ballina
shire council

DRAFT

Koala Plan of Management

Prepared by Ballina Shire Council

08/2015

General Publishing Information

Plan Preparation: Ballina Shire Council in association with Steve Phillips (Biolink Ecological Consultants) and the Ballina Shire Comprehensive Koala Plan of Management Project Reference Group

Published by
Ballina Shire Council
40 Cherry Street
BALLINA NSW 2480

PO Box 450
BALLINA NSW 2480
Tel: (02) 6686 4444
Fax: (02) 6686 7035
Email: council@ballina.nsw.gov.au
Website: www.ballina.nsw.gov.au

Citation: Ballina Shire Comprehensive Koala Plan of Management (Ballina Shire Council 2015)

Cover Photograph:

Version History

Date	Version	Change Reference
15 January 2015	1.0	Draft for Council Reporting (Public Exhibition)
13 August 2015	2.0	Draft for Council Reporting – changes made as a result of changes to NSW Government Policy

Executive Summary

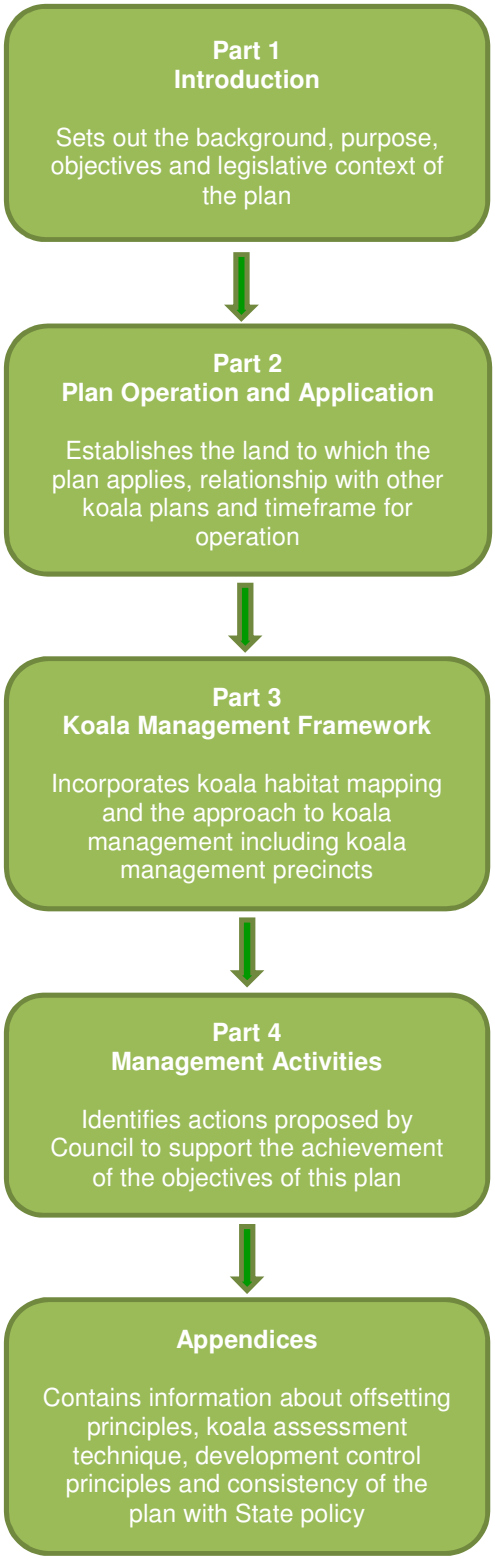
Koalas are an iconic part of the Australian landscape. Whilst many local people have lived with and known about koalas living around Ballina Shire, the 2013 *Koala Habitat and Population Assessment: Ballina Shire Council LGA* (Biolink, 2013) identified the presence of a "nationally significant" population living in the southern parts of the shire. This study provided significant insights into the distribution and abundance of koalas in the local area and their importance regionally.

Koalas in Ballina Shire are predominantly found around Meerschaum Vale, Wardell, Bagotville, Uralba, the Blackwall Range and on the Alstonville Plateau. Koala habitat in Ballina Shire is generally not in areas subject to planned urban development and so the focus on the Ballina Shire Comprehensive Koala Plan of Management is around infrastructure and rural land management. More specifically, the Pacific Highway upgrade, other road infrastructure, dogs, rural land use and private native forestry are key considerations of the plan. The plan is designed to be part of the long term management strategy of sustaining a viable koala population in the shire.

Council sees the management of lands across the shire as a collaborative partnership between community, landholders (particularly rural landholders and farmers) and government. This document is primarily a strategy to effectively achieve this collaboration but also addresses regulatory aspects of land management where there are identified benefits to the achievement of the objectives of the plan.

The plan also recognises the significant role of the NSW Government in infrastructure and forestry activities, and the impacts these activities may have on koalas. It also addresses elements of koala management where Council has roles and responsibilities.

The Ballina Shire CKPoM recognises the unique qualities of place that have supported koalas within the shire and recognises significant intrinsic value in the ongoing presence of koalas in the shire into the future.



The above flow chart provides an overview of the structure and content of the Ballina Shire Comprehensive Koala Plan of Management

Acknowledgements

This Comprehensive Koala Plan of Management (the CKPoM) was overseen in its development by the Ballina Shire Koala Project Reference Group (PRG). The PRG was convened by Ballina Shire Council as a way to ensure that all relevant issues could be included for consideration within the Plan.

The membership of the PRG was as follows:- Councillor Sharon Cadwallader (Chair, Ballina Shire Council), Lorraine Vass (Friends of the Koala, Inc), Kath Robb (NSW Farmers), Jolyon Burnett (Australian Macadamia Society), Steve Jensen (Department of Planning and Environment), John Turbill (Office of the Environment), Greg Collins (Roads and Maritime Services), A/Professor Ross Goldingay (Southern Cross University), Dr Effie Ablett (Ballina Environment Society) and Zofie Lahodny-Gesco (NSW Rural Fire Service). John Nagle (Local Land Services) provided specialist input on habitat and rural landholder issues, and Ian Gaskell (Environmental Scientist, Ballina Shire Council) on habitat.

Dr Steve Phillips, of Biolink Pty Ltd Ecological Consultants provided extensive koala expertise in development of the Koala Habitat Study to the PRG as well as the Plan. Biolink prepared the *Koala Habitat and Population Assessment: Ballina Shire Council LGA – November 2013*. This work underpinned further study on vegetation types suitable for the use of koalas in Ballina Shire. Modelling of the impacts on koala population of various events including dog attack and vehicle strike were also prepared by Dr Phillips and his team reflects a level of input well above that which was originally contracted for, but which has provided a solid basis for the preparation of the Plan.

During preparation of the Plan, rural landholders were separately engaged as a group that had a very practical interest in the provisions of the Plan. The result of this discussion has shaped many of the strategic and ancillary actions of this Plan.

The Koala Habitat Study and the CKPOM have been prepared by Council and Biolink Ecological Consultants, with funding support provided by the Office of Environment and Heritage.

Table of Contents

Executive Summary

Acknowledgements

1.0 Introduction

1.1 Plan Preparation Overview 1
1.2 Koala Habitat and Population Assessment: Ballina Shire Council LGA 1
1.3 Plan Development and Project Reference Group 2
1.4 Plan Exhibition and Adoption 3
1.5 Vision, Aims and Objectives 3
1.6 Ballina Shire Koala Population 7
1.7 Threats to Koalas in Ballina Shire 8
1.8 Important Population 12
1.9 Statutory Context 14

2.0 General Provisions

2.1 Name of the Plan 18
2.2 Land to which this Plan Applies 18
2.3 Making and Commencement of the Plan 20
2.4 Relationship to other Koala Plans of Management 20
2.5 Duration of the Plan 20

3.0 Koala Management Framework

3.1 Preferred Koala Habitat 21
3.2 Core Koala Habitat 26
3.3 Special Considerations 28
3.4 Koala Management Area and Precincts 29
3.5 Development Control 36

4.0 Management Activities 37

Dictionary 52
References 57
Appendix 1 Approved Individual KPOMS within Ballina Shire 58
Appendix 2 Methodology for sampling and assessment of Koala Habitat 59
Appendix 2a Explanation of Spot Assessment Technique 61
Appendix 3 Principles for Integration of Koala Management into Local Regulatory Planning Framework 71
Appendix 4 Basis for Offset Provisions 73

Part 1 Introduction

1.1 Plan Preparation Overview

Ballina Shire Council commenced investigations in to the koala population in Ballina Shire through the Ballina Shire Koala Habitat Study project in late 2012. With funding support from the Office of Environment and Heritage, Council engaged Biolink Ecological Consultants to prepare the *Koala Habitat and Population Assessment: Ballina Shire Council LGA* (this plan is generally known as the Ballina Shire koala habitat study).

The habitat study, completed in November 2013, was based on historic record analysis and field survey work as well as the involvement of a project reference group comprised of various stakeholder representatives. Following on from the completion of the habitat study, Council resolved to progress to the preparation of a comprehensive koala plan of management for the shire. The drafting of the plan of management has also been supported by a stakeholder project reference group.

Council initially drafted a plan of management for public exhibition in January 2015 but the plan has required review due to a number of issues identified by the Department of Planning and Environment in relation to the interpretation and application of State Environmental Planning Policy No.44.

This plan has been prepared in accordance with State Environmental Planning Policy No.44 – Koala Habitat Protection having regard for the contemporary application of comprehensive koala plans of management and the maintenance of a viable koala population in Ballina Shire.

1.2 Koala Habitat and Population Assessment: Ballina Shire Council LGA

Ballina Shire Council engaged Biolink Ecological Consultants to prepare a habitat study for the local koala population in the Ballina Shire local government area in 2012. The study, being the *Koala Habitat and Population Assessment: Ballina Shire Council LGA*, was completed in 2013 and endorsed by the elected Council at its Ordinary meeting held on 19 December 2015.

This plan of management is based on the outcomes and findings of the habitat study and subsequent additional investigations and knowledge arising in relation to koalas in Ballina Shire.

1.3 Plan Development and Project Reference Group

The development of this plan was undertaken in consultation with a project reference group and with assistance from the Office of Environment and Heritage and Biolink Ecological Consultants. The foundations of this plan were developed collectively between Council, the project reference group and Biolink Ecological Consultants and having regard for advice from state government agencies and other councils.

The project reference group (PRG) was convened to provide input to the plan which covered the diverse range of interests in koala management present within the shire, and also more regionally. The PRG included representation from NSW Department of Planning and Environment, NSW Office of the Environment and Heritage, Roads and Maritime Services, Southern Cross University, Friends of the Koala, NSW Farmers, NSW Rural Fire Service, Ballina Environment Society and the Australian Macadamia Society. Specialist input was also provided by Local Land Services and Council's Development and Environmental Health Group.

The terms of reference for the PRG established the group primarily as a sounding board for the discussion of key elements of the plan during its preparation. At times, the PRG and its members were asked to indicate a view on key aspects of the Plan. The PRG membership followed the process over two years from the initiation and development of the Koala Habitat Study to the finalisation of the basis for the KPoM. In relation to the KPoM, the group considered the vision, aims and objectives of the plan, the planning framework for the plan and a number of key issues associated with ecological, rural land management and development matters in relation to Ballina Shire.

Further to the PRG, a rural landholder engagement process invited members from the peak bodies of rural industry groups with a presence within Ballina Shire to participate in a discussion about koala management and agriculture. This allowed farmers and rural industry as much input as possible to the plan prior to exhibition.

