchmarks.** The site did not reach any benchmarks for native species richness, canopy cover, small tree height, small tree cover and weed cover in this monitoring period (same as previous monitoring), and declined significantly in shrub cover from an IMO-3 to failure to meet any benchmark. These sites are predominantly characterised by a dense ground cover or shrub layer comprised of

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Imperata cylindrica in association with juvenile *Pinus elliotti*. The dense ground cover may be out-competing other species for space in the ground layer, particularly those vulnerable to hot and dry conditions where there is little canopy cover. The conditions of these sites should improve with the return of more favourable climatic conditions, however they should also **be included amongst those prioritised for rehabilitation within the next 6 months, with focus on weed control to bring weed cover to <5%, potentially combined with thinning of *Imperata cylindrica* in the ground layer to give opportunity for the native seed bank to propagate - for increased species richness through assisted natural regeneration.** Overall, the low number of **poorest condition** sites (with less than four benchmark variables at IMO-3 or greater) is a positive result, considering this is the first monitoring period in the IMO-3 benchmark year.

The same sites were amongst those considered to have **the least improvement overall in the 6th monitoring period** (sites that had 4 or less IMO-3 or greater benchmarks achieved across variables, with the lowest number of variables improving overall). There were eight other 'least improvement" sites (3 more than 5th monitoring period) that, while they attained 4 or more IMO-3 variables, they did not have any reported improvements to benchmark results. These other least improved sites in some cases had already met high benchmarks and although not improving, were not strictly included amongst those as highest priority for management. This included site 24, site 31, site 57, site 60, site 131, sites 137-138 and site 144. All seven sites consistently failed to meet the benchmark for native species richness, with all sites declining or remained the same for the other benchmark variables. The variable that had the greatest number of sites declining was shrub cover (sites 24, 57, 60 and 131). Areas that need most improvement include the T1 canopy cover for sites 131 and 138, small tree cover for sites 57 and 60, shrub height for sites 137 and 144 and native ground cover for sites 131 and 138 and weed cover <5% for sites 24, 57, 60, 137 and 138. **It is recommended that rehabilitation efforts within these sites are focussed on assisted natural regeneration of the ground and shrub layers and potential planting within appropriate strata where possible at all five sites, with weed management in the ground layer at sites 24, 57, 60, 137 and 138.**

Overall, this assessment reveals that rehabilitation efforts have continued to improve vegetation condition in a number of the targeted offset rehabilitation areas, including areas ORU6, ORU16, ORU19 and ORU7, which are no longer considered as top priority areas for management. In addition, the number of sites that fail to meet the ≤5% benchmark for total weed ground layer has decreased to 18 (30.5%, 18.5% less than 55th monitoring period) and there has been a trend of improvement. Looking forward, it is recommended that **rehabilitation continues to prioritise weed control in areas that fail to meet the <5% weed cover benchmark, particularly those in ongoing sensitive areas, precincts 3 (ORU8), 5 (ORU15), 13 (ORU17)**, **with the addition of ORU2 and CRU11 (precinct 5) and CRU3 (precinct 3).** There are a total of 8 sites in these ORU's, none of which yet meet the ≤5% benchmark for weed cover. Priority species for weed control include **the graminoids *Andropogon virginicus* and *Setaria sphacelata,* shrubs / vines including *Lantana camara* and *Passiflora suberosa,* as well as the exotic tree species *Pinus elliotti.***

Where appropriate, rehabilitation efforts are to also prioritise ongoing maintenance of stock exclusion fencing, and planting of shrub and ground cover species specific to the pre-clearing RE type, as an integrated measure for reducing weed cover to below the 5% benchmark for all sites, in the shortest time frame possible and thereby restoring native species richness. **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, Pteridium esculentum* or exotic ground cover species may also be**

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considered, in order to provide opportunity for the natural seed bank to propagate and help improve species richness.

In conclusion, according to results for benchmark indicators and weed cover**, there are three Rehabilitation Units to be considered highest priority action, including ORU2, ORU15 and ORU17,** which have a combination of ≤4 parameters meeting benchmarks and also fail to meet the benchmark for <5% weed cover. **An additional four 'least improved' Rehabilitation Units need to be prioritised for benchmark improvements in one or more areas including CRU11 and ORU8, (native species richness, canopy height and cover, shrub cover and weed cover), CRU3 (native species richness, canopy height and cover, weed cover) and ORU23 (native species richness, canopy height and weed cover), from highest to lowest priority.** This has been determined by assessment of highest % total ground weed cover, and sites which require the most improvement.