The KPoM was initially drafted for exhibition in the first quarter of 2015. However, due to variation in the interpretation of State Environmental Planning Policy No.44 identified by the Department of Planning and Environment, this plan has been redrafted to align with contemporary thinking about the application of the SEPP and the achievement of the objectives set out in section 1.5.

Overall, the plan recognises the national importance of Ballina's koala population and Council recognises that endeavours to ensure a future for Ballina's koalas and their habitat requires the involvement of the whole of the Ballina community including rural landholders as well as government.

1.4 Plan Exhibition and Adoption

Council resolved to publicly exhibit the draft Ballina Shire Comprehensive Koala Plan of Management at its August 2015 Ordinary Meeting. The draft plan was exhibited for a period of NUMBER weeks between DATE and DATE.

Council received NUMBER of submissions in response to the exhibition period. These submissions are addressed in reporting to the Council's MONTH Ordinary Meeting.

Council resolved to adopt the Ballina Shire Comprehensive Koala Plan of Management at its Ordinary Meeting held on DATE [MINUTE NUMBER].

1.5 Vision, Aims and Objectives

This Plan represents a co-ordinated approach to landscape management with regard to providing a viable long term future for the Ballina koala population. It implements the recommendations of the supporting the *Koala Habitat and Population Assessment: Ballina Shire LGA* and has been prepared in accordance with SEPP 44 and the approved Recovery Plan for the Koala (DECC 2008).

Accordingly, this Plan covers a range of issues including development control, strategic planning, koala habitat restoration, managing threats from roads, dogs, fire and disease, community engagement, implementation, and ongoing monitoring, reporting and review. The Plan also has relevance to a wide range of stakeholders.

The plan has a number of over-arching visions and aims, as well as expected outcomes from its implementation.

1.5.1 Vision and Aims

Vision

A self-sustaining long-term koala population in Ballina Shire.

This vision is intended to be achieved through the following aims:

a. To retain and consolidate areas of core koala habitat and create or enhance koala habitat linkages.

b. To support the community in protecting and enhancing Ballina Shire's koala population.

c. To enhance community awareness of the extent and importance of the koala population in Ballina Shire.

d. To support the koala population more broadly within the Northern Rivers.

1.5.2 Objectives and Outcomes

The following can be read as objectives or outcomes that Council is seeking to achieve or substantially advance towards over the life of the Plan.

The objectives (or desired outcomes) of this plan are to:

(a) Minimise the potential for adverse impact within current and future areas of core koala habitat.

(b) Create, manage and/or restore koala habitat linkages and corridors to re-establish a complex and biodiverse landscape.

(c) Facilitate the mutually productive co-existence of people and koalas by working with landholder communities.

(d) Provide a transparent and consistent assessment pathway and criteria for the processing of development applications, as well as present guidelines for: koala habitat assessment, food tree and koala habitat retention as well as compensation for the loss of food trees and koala habitat.

(e) Promote koalas as an asset for Ballina Shire's economic development and tourism.

(f) Support allocation resources for the effective implementation and monitoring of the CKPoM.

(g) Improve community knowledge, understanding and awareness of the local koala population and koala habitat.

(h) Ensure that koalas, koala habitat and koala movement patterns are integrated considerations in infrastructure planning.

(i) Underpin a broad community and landholder ethos that values the presence of a sustainable koala population in Ballina Shire.

It is expected that the above objectives will be realised through both management activities and regulatory measures.

To assist in determining whether or not the vision, aims and objectives of this plan are being achieved, Table 1 outlines some indicators and targets that the plan can be measured against.

Table 1 Indicators for Consideration in Relation to the Sustainability of the Ballina Shire Koala Population

Description of Measure	Unit of Measurement	What will this Tell Us?	Desired Outcome
Total number of koalas	Number	Increase or decrease in population/corollary of ongoing viability of Important Population	Increase in the number of koalas within the important population area (compared to population estimated for RMS population modelling for Pacific Highway Upgrade). Increase in the number of koalas in Ballina Shire (compared to population estimated for RMS population modelling for Pacific Highway Upgrade).

Description of Measure	Unit of Measurement	What will this Tell Us?	Desired Outcome
Age cohort distribution	Number	Measure of healthy population with long term viability	Cohort distribution consistent with a normal distribution. Presence of breeding age males and females in the population suitably proportionate to the population size for population growth.
Area of habitat	Hectares	Increase or decrease in area of potentially inhabitable vegetation	Area of habitat capable of supporting koalas at least 100% of available area as at publication of this plan.
Extent of occurrence	Hectares	Area of Ballina Shire where koalas are found	Area of occupancy in important population area at 100%. Area of occupancy shire wide at least 90% of area defined in the Ballina Shire koala habitat study (43982 hectares).
Area of occupancy	Percentage (hectares occupied against habitat available)	Vegetation which is actually inhabited. Corollary measure over time in terms of ecosystem structure which supports koala populations.	Increase from 32% as identified in the Ballina Shire habitat study to a target of approximately 50%.
Connectivity of habitat	Effective habitat area (Monitored by the NSW Government, SoE process)	Effective of planting and bush regeneration programs on both public and private lands. Current measure = Poor (2012 Regional SoE Report)	Improve SOE measure above “poor”.
Koala deaths recorded by Friends of the Koala (other native animal assistance by Northern Rivers Wildlife Carers and WIRES)	Number	Measure of known koala mortality and reasons.	Reduce number of koala mortalities as a proportion of the population estimate.

1.6 Ballina Shire Koala Population

The analysis of the local koala population undertaken as part of the *Koala Habitat and Population Assessment: Ballina Shire Council LGA* (Biolink Ecological Consultants 2013) is one of nine similar studies across NSW (eight) and south-east Queensland (one).

On the whole, the results of these studies suggest there has been an average range contraction of about 30% over the last three koala generations (equivalent to approximately 18 years). Additionally there appears to have been a decrease of about 45% in the amount of otherwise suitable habitat that is being used by koalas over the same time period (pers. comm. Dr S. Phillips). This establishes a picture of declining koala populations in north east NSW and south east QLD as a background to the management of koalas in Ballina Shire.

The local analysis for Ballina Shire provides a complex picture. There was a reduced extent of occurrence and the area of occupancy during the early to mid 20th century likely related to clearing for forestry, agriculture and other purposes. Since that time, records of koala incidence had implied some recovery for both the Ballina and adjoining south-east Lismore LGA populations. It is thought that this is partly due to extensive eucalypt windbreak plantings on the Alstonville Plateau during the 1980's, providing a high nutrient food source as well as a potential transport corridor.

The apparent recovery shire-wide indicated in the records analysis was not borne out by the field surveys undertaken. Possible reasons for this include population cycling, the ongoing population isolation effects of habitat fragmentation, as well as an underestimate of numbers of koalas being subject to vehicle strike, dog attack and disease.

Notwithstanding these impacts, Ballina's koala population within the Bagotville, Meerschaum Vale and Wardell areas (the Southern Koala Management Precinct) meets the criteria for an 'Important Population' for the purposes of the *Environmental Planning and Biodiversity Conservation Act (1999).* This means that the population in Ballina Shire is recognised as a nationally significant one.

The following provides a summary of key koala population statistics derived from the Ballina Shire habitat study.

- Legislative Status: NSW – Vulnerable - Threatened Species Conservation Act 1995

  Commonwealth – Vulnerable – Environment Protection and Biodiversity Conservation Act (Southern Koala Management Precinct meets criteria for an Important Population under the EPBC Act).

- Ballina Shire Koala Population Estimate: 285-380 individuals.

Southern KMP	170 – 200
Plateau KMP	100 – 140
East Ballina KMP	3 – 4

- Area of Occupancy: 32% (trending down)
- Extent of Occurrence: 43 982 hectares (trending up)
- Area of Preferred Koala Habitat: 2000 hectares (steady)[1]
- Generational Persistence: 6 generations recorded in Ballina Shire

This Plan seeks to provide a pathway to support a nationally important koala population, whilst recognising that there are significant barriers to its ongoing sustainability. In assisting this important population the plan is also working to support other koala populations within the shire and greater Northern Rivers region through retaining, increasing and connecting available preferred habitat over time, and increasing awareness of koalas and their management needs across the broader community.

1.7 Threats to Koalas in Ballina Shire

The Koala Habitat and Population Assessment: Ballina Shire Council LGA outlines the processes threatening koala populations and their habitat in the shire. These processes include:

- Clearing of koala habitat for urban development, roadwork, forestry, agricultural and mining activities.
- Fragmentation of koala habitat which isolates individuals and populations, impedes gene flow and the ability to maintain effective recruitment levels. This includes degradation of habitat by logging of preferred food trees.
- Mortalities caused by dog attack and vehicle strike.
- Mortalities caused by random events such as fire and/or extreme weather conditions.
- Disease, mainly associated with Chlamydia.

As a guide to human impacts on koalas, the information in Table 2 shows the numbers of koalas found dead or brought into care by Friends of the Koala in Ballina Shire and

[1] The area of Preferred Koala Habitat occurs within the Extent of Occurrence, which is the reason for the much smaller area of PKH in comparison to the Extent of Occurrence.

surrounding areas during the period between 2012 and 2014. Table 2 and Figure 1 also illustrate regional figures for koala care and mortality as recorded by Friends of the Koala.

Based on a population estimate of 300 koalas within the shire and the fact that mortalities due to dog attack and road-strike are likely to be under-reported (perhaps by as much as 100%), this represents between a minimum of 3% and 5% of the population dying from anthropogenic (or non-natural events) causes each year.

This information is regional in nature, presented on a Local Government Area basis, and likely represents an under-estimate of koalas dying from these causes as they are animals found and accounted for. The higher numbers of sightings, advice and assistance provided may or may not represent greater numbers of koalas. It is possible that they represent greater awareness of the activities of Friends of the Koalas, or a larger habitat-human land use interface.

Table 2 Koala Hospital Admittance and Mortality Information 2012 - 2014

LGA	Sightings/ Advice	Admittances	Information	Mortalities
Ballina 2013-14	28	11	1 – in care 10 - mortalities	Disease – 6 Injury – 2 Unknown - 2
Ballina 2012-13	21	17	2 - released 15 - mortalities	Disease – 4 Car hits – 4 Dogs – 1 Injury – 2 Unknown - 4
Byron 2013-14	93	43	3 – in care 3 - released 35 - mortalities	Disease – 20 Car hits – 4 Dogs – 3 Injury – 3 Unknown - 3
Byron 2012-13	101	70	3 – in care 10 – released 3 - relocations 55 - mortalities	Disease – 27 Car hits – 13 Unknown - 15
Richmond Valley 2013-14	12	6	5 – mortalities 1 - released	Disease – 1 Car hit – 1 Injury – 1 Unknown 5
Richmond Valley 2012-13	10	8	9 - mortalities	Disease – 2 Car hit – 3 Injury – 1

LGA	Sightings/ Advice	Admittances	Information	Mortalities
				Geriatric – 1 Unknown - 1
Lismore 2013-14	210	175	12 – in care 10 – released 3 – relocated 150 - mortalities	Disease – 66 Car hits – 30 Dogs – 10 Injury – 6 Geriatric – 4 Orphans – 4 Unknown – 30
Lismore 2012-13	187	161	0 – in care 26 - released 135 - mortalities	Disease – 74 Car hits – 18 Dogs – 11 Injury – 11 Orphans – 8 Unknown - 13

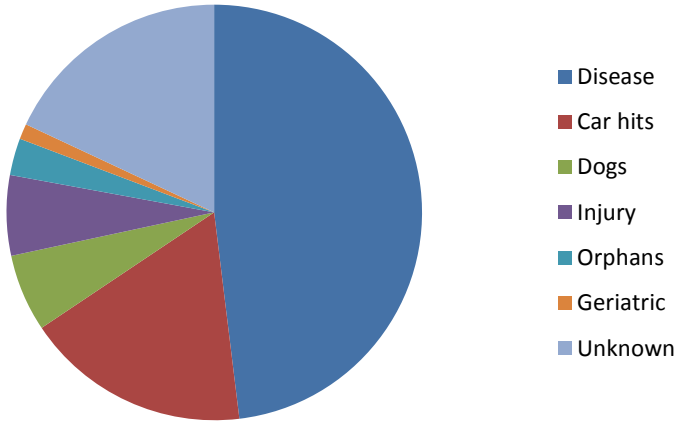


Figure 1 **Koala Mortality by Cause - 2012 to 2014, Ballina, Byron, Richmond Valley and Lismore LGAs Combined**

Disease is recognised as having a major impact on koalas, with euthanasia of diseased animals accounting for the majority of known mortalities since 2003. The *Koala Habitat and Population Assessment: Ballina Shire LGA* identifies that increases in disease can naturally occur due to reduced metabolic/genetic fitness and/or immunity caused by natural stressors such as reduced food tree availability and/or increased interaction of threats to koalas.

However, with human development in and around koala habitat, koalas face additional stress factors such as habitat loss, impediments to movement (fences, roads), vehicle strike, and dog attack, which consequently leads to increased levels of disease. Where these stress factors are not managed, the impacts of disease on individuals and koala populations are much greater.

The impacts of fire on koala populations have also been well documented for areas such as the Tweed coast and south-east Queensland. The two populations in Ballina Shire of particular concern in relation to fire are the small population located in East Ballina, and the nationally significant population in the Bagotville, Meerschaum Vale and Wardell area. Both these populations live in vegetation adjacent to and contiguous with large areas of coastal heath, which is quite prone to (and well adapted for) fire. The proximity of the heath to the important koala population area means that fire is of particular concern to the Ballina Shire koala population.

One of the most significant threats to koala habitat in Ballina Shire is the potential loss of native forests and feed trees through private native forestry. In addition to direct habitat loss, private native forestry activities may also increase the stress on koalas impacted by forestry operations raising the potential for the emergence of disease.

The siting and construction of Section 10 of the Woolgoolga to Ballina Pacific Highway upgrade also has the potential to negatively impact the koala population in the Southern Koala Management Precinct. Koala habitat will be impacted as a result of clearing for the construction of the highway and the construction and operational phase of the project may lead to increased mortalities through factors such as road strike if not adequately mitigated.

At the time of preparing this plan, the NSW Roads and Maritime Service (RMS) was engaged in detailed assessment and evaluation of the koala population in the southern part of Ballina Shire and identification of mitigation and management options. This work is being undertaken in order to meet conditions of approval for the upgrade. The investigations being undertaken by the RMS may provide significant additional information assist in understanding the local koala population, threats to its viability and opportunities to support the population. This in turn may assist in the implementation of this plan and management of the koala population in the shire over the long term.

As investigation and consideration of the Ballina Shire koala population continues, it is emerging that vehicle strike and dog attack related mortalities are significant factors to be addressed to maintain the important koala population in the southern part of the shire

(drafting note: Council is monitoring the work being undertaken by the RMS as it may provide further insight into the key threats to the koala population in the shire. Relevant information in this regard may be incorporated into this plan post exhibition).

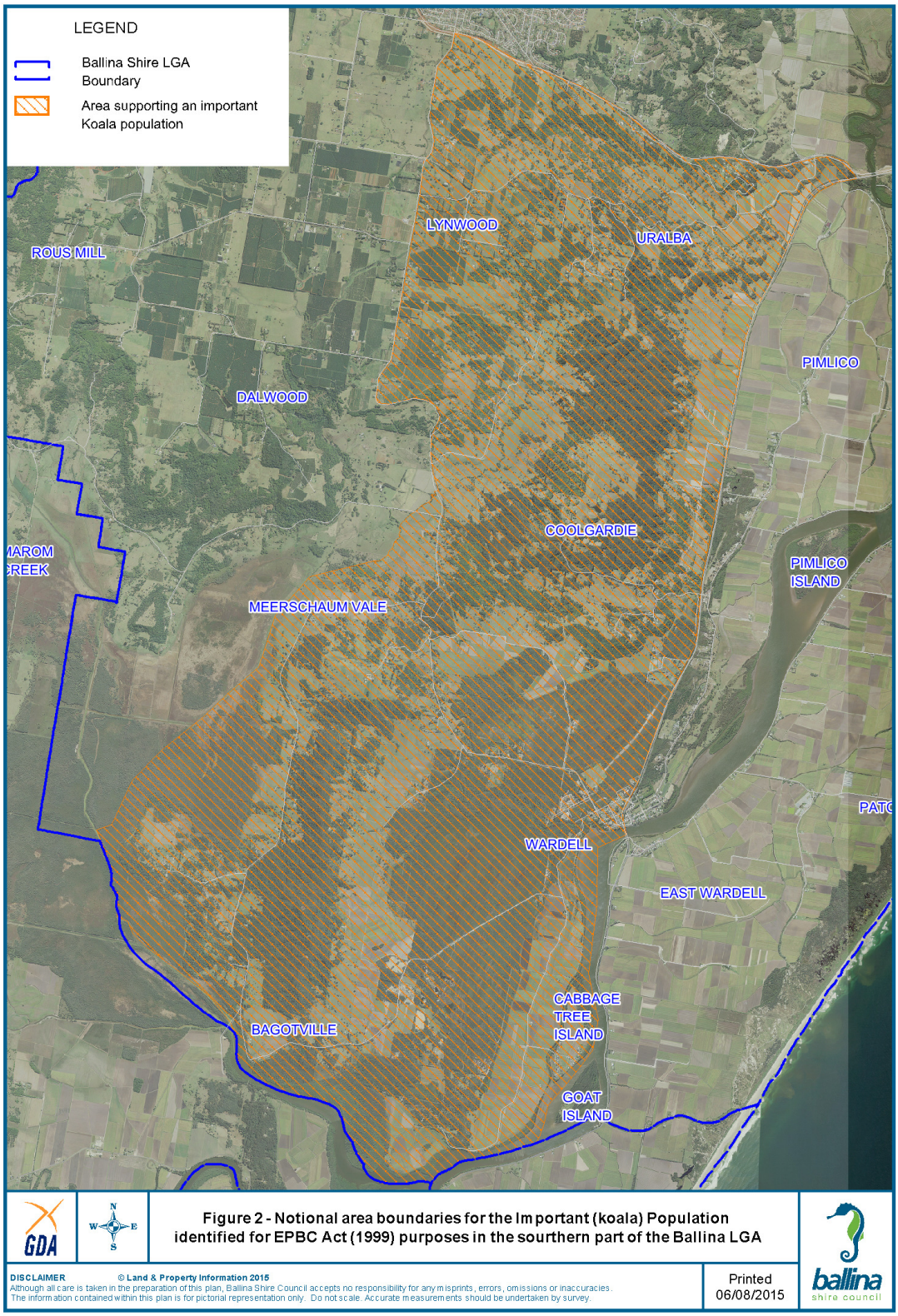
1.8 Important Population

The study *Koala Habitat and Population Assessment: Ballina Shire Council LGA* concluded that the southern half of Ballina Shire supports an Important Population of koalas, as defined by the Federal Government's *Environmental Protection and Biodiversity Conservation Act 1999.* Figure 2 outlines the boundaries of the habitat supporting the Important Population.

The population contained within the area defined in Figure 2 is also referred to as a nationally significant population.

As indicated in section 1.7, a key consideration in relation to the long term viability of the koala population in Ballina Shire, particularly within the boundaries of the Important Population as shown in Figure 2, is the construction and subsequent operation of the recently approved Pacific Highway Section 10 as part of the Woolgoolga to Ballina Pacific Highway Upgrade program.

This plan recognises the significance of the 'important (koala) population' as defined by the EPBC Act 1999 in the southern part of the shire and seeks to respond to identified threats to the shire's koala population.


LEGEND
Ballina Shire LGA Boundary
Area supporting an important Koala population
LYNWOOD
URALBA
ROUS MILL
PIMLICO
DALWOOD
COOLGARDIE
MAROM CREEK
PIMLICO ISLAND
MEERSCHAUM VALE
WARDELL
EAST WARDELL
CABBAGE TREE ISLAND
BAGOTVILLE
GOAT ISLAND
GDA
N
W
E
S
Figure 2 - Notional area boundaries for the Important (koala) Population identified for EPBC Act (1999) purposes in the sourthern part of the Ballina LGA
DISCLAIMER © Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies.
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed 06/08/2015
ballina shire council

1.9 Statutory Context

State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 is made under the *Environmental Planning and Assessment Act* 1979 with the aim of encouraging the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

b) by encouraging the identification of areas of core koala habitat, and

c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

The policy applies to any development application (DA) on contiguous areas of land under the same ownership that are greater than 1 hectare in area, and where 'potential' and/or 'core' koala habitat (as defined in SEPP 44) is found. In cases where such a DA proposes to disturb 'potential' or 'core' koala habitat, the DA assessment pathway identified in SEPP 44 must be followed.

Under SEPP 44, there is provision for preparation of plans of management which aim to protect areas of koala habitat and mitigate negative effects of a proposed development on resident koalas and their habitat. These are known as Individual (IKPoM) or Comprehensive Koala Plans of Management (CKPoM). A CKPoM can be prepared for part of or the whole of a local government area. Individual Koala Plans of Management are prepared for specific land and developments. A DA on land that supports core or potential koala habitat cannot be approved by Council unless an approved Comprehensive or Individual Plan of Management is in place.

A CKPoM offers a number of significant advantages to both Council and the proponents of development activities. For Council, the CKPoM:

- facilitates a strategic and coordinated approach to management of koalas and their habitat.
- utilises a scientific basis to consider long term koala management and associated planning outcomes in the shire.
- reduces the resources required to process individual DAs.
- facilitates further government, non-government and community involvement in koala conservation in the Ballina LGA.

- identifies the philosophy and management approach taken by Council with respect to koalas.
- identifies priorities for the application of resources and associated rationale.

For development proponents, the CKPoM:

- removes the need to prepare an Individual Koala Plan of Management (in areas where the CKPoM applies).
- supports the DA assessment process and provides overarching direction in relation to the consideration of koalas.

Ballina Local Environmental Plans and *Ballina Shire Development Control Plan 2012*

The Ballina Local Environmental Plan 2012 and Ballina Local Environmental Plan 1987 made under the *Environmental Planning and Assessment Act* 1979 (EP&A Act) provide a statutory planning framework for Council to regulate development and protect important aspects of the built and natural environment. The LEPs identify land use zones for all land in the LGA. For each zone, the LEPs set out objectives and identify what kinds of development are permitted either with or without development consent.

For development that is permitted with consent, the Ballina Development Control Plan supplements the Ballina LEP 2012 and Ballina LEP 1987 by providing more detailed information and controls. Ballina Shire's DCP provides for the protection and enhancement of ecologically significant areas. This CKPoM addresses how this can occur with respect to koalas and koala habitat.