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Table 9 6th 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 Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (<5%?)
18	ORU1	12.9-10.17/12.9-10.2	X (D)	IMO-10 (I)	IMO-10 (S)	IMO-5 (S)	IMO-5 (S)	FMO-15 (I)	FMO-15 (I)	IMO-5 (D)	X (S)
19	ORU1	12.9-10.17/12.9-10.2	X (D)	IMO-10 (S)	X (S)	IMO-10 (I)	IMO-5 (S)	IMO-5 (D)	FMO-15 (I)	IMO-3 (D)	FINAL (I)
23	CRU11	12.3.11/12.3.6/12.3.7	X (D)	X (S)	X (S)	IMO-5 (I)	FMO-15 (I)	FMO-15 (I)	FINAL (I)	FINAL (S)	FINAL (S)
24	CRU11	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-10 (S)	FMO-15 (S)	X (D)	FMO-15 (S)	FINAL (S)	X (S)
25	ORU2	12.3.11/12.3.6/12.3.7	X (D)	X (S)	X (S)	FINAL (I)	FINAL (S)	IMO-3 (S)	FINAL (I)	FINAL (S)	FINAL (S)
26	ORU2	12.3.11/12.3.6/12.3.7	X (D)	X (S)	X (S)	FINAL (S)	IMO-5 (D)	FMO-15 (I)	FMO-15 (D)	FINAL (S)	X (S)
27	ORU2	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (S)	FMO-15 (S)	FINAL (S)	FINAL (I)	FMO-15 (I)	FINAL (I)
28	ORU2	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-3 (I)	IMO-2 (S)	IMO-2 (D)	FINAL (I)	FINAL (S)	X (S)
29	ORU4	12.9-10.17/12.9-10.2	X (D)	IMO-1 (S)	IMO-10 (S)	IMO-10 (I)	FMO-15 (S)	X (S)	FMO-15 (I)	IMO-10 (S)	X (S)
30	ORU4	12.9-10.17/12.9-10.2	FINAL (S)	FMO-15 (S)	FMO-15 (I)	FMO-15 (I)	IMO-5 (S)	X (S)	IMO-5 (S)	IMO-3 (D)	FINAL (S)
31	ORU4	12.9-10.17/12.9-10.2	X (S)	IMO-1 (S)	IMO-10 (S)	IMO-10 (S)	FMO-15 (S)	X (S)	IMO-10 (S)	X (S)	FINAL (S)
32	ORU4	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-5 (S)	FMO-15 (S)	IMO-3 (I)	FMO-15 (I)	X (S)	FINAL (S)
33	ORU4	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-10 (I)	FMO-15 (S)	FMO-15 (S)	FINAL (I)	IMO-1 (S)	FINAL (I)
44	ORU5	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (S)	IMO-5 (I)	FINAL (S)	FINAL (S)	FMO-15 (D)	FINAL (S)
45	ORU5	12.3.11/12.3.6/12.3.7	X (S)	IMO-3 (S)	FMO-15 (S)	FMO-15 (S)	FINAL (S)	IMO-1 (I)	FINAL (I)	IMO-10 (D)	FINAL (I)
46	ORU5	12.3.11/12.3.6/12.3.7	X (D)	IMO-3 (S)	FMO-15 (S)	FINAL (I)	FINAL (S)	IMO-1 (S)	FMO-15 (S)	IMO-10 (D)	FINAL (I)
47	ORU5	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (D)	IMO-3 (D)	FINAL (I)	FINAL (I)	FINAL (S)	FINAL (I)
49	CRU15	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-10 (S)	IMO-10 (I)	FMO-15 (D)	FMO-15 (S)	FINAL (S)	FINAL (S)
54	ORU6	12.3.11/12.3.7	X (D)	X (D)	X (D)	IMO-5 (D)	IMO-2 (D)	FMO-15 (I)	FMO-15 (D)	FINAL (S)	FINAL (S)
55	ORU6	12.3.11/12.3.7	FINAL (S)	IMO-3 (I)	FMO-15 (I)	FINAL (I)	FINAL (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (S)
56	CRU3	12.3.11/12.3.7	X (D)	X (S)	X (S)	IMO-10 (I)	FMO-15 (I)	FMO-15 (S)	FINAL (S)	FINAL (S)	FINAL (I)
57	CRU3	12.3.11/12.3.6/12.3.7	X (D)	X (S)	X (S)	IMO-5 (D)	IMO-10 (D)	FMO-15 (D)	FINAL (S)	FINAL (S)	X (S)
58	ORU7	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (I)	FMO-15 (I)	FINAL (I)	FINAL (I)	FMO-15 (D)	X (S)
59	ORU7	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (S)	IMO-10 (I)	IMO-2 (S)	FINAL (I)	FINAL (I)	X (S)
60	ORU8	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-5 (S)	IMO-5 (D)	X (D)	FMO-15 (S)	IMO-10 (S)	X (S)

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

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Site	Rehab Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (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)	FMO-15 (I)	FINAL (S)	FMO-15 (D)	FMO-15 (D)	IMO-3 (S)	FINAL (S)
135	ORU22	12.11.5/12.11.3	X (D)	X (S)	X (S)	FINAL (S)	FINAL (S)	IMO-5 (D)	FINAL (S)	IMO-5 (D)	FINAL (I)
136	ORU22	12.11.5/12.11.3	X (D)	IMO-10 (I)	X (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (S)	X (D)	FINAL (S)
137	ORU23	12.11.5	X (D)	IMO-2 (S)	X (S)	FINAL (S)	FINAL (S)	FINAL (S)	IMO-10 (D)	FMO-15 (S)	X (S)
138	ORU23	12.11.5	X (D)	IMO-1 (D)	X (S)	FINAL (S)	FINAL (S)	FINAL (S)	FINAL (S)	IMO-3 (D)	X (S)
143	CRU8	12.11.5/12.11.3	X (D)	X (S)	FMO-15 (I)	FINAL (S)	FINAL (S)	FINAL (I)	FMO-15 (I)	IMO-3 (D)	FINAL (I)
144	CRU8	12.11.5/12.11.3	X (D)	X (S)	X (D)	FINAL (S)	FINAL (S)	FMO-15 (S)	IMO-3 (D)	FMO-15 (S)	FINAL (S)
Total meeting a benchmark (current mon.)			**10**	**28**	**27**	**56**	**58**	**41**	**58**	**53**	**41**
Total meeting a benchmark (5th mon.)			**28**	**29**	**27**	**55**	**54**	**44**	**53**	**55**	**30**
Total improving (since 5th mon.)			**4**	**9**	**6**	**25**	**13**	**17**	**32**	**5**	**13**
Total declining (since 5th mon.)			**22**	**13**	**5**	**4**	**10**	**15**	**7**	**24**	**1**
Total same (since 5th mon.)			**32**	**36**	**46**	**29**	**35**	**27**	**20**	**29**	**44**
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

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