Threatened Species Conservation Act 1995 and Environment Protection and Biodiversity Conservation Act 1999

The koala is listed as a vulnerable species throughout NSW for purposes of both the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Both pieces of legislation require individuals and/or Council to determine whether or not their actions are likely to have a significant impact on koalas or their habitat based on specific criteria.

The koala population in the southern part of Ballina Shire meets the definition of an Important Population definition for the purposes of the EPBC Act. This places particular

requirements on individuals and all levels of government when considering development in this area.

Native Vegetation Act 2003

In NSW, the *Native Vegetation Act* 2003 regulates the clearing of native vegetation on land zoned for rural purposes. Urban areas and land in conservation and forestry estates are not subject to the provisions of the Native Vegetation Act. Clearing approvals under the Native Vegetation Act are determined by the Northern Rivers Local Land Services. Depending on the zoning of the land, development consent may also be required under the applicable LEP for certain types of development or clearing.

Approval for harvesting timber from native forests on private land (private native forestry) is determined and regulated by the Environment Protection Authority. There is a Private Native Forestry Code of Practice for Northern NSW that should be followed and this is supported by the Native Vegetation Regulation 2013. Forest operations are not permitted within any area identified as 'core koala habitat' within the meaning of State Environmental Planning Policy No. 44 – Koala Habitat Protection.

Under this plan, core koala habitat is defined as including Primary, Secondary A, Secondary B Habitat and Secondary C habitat located within the Southern Koala Management Precinct (see section 3.3).

Companion Animals Act 1998

The *Companion Animals Act* 1998 and the *Companion Animals Regulation* 2008 provide for the identification and registration of cats and dogs, how they are managed and the duties and responsibilities of their owners in NSW. In particular, pet owners must ensure that their dog (or cat) does not threaten or harm a person or animal (such as a koala) and is prevented from straying or causing other nuisance.

The *Companion Animals Act* 1998 also provides for Council to prohibit dogs and cats on public land in certain circumstances for the purpose of protecting wildlife.

Local Government Act 1993

The NSW *Local Government Act* 1993 establishes and directs the functions of local government. Koala management is a relevant consideration for councils as the Act includes the following requirement by way of the Council Charter:

'to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ecologically sustainable development'.

The Act also requires Council to have in place an Integrated Planning and Reporting Framework to ensure Council operations and strategic planning are meeting the needs of the community. Within this framework, Council's Delivery Program and Operational Plan for 2015/2016 commits to preparation of a Comprehensive Koala Plan of Management for the shire.

Part 2 Plan Operation and Application

2.1 Name of the Plan

This document is to be referenced as the Ballina Shire Comprehensive Koala Plan of Management 2015.

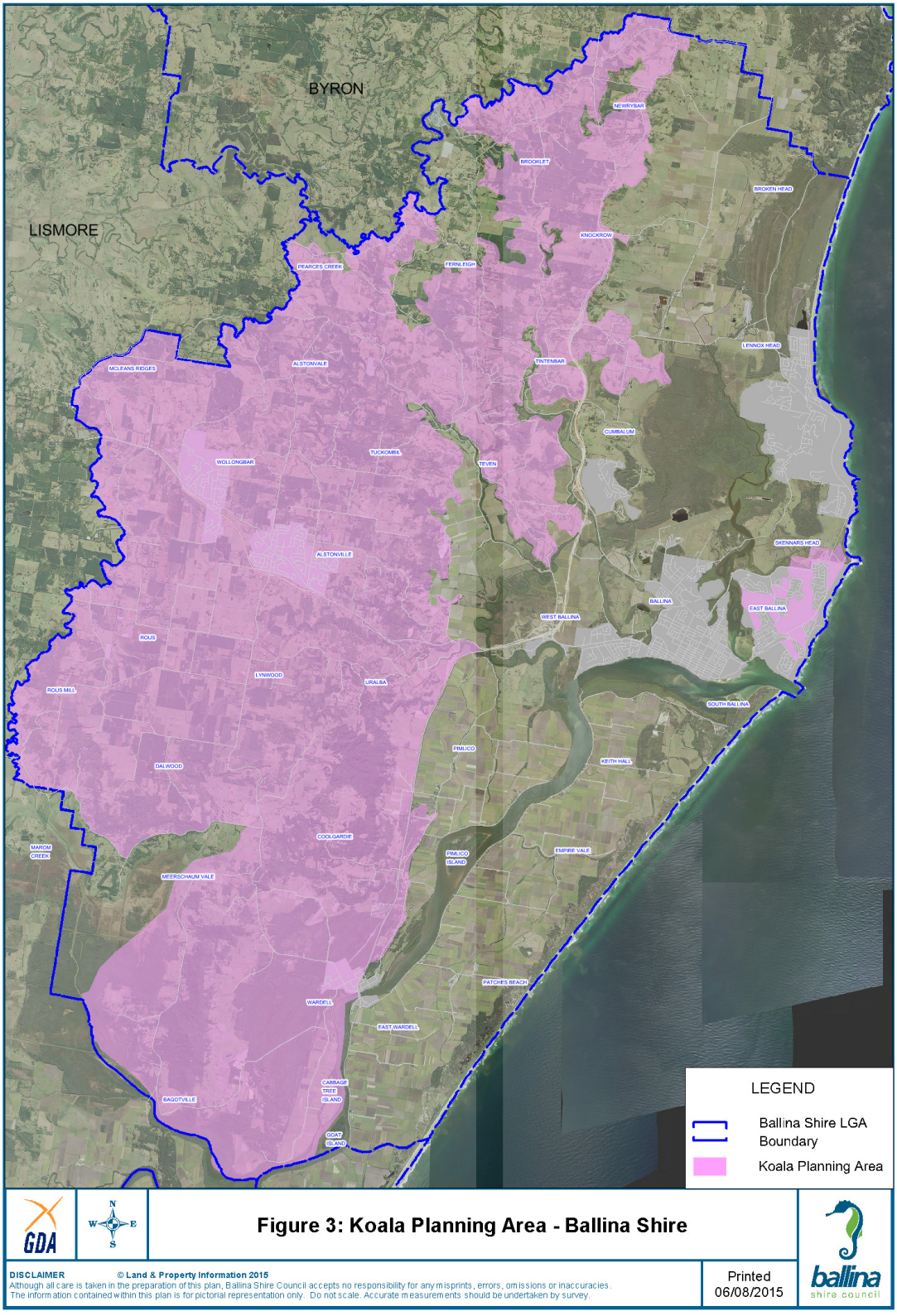
2.2 Land to which the Plan Applies

The land to which this Plan applies is identified as the koala planning area as shown in Figure 3. Further and more detailed information about the koala planning area and the associated koala management precincts is found in Chapter 3.

The Plan does not apply to:

1. Crown lands within the *koala planning area* that are dedicated as either a conservation reserve or a State Forest under the *National Parks & Wildlife Act 1974* (NPW Act) and *Forestry Act 1916* respectively; and
2. Lands that are outside the *koala planning area*.

There are areas of vegetation which were identified as meeting the criteria for identification as preferred or core koala habitat that are not contained within the koala planning area. These areas were not identified in the koala habitat study as a focal point for koala activity at the time of the habitat study completed for the shire. These areas are typically small and isolated. Notwithstanding this, these areas may still be subject to the provisions of SEPP 44 despite not being subject to this CKPOM.


BYRON
LISMORE
NEWRYBAR
BROCKLET
BROKEN HEAD
KNOCKROW
PEARCES CREEK
FERNLEIGH
LENNOX HEAD
MCLEANS RIDGES
ALSTONVALE
TINTENBAR
CUMBALUM
TUCKOMBIL
WOLLONGBAR
TEVEN
ALSTONVILLE
SKENNARS HEAD
BALLINA
EAST BALLINA
WEST BALLINA
ROUS
LYNWOOD
URALBA
ROUS MILL
SOUTH BALLINA
PIMLICO
KEITH HALL
DALWOOD
COOLGARDIE
MAROM CREEK
PIMLICO ISLAND
EMPIRE VALE
MEERSCHAUM VALE
PATCHES BEACH
WARDELL
EAST WARDELL
CABBAGE TREE ISLAND
BAGOTVILLE
GOAT ISLAND
LEGEND
Ballina Shire LGA Boundary
Koala Planning Area
GDA
N
W
E
S
Figure 3: Koala Planning Area - Ballina Shire
DISCLAIMER
© Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies.
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed
06/08/2015
ballina
shire council

2.3 Making and Commencement of the Plan

This plan has been prepared in accordance with State Environmental Planning Policy No.44 and the associated guidelines published by (the former) Department of Urban Affairs and Planning (1995) and National Parks and Wildlife Service (1999) as well as contemporary understandings of koala ecology and management. The plan also has regard for the recovery plan for the koala in NSW (2008).

This Plan was adopted by Ballina Shire Council by resolution on DATE.

This Plan (or part as specified by DPE) was endorsed by the Department of Planning and Environment under the terms of SEPP 44 on DATE.

2.4 Relationship to other Koala Plans of Management

The Plan does not supersede any approved Koala Plans of Management that are currently in force in the koala planning area. Current approved and conditional Individual Koala Plans of Management (IKPOM's) are detailed in Appendix 1. Should any of these IKPOM's have a requirement to be reviewed or updated, that review or update should be match the aims and objectives, and management actions, of this Plan.

2.5 Duration of the Plan

The Plan is to remain in effect for a period of 20 years unless amended or superseded, but may be extended at the discretion of Council.

The Plan is to be reviewed at five yearly intervals, including a comprehensive review at 10 years. The 10 year review must consider any periodic koala surveys, impacts of intervening infrastructure projects, new legislation and effectiveness of the provisions of this CKPoM in meeting the aims and expected outcomes of the Plan. Notwithstanding, the Plan may be reviewed at any time at the discretion of Council.

Part 3 Koala Management Framework

3.1 Preferred Koala Habitat

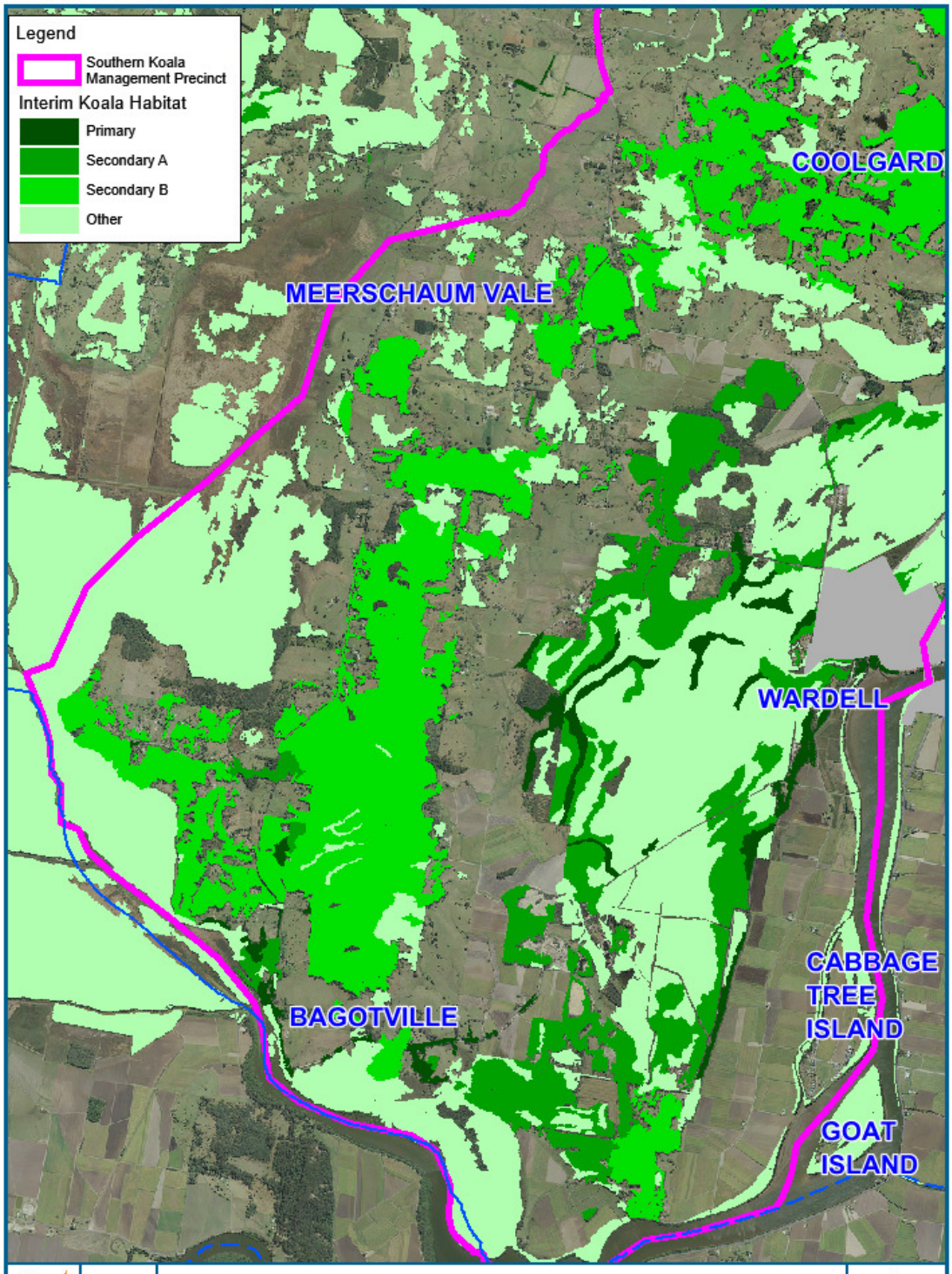
Koala habitat mapping has been undertaken to support decision making with regard to the boundaries of the koala planning area and koala management precincts. Existing vegetation mapping undertaken by Council staff, along with koala surveys undertaken as part of the 2013 Koala Habitat Study and additional field work and mapping for this plan, have been utilised to determine the following:

- The presence or absence of koala food trees and their correlating vegetation communities.
- The presence or absence of koalas.
- The relationship that can be inferred between the presence of koalas and particular vegetation communities.

This field work has then been reviewed in the context of the geomorphological attributes of the koala planning area at a landscape scale to further determine correlations between vegetation, soils, and geomorphology and the habitat preferences of koalas.

An excerpt from the resulting map of Preferred Koala Habitat is contained in Figure 4, and the full map in Figure 4a.

The habitat mapping has informed the development of the koala management precincts, as well as the actions outlined in this plan to support the Ballina Shire koala population.


Legend
Southern Koala Management Precinct
Interim Koala Habitat
Primary
Secondary A
Secondary B
Other
COOLGARD
MEERSCHAUM VALE
WARDELL
CABBAGE TREE ISLAND
BAGOTVILLE
GOAT ISLAND
GDA
N
W
E
S
Figure 4: Excerpt of Koala Habitat within the Southern Koala Management Precinct
DISCLAIMER
© Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccu
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed
06/08/2015
ballina

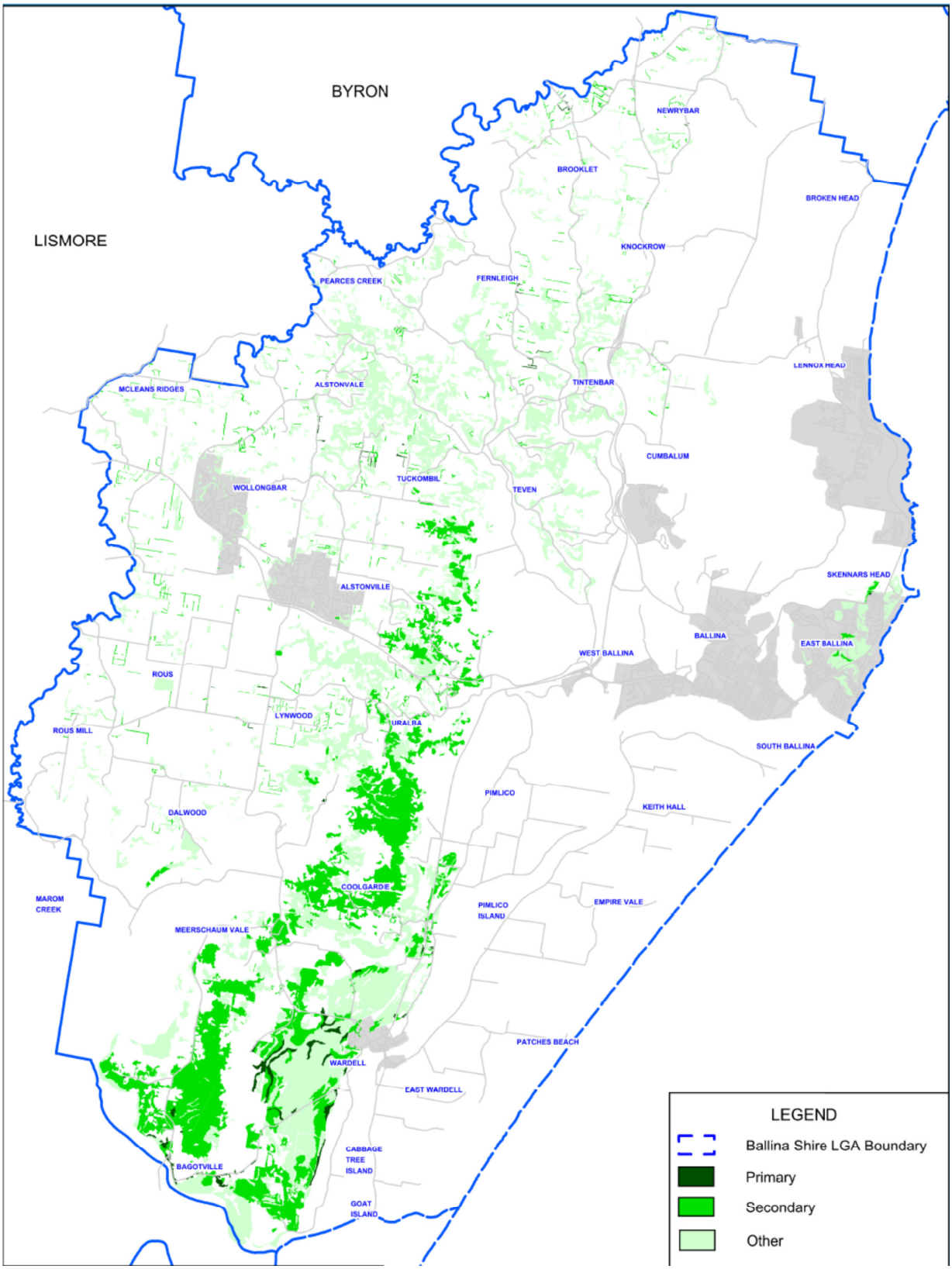


Figure 4a Preferred Koala Habitat Map

In summary, habitat categorisations used in this plan (Table 3) are based on the presence/absence of preferred koala food trees and their geomorphological location within the landscape. To this end the terms “Primary”, and “Secondary” koala food tree species as used in the following definitions are based on the mathematical models and associated definitions of Phillips (2000b) and are thus consistent with terminology used in the approved Recovery Plan for the Koala (DECC 2008).

Ongoing analyses of koala activity data from low nutrient substrates (Phillips and Allen 2014) established the basis for further partitioning of Secondary (Class B) habitat based on differences in the relative abundance of identified Secondary food tree species. Specifically, vegetation communities wherein secondary food tree species are a dominant or co-dominant component of the tallest stratum support significantly higher koala activity levels (and hence have a higher koala carrying capacity) than do vegetation communities wherein secondary food tree species occur at lower densities (Phillips and Allen 2014). This knowledge has resulted in the need to recognise a further habitat category - Secondary (Class C) Koala Habitat - as described in further detail in Table 3.

Table 3 Koala Habitat Categorisations

Habitat Class	Explanation
Primary Koala Habitat	Forest and/or woodland communities occurring on soils of medium to high nutrient value whereupon primary koala food tree species are dominant or co-dominant (i.e. ≥ 50%) components of the tallest stratum species.
Secondary (Class A) Koala Habitat	Forest and/or woodland communities occurring on soils of medium to high nutrient value whereupon primary food tree species are sub-dominant components of the tallest stratum species.
Secondary (Class B) Koala Habitat	Forest and/or woodland communities occurring on soils of low to medium nutrient value whereupon primary food tree species are absent, the tallest stratum instead dominated or co-dominated by secondary food tree species only.
Secondary (Class C) Koala Habitat	Forest and/or woodland communities occurring on soils of low to medium nutrient value whereupon primary food tree species are again absent and secondary food tree species are sub-dominant components of the tallest stratum species.

Each of the preceding classifications reflect the different koala carrying capacities of the associated vegetation communities, with areas of Primary Koala Habitat capable of

sustaining high density populations (i.e. > 0.5 koalas ha^{-1}), whereas Secondary (Class C) Koala Habitat can only sustain low density populations (i.e. < 0.1 koalas ha^{-1}).

Collectively, the four major habitat classifications function to identify areas of Preferred Koala Habitat. As a component of this classification system a habitat code of "Other" was generally applied to those communities wherein koala food tree species were absent.

However, there are many variables contributing to the distribution of koalas within a landscape. The limited extent of remaining patches of Primary Habitat within the Southern KMP does not reflect the complex nature of the landscape in terms of its ability to support the Important Population that has been identified as resident there. The population is adapted to a mix of Primary and Secondary (Class A) Habitat within a larger Secondary (Class B) and Secondary (Class C) Habitat landscape. In the Southern KMP, all types of koala habitat and the surrounding vegetation network is important for the continued occupation of the landscape by koalas. The importance of existing vegetation regardless of type and class is also illustrated by the extent of fragmentation in Ballina Shire.

This plan is designed to work at a landscape level whilst acknowledging the significance of smaller areas of habitat and the role played by individual trees and species. Management actions within this Plan are written with the intention to retain the existing complexity of vegetation landscapes and increase the connectivity between those areas which are already vegetated and supporting koalas. This approach is consistent with the application of the precautionary principle and the categorisation methods recommended in the Recovery Plan for the Koala (DECC, 2008).

Koalas living in Ballina Shire on the Alstonville Plateau are primarily dependent on windbreak plantings of Tallowwood (*Eucalyptus microcorys*) or Forest Red Gum (*Eucalyptus tereticornis)*. These plantings support a significant number of animals both in residence and in transit to other locations. Due to their location, function and presence on agricultural lands there is typically no regulatory role for Council in managing these windbreak areas.

Disruption (such as clearing or a mass dying out) of the windbreaks over time is a threat to koala populations that have established themselves in these areas, given the importance of the long-term relationship koalas have with their home range (Mitchell, 1990; Phillips, 1999 as referenced in Phillips 2013). A number of the management actions noted in this CKPOM are designed to address this.

In addition, a large portion of mapped vegetation is mapped as Unknown habitat. For vegetation mapped as Unknown habitat, there was insufficient data to enable classification. This vegetation may include both individual trees and clumps of trees which are unmapped owing to the resolution of the mapping. There is potential for these areas to support koala food trees, and koalas.

It is also known that preferred koala food trees may be scattered across land outside vegetation communities that are identified and mapped as preferred koala habitat.

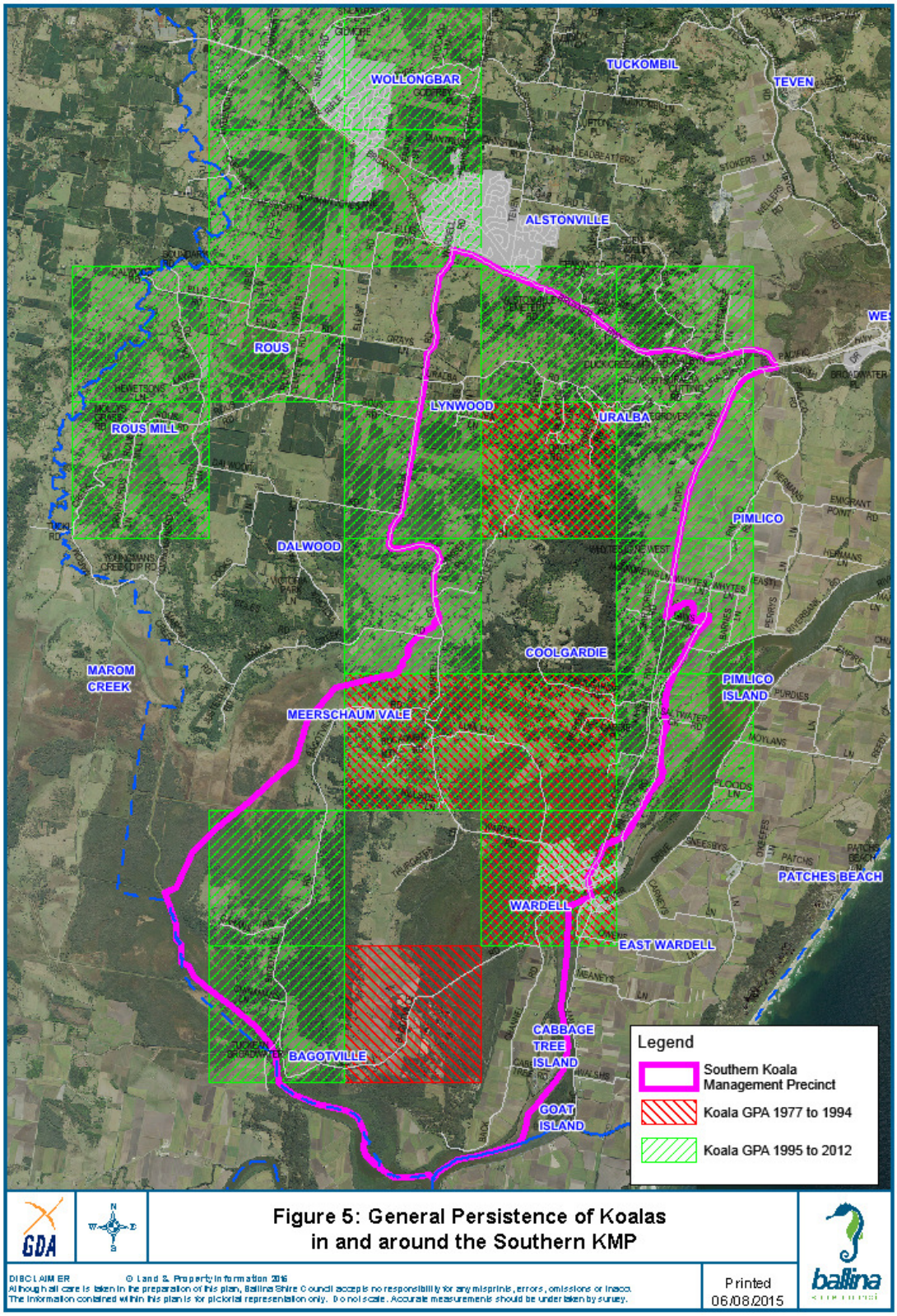
3.2 Core Koala Habitat

SEPP 44 aims "*to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".*

The definition of Core Koala Habitat within SEPP 44 means '*an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'*.

Figure 4 demonstrates the complexity of the koala habitat and how vegetation communities form a mosaic to link together and create habitat. Figure 5 shows the extent of occurrence over time within the Southern KMP, from which has been derived generational persistence. Koalas have a long recorded residence time in this area, and their contemporary presence has also been comprehensively mapped (2013) as well as being subject to ongoing monitoring.

There is a very clear link between the habitat available and the ongoing persistence of koalas, including breeding females, in this location. The habitat study and subsequent investigations in the area have demonstrated the contemporary and historic presence of a koala population throughout the Southern KMP area. It is therefore considered that all Preferred Koala Habitat within the full geographic extent of the Important Population Boundary (Figure 1 and Figure 6 – Southern Koala Management Area) meets the *Core Koala Habitat* descriptor given that it currently supports a permanent resident free living population.


WOLLONGBAR
TUCKOMBIL
TEVEN
ALSTONVILLE
ROUS
ROUS MILL
LYNWOOD
URALBA
PIMLICO
DALWOOD
COOLGARDIE
MAROM CREEK
PIMLICO ISLAND
MEERSCHAUM VALE
PATCHES BEACH
WARDELL
EAST WARDELL
CABBAGE TREE ISLAND
BAGOTVILLE
GOAT ISLAND
Legend
Southern Koala Management Precinct
Koala GPA 1977 to 1994
Koala GPA 1995 to 2012
GDA
Figure 5: General Persistence of Koalas in and around the Southern KMP
DISCLAIMER © Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccu
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed 06/08/2015
ballina

Specifically, the Ballina Koala Habitat Study (Phillips, 2013) notes that:-

- The extent of occurrence of koalas across the LGA has expanded by 24% over the last 3 koala generations.
- The Southern KMP appears to be a significant source population for regional population recovery over past 60 years.
- Approximately 70% of the Ballina LGA koala population lives within the Southern KMP, which exposes the LGA's population as a whole from a risk management point of view.

3.3 Special Considerations

Windbreaks on the Alstonville Plateau and areas within East Ballina are identified as Preferred Koala Habitat under SEPP 44. They have not been identified as Core Koala Habitat despite supporting koalas over at least 3 koala generations for the following reasons:-

- Windbreaks on the Alstonville Plateau are typically exempt from clearing regulation due to their location, function and occurrence on agricultural lands. Notwithstanding this, their importance to the ongoing existence of approximately 30% of the Ballina LGA's koala population is evident.
- The East Ballina population is very small, approximately 3 or 4 individuals. This may not a sustainable population in itself without support, and the population's ability to persist long term in this area is not clear.

Whilst the decision has been taken to place a greater planning emphasis on the Southern KMP as Core Koala Habitat, this does not mean that koalas living in the Plateau KMP or the East Ballina KMP (see below) are not a focus of this Plan. Core koala habitat may be present in these areas upon investigation as required by the applicable development assessment framework. The provisions of Chapters 2 and 2a of the DCP require consideration of the environmental constraints of a site being considered for development in any location. The assessment undertaken in considering the general and environmental considerations for a site should identify vegetation onsite, as well as its potential for supporting koalas, and should be considered in the context of the habitat classes presented within this CKPoM.

3.4 Koala Management Area and Precincts

This plan provides for three koala management precincts, within a single koala planning area (KPA is shown in Figure 3). The precincts have been developed based on the recommendations made in the habitat study for the shire and the subsequent habitat mapping undertaken to support this plan. The philosophy behind their selection has been to identify the locational characteristics of koala habitat and the koala population, as well consider existing land use and future land management.

This has resulted in the identification of three precincts managing different aspects of the Ballina koala population, each with a slightly different objective for long-term land management but each with the overall objective of supporting this Plan's vision of a self-sustaining, long-term koala population in Ballina Shire. The precincts are illustrated in Figures 6, 7 and 8.

Areas shown as preferred koala habitat in the vegetation/habitat mapping accompanying this plan meet or exceed the definition within SEPP 44 where the trees listed (see definitions for locally relevant food tree species) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component, for each specific ecological community. This is based on assessment of vegetation community types as opposed to property based analysis.

It is possible that during the life of this Plan that koala management precincts may change or expand, depending on the results of the Management Action 3 – four yearly reviews of koala activity across the shire.

As noted below, three koala management precincts (KMP) are identified within the *koala planning* area. Their role is to provide for a specific management focus for populations within these areas. The precincts are as follows:

3.4.1 Southern (Bagotville/Meerschaum Vale/Wardell/Blackwall Range/Uralba) KMP

The principal objective of this precinct is that of ensuring that the koala population can continue living in and from the area. To this end, this Plan aims to:

a) Retain koala habitat and food trees.

b) Build on the above to extend linkages to other preferred koala habitat.

c) Reduce the incidence of koala mortality by addressing key threats such as habitat loss and fragmentation, road strike and dog attack.

d) Support the occupation of the broader landscape within the Important Population Area by koalas in the form of a self-sustaining population.

This precinct is the main area in which regulatory provisions are proposed to support retention of koala habitat. This is because the Southern KMP is the core area in which the koalas of Ballina Shire live. Remnant vegetation on lenses of residual soils within poorer erosional soils on slopes provide core koala habitat now, as well as previously providing a refuge from the large clearing events of the early to mid-1900s. The objectives of this KMP are therefore intended to retain koala habitat over time, encouraging the long-term preservation of remaining habitat. Areas that do not currently support trees may provide landholders with an opportunity to engage in the planting of koala habitat. Such planting may create linkages between areas of existing habitat important for this KMP.

Whilst the precinct currently exhibits some good contiguous vegetation with ecotones between topography, soil types and groundwater conditions (with koalas occupying this vegetation between Bagotville, Wardell, Uralba and Rous), construction of Section 10 of the new Pacific Highway has been approved to longitudinally transect this vegetation.

The koala population within the Southern KMP is an 'Important Population' under the provisions of the *Environmental Protection and Biodiversity Conservation Act (1999)*. The approval issued by the Federal Government in relation to the highway upgrade notes that a Koala Management Plan must be prepared for Section 10 of the Pacific Highway upgrade to ensure that an unacceptable impact will not occur to the Ballina koala population. This condition indicates the importance of the objective of ensuring that the koala population is supported to continue living in and colonising from the area.

Even without the possibility of issues posed by the Pacific Highway, current figures suggest that the population is experiencing mortality rates of up to 20% per annum. Fifty percent of the mortalities currently experienced within the koala population are due to dog attack, often domestic dogs, and vehicle strike (pers. comm. S. Phillips). Two main cohorts of the koala population are missing from the demographic profile. These are the sub-adult males who are typically the most mobile cohort whilst looking for an unoccupied home range, and older breeding males, who again are relatively more mobile.

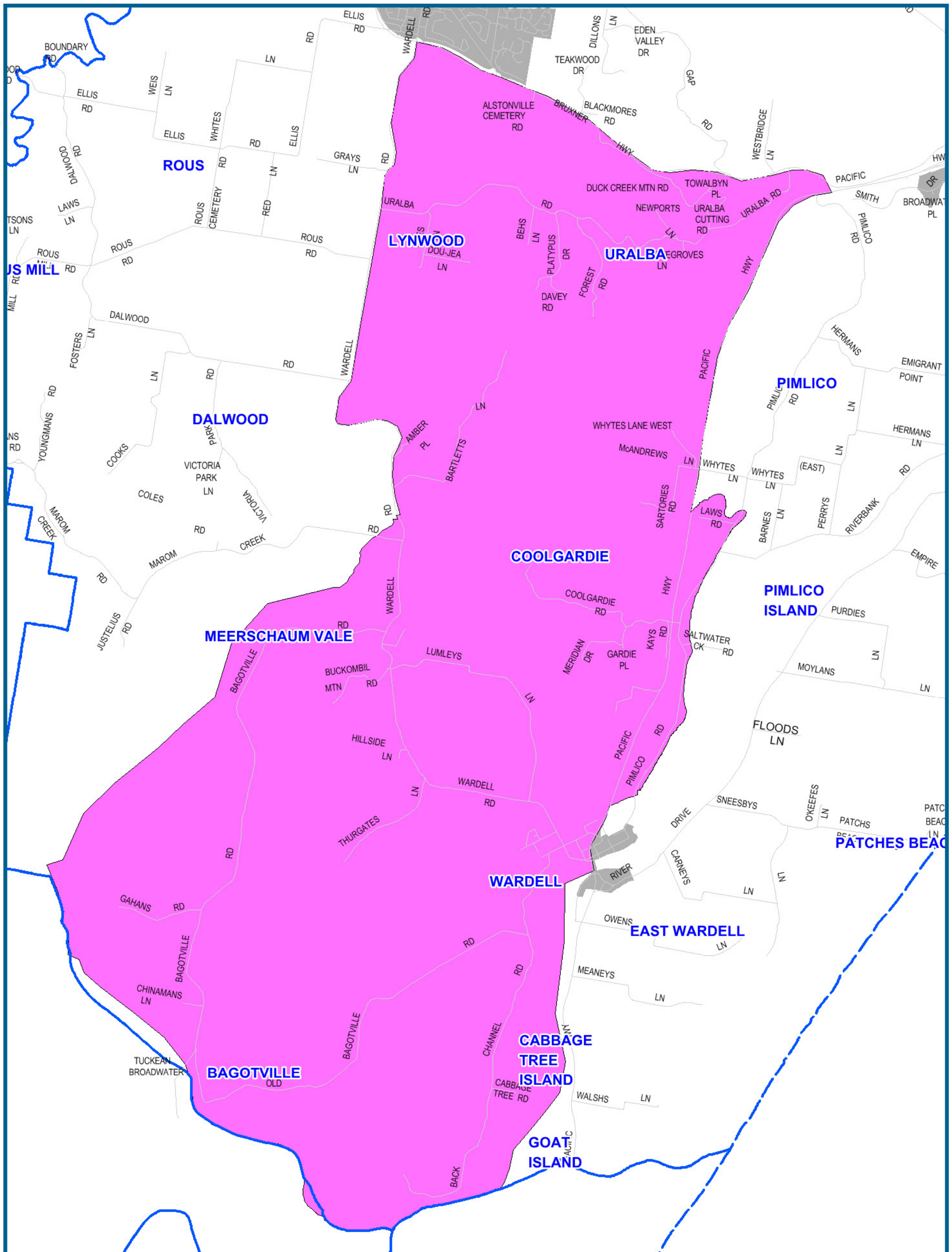


Figure 6: Southern Koala Management Precinct

DISCLAIMER

© Land & Property Information 2015

Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies. The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.

Printed 06/08/2015

3.4.2 Plateau KMP

The principal objective of this KMP is to support the ongoing viability of the Plateau population in a highly fragmented and working farmland landscape. This area traditionally supported Big Scrub vegetation and is additionally identified as an area of State Significant Agriculture. As part of the agricultural history of the area, eucalypt windbreaks were planted during the 1980's. These windbreaks now support up to 30% of Ballina's koala population.

With respect to this KMP, this Plan aims to:

a) To minimise threats to the persistence of the population;

b) Support collaboration between landholders and the community to manage koalas living in windbreaks and isolated pockets of vegetation on the Alstonville Plateau;

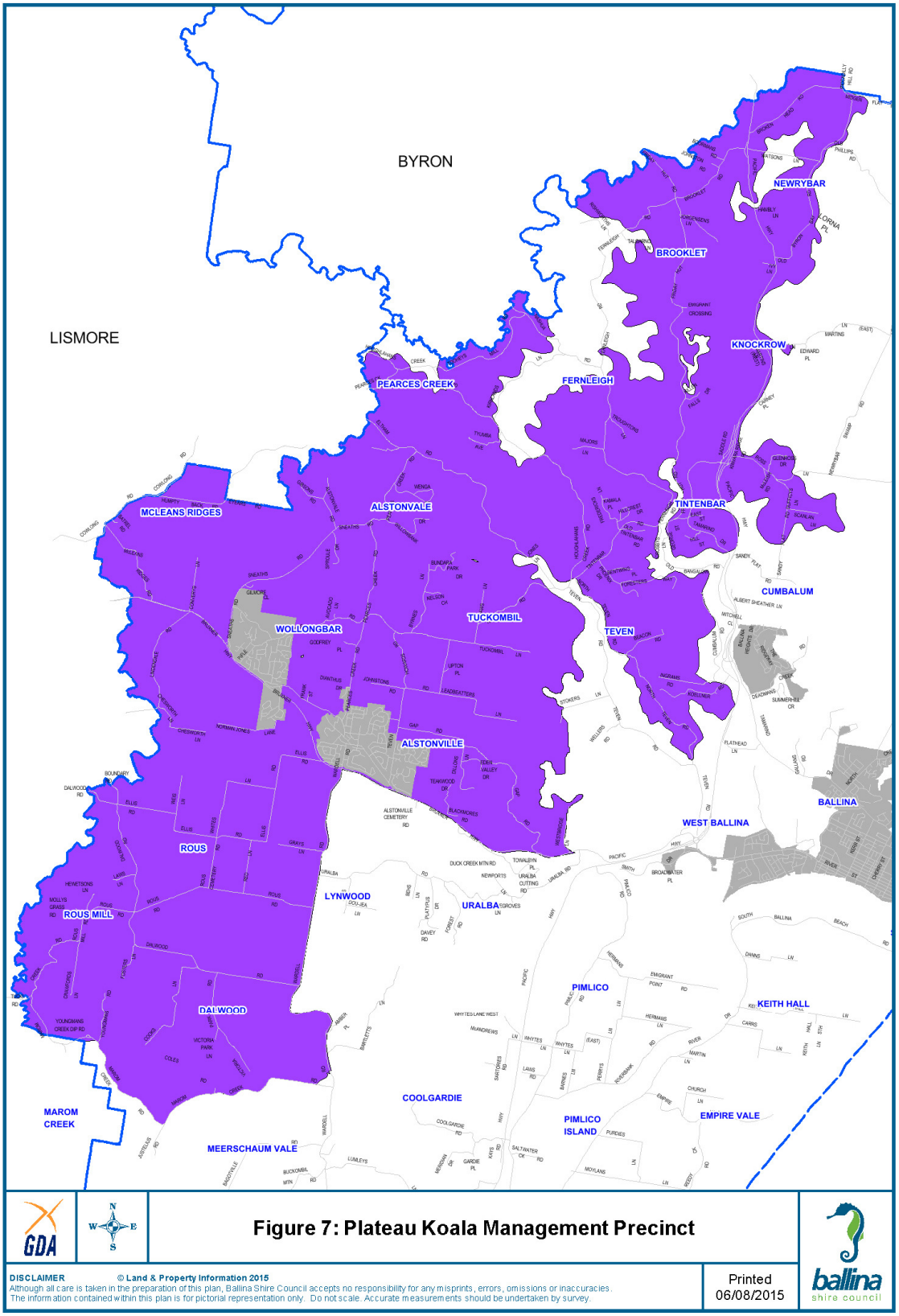
c) Identify strategic areas for planting of transitional linkage vegetation; and

d) Monitor the use of the area by koalas – that is, in terms of its permanent koala residents and those using the area as a transport corridor – to determine longer-term outcomes for this KMP.

It is understood that many of the trees in which koalas live in this KMP were planted by farmers in response to tree giveaways of Tallowwood and less often, Forest Red Gum, during the 1980s and 1990s. These species are not native to the vegetation communities which would previously have grown on the Plateau, but the fertile soils have resulted in long planted avenues of particularly nutritious trees, which have been, and are being, utilised by koalas.

Habitat in this KMP is also held in small pockets of highly fragmented remnant vegetation, supplementing the koala food trees found in windbreaks. Landscape scale changes have significantly modified the Plateau and surrounding landscapes due to widespread clearing. Koalas are now utilising a niche which has effectively replaced habitat areas in which they previously lived.

Over time, it is envisaged that a collaborative approach to managing the availability of koala habitat will result in an increase in areas which are not utilised for agricultural purposes providing koala habitat.


BYRON
LISMORE
NEWRYBAR
BROOKLET
KNOCKROW
FERNLEIGH
PEARCES CREEK
TINTENBAR
ALSTONVALE
MCLEANS RIDGES
CUMBALUM
TUCKOMBIL
TEVEN
WOLLONGBAR
ALSTONVILLE
BALLINA
WEST BALLINA
ROUS
ROUS MILL
LYNWOOD
URALBA
DALWOOD
PIMLICO
KEITH HALL
COOLGARDIE
PIMLICO ISLAND
EMPIRE VALE
MAROM CREEK
MEERSCHAUM VALE
GDA
N
W
E
S
Figure 7: Plateau Koala Management Precinct
DISCLAIMER © Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies.
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed 06/08/2015
ballina shire council

3.4.3 East Ballina KMP

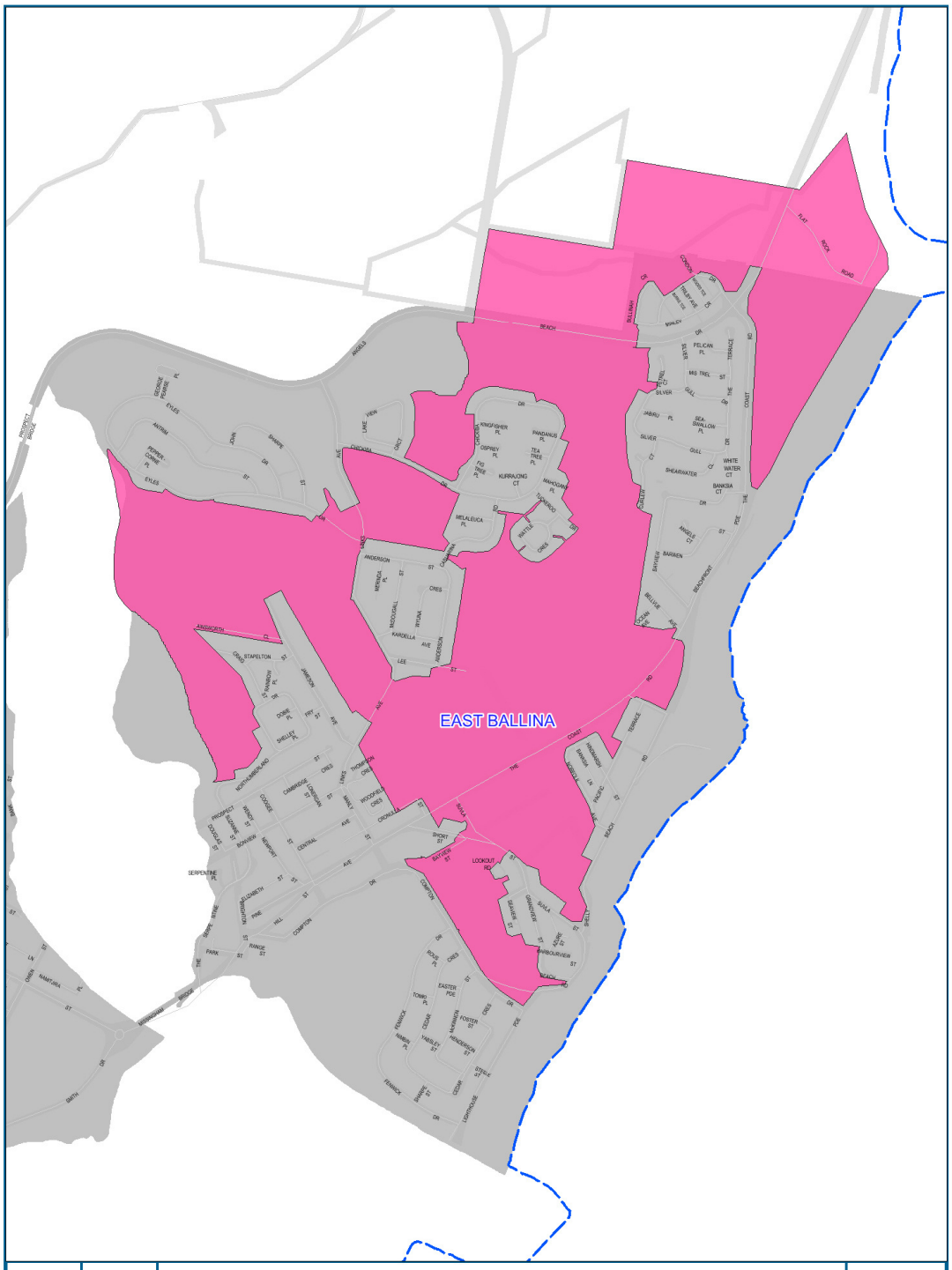
The East Ballina KMP recognises the presence of a very small population, the establishment of which probably preceded construction of the recently upgraded Pacific Highway Ballina Bypass. Little is known about koalas in this area, particularly their capacity to persist as a viable population. Management actions within this Plan aim to improve understanding and monitoring of the koala population in East Ballina, to inform reviews of this CKPoM and support development of future management objectives.

The management objectives in this Precinct are:-

a) To monitor the use of the area by koalas with the aim of reviewing the provisions of this Plan for this KMP if required, and

b) To minimise threats to the persistence of the population.

Most vegetated land is held in public ownership here, although the only mapped area of Primary Koala Habitat is situated at North Angels Beach. There are likely adverse impacts from road strike and uncontrolled domestic dogs. Management actions will focus on these aspects in the initial phase of the Plan's implementation.


EAST BALLINA
GDA
N
W
E
S
Figure 8: East Ballina Koala Management Precinct
DISCLAIMER © Land & Property Information 2015
Although all care is taken in the preparation of this plan, Ballina Shire Council accepts no responsibility for any misprints, errors, omissions or inaccuracies.
The information contained within this plan is for pictorial representation only. Do not scale. Accurate measurements should be undertaken by survey.
Printed
06/08/2015
ballina
shire council

3.5 Development Control

This plan of management defines the extent of core koala habitat in the Southern KMP for the purposes of SEPP 44. As well as demonstrating overall consistency with this plan, all development proposed in this area must be consistent with the objectives of this plan and the objectives of the Southern KMP. These requirements, as set out under this plan, are supplemented by planning provisions contained in Council's local environmental plan and development control plan documents.

Assessment of potential and core koala habitat is required to be undertaken in relation to the provisions of SEPP 44 for the Plateau and East Ballina KMP areas.

The development control framework envisaged under this plan as it relates to Council's local environmental plan and development control plan documents is outlined in Appendix 3.

4.0 Management Activities

The aim of this section is to set out management activities that advance the objectives of this plan and the KMPs within it. Broadly, these activities are designed to:

- minimise threats to koalas and their habitat;
- reduce anthropogenic caused koala mortality;
- increase the amount of koala habitat in the koala planning area;
- maintain and where possible improve the quality of existing koala habitat in the koala planning area;
- ensure effective implementation and monitoring of the Plan by Council.

Management activities to be conducted by Council to support the achievement of this plan's objectives are detailed in Table 4. The actions have been classified into the following categories: implementation and monitoring; regulatory processes; habitat conservation, restoration and management; communication and education; road and traffic management; dog management; koala health and welfare; bushfire management; funding; research and economic development and tourism. A category for aspirational or stretch actions (marked as A under priority in the table) is also incorporated into the table (with these matters being subject to the availability of opportunistic resources – that is, they are not core priorities of the plan but could be beneficial if resources become available).

Some of the management activities and actions outlined in Table 4 can be completed under existing Council service levels and recurrent budgets. Other elements require additional resourcing. Completion of the actions is subject to the allocation of resources, whether time or budget, via Council's Delivery Plan process and/or successful applications for external funding.

Table4 Schedule of Management Actions

Activity / Action ID	Management Action	Priority 1/2/3	Target for Implementation	Planned Return Interval	Estimated cost (per action per time, exclusive of staff time)	Rationale
Implementation and monitoring						
1	Establish a Koala Advisory Group to monitor the implementation of management activities identified in this Plan.	1	Initiation within one year of adoption of the Plan	Annually	$250	Monitor implementation of plan. Provide an ongoing role for organisations involved in developing the CKPoM.
2	Provide a public report on the implementation of the plan and the status of the koala population and habitat in Ballina Shire.	2	First report within two years of adoption of the Plan	Four yearly	$500	Provide transparency of process and consistent flow of information. Support community education about the koala population.
3	Establish a regular monitoring program to assess the status of the koala population.	2	Four – five years after adoption of the Plan	Four yearly	$10,000 - $20,000	Monitor koala population. Monitor effectiveness of actions and provide scientific basis for decision-making.

Activity / Action ID	Management Action	Priority 1/2/3	Target for Implementation	Planned Return Interval	Estimated cost (per action per time, exclusive of staff time)	Rationale
4	Integrate koala habitat outcomes associated with development approvals into Council's compliance program.	2	Within three years of adoption of the Plan	Ongoing	$0 Integrated into existing compliance program	Monitor effectiveness of conditions including in relation to long-term viability of food tree and habitat compensation measures. Ensure compliance with conditions.
Regulatory processes						
5	Include *preferred koala habitat* in best available environmental protection zone and incorporate provisions requiring consideration of koalas and koala habitat in relation to development under the *Ballina Local Environmental Plan*.	1	Within one year of adoption of the Plan (subject to E zones review being undertaken by NSW Planning)	N/A	$0 Integrated into existing LEP program	Recognition of habitat values in local planning instrument with accompanying regulatory provisions to address habitat values.
6	Amend the Natural Areas and Habitat Map within the *Ballina Shire DCP 2012* to incorporate all Core and Preferred Koala Habitat.	1	Within six months of adoption of the Plan	N/A	$0 Integrated into existing DCP program	Ensure consistency in mapping. Ensure recognition and address of habitat values in local planning provisions.

Activity / Action ID	Management Action	Priority 1/2/3	Target for Implementation	Planned Return Interval	Estimated cost (per action per time, exclusive of staff time)	Rationale
7	Amend the *Ballina Shire DCP 2012* to require consideration of koalas and koala habitat consistent with the principles and objectives of this Plan (refer to Appendix 3).	1	Within one year of adoption of the Plan	N/A	$0 Integrated into existing DCP program	Implementation of koala management provisions into local planning framework.
8	Apply objectives of this plan and the identified impact assessment principles of this Plan to LEP amendment processes (refer to Appendices 2, 3 and 4).	1	On adoption of the Plan	Ongoing	$0 Integrated into existing DCP program	Incorporation of koala management provisions consistent with this Plan into strategic planning processes.
9	Implement standard conditions of consent giving effect to the objectives of this Plan and the associated regulatory provisions arising from actions 5, 6 and 8.	1	Within six months of adoption of the Plan	Ongoing	$0 Integrated into existing regulatory planning program	Integration of koala management planning outcomes into development assessment and approval framework.
10	Include information regarding the presence of mapped *preferred and core koala habitat* on certificates issued under Section 149 (5) of the EP&A Act.	2	Within three months of adoption of the Plan	Ongoing	$0 Integrated into existing s149 certificate program	Identification and communication of information to landowners and property purchasers.
11	Develop and deliver a training program for Council staff prior to implementation of this Plan.	2	Prior to adoption by Council.	N/A	$250	Ensure consistency in understanding of issues and application of this Plan and associated planning processes.

Activity / Action ID	Management Action	Priority 1/2/3	Target for Implementation	Planned Return Interval	Estimated cost (per action per time, exclusive of staff time)	Rationale
12	Communicate with planning and natural resource management consulting industry with regard to requirements of KPoM.	2	Within one year of adoption of the Plan	Ongoing	$250	Support consultants in understanding the requirements of this Plan and associated regulatory provisions.
13	Undertake an assessment of the economic value of preferred koala habitat and the koala population in Ballina Shire.	A	Where resources become available	N/A	$25,000+	Provide an understanding of the economic contribution of the koala population in Ballina Shire.
14	Implement guidelines for the provision of new or compensatory habitat on public and private land (refer to Appendix 4).	2	Within two years of adoption of the Plan	Ongoing	$2,000	Provide a benchmark for compensatory habitat requirements and enhance consistency and clarify. Improve communication in relation to koala management requirements.

Habitat conservation, restoration and management						
15	Engage the Minister and the responsible Department with regard to PNF to request that private native forestry not be approved in areas of core koala habitat in Ballina Shire.	1	Within two months of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Address a primary mechanism for clearing of significant koala habitat
16	Engage the Minister and the responsible Department with regard to E zones to seek inclusion of preferred koala habitat in environmental protection zones.	1	Within two months of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Support recognition of koala habitat in local planning framework.
17	Identify measures to address and manage PNF in Ballina Shire with respect to the aims and objectives of this Plan.	1	Within two years of adoption of the Plan	N/A	$0 Integrated into existing strategic planning program	Reduce potential impact of PNF on koala habitat
18	Identify public lands (such as roads and road reserves, parks and other public lands) and areas of possible koala habitat in Council and public ownership potentially suitable for revegetation and restoration projects in partnership with rural landholders.	1	Within two years of adoption of the Plan	N/A	$15,000	Enhance extent of koala habitat. Support Plateau KMP koala population where windbreaks are cleared or lost.
19	Prepare a priority koala habitat restoration program (including map) to prioritise restoration and revegetation of strategic areas within the koala planning area.	2	Within three years of adoption of the Plan	N/A	$5,000	Assist with prioritising grant funding for community, landholders and Council. Support revegetation programs.

20	Support growth of koala food tree leaf sources within Ballina Shire for care and rehabilitation of koalas.	3	Within five years of adoption of the Plan	Ongoing	$0 Integrated into existing public land and open space management program	Assist local care organisations with availability of appropriate leaf sources.
21	Implement restoration works identified under the restoration program.	A	After action 20 and where resources become available	Ongoing	Dependent on works identified	Obtain funds from other levels of government to assist with resourcing restoration works (including Council funds). Enhance extent of koala habitat and quality.
22	Establish a register of landholders who are willing to use their land for habitat restoration, including those who wish to register their 'Koala Friendly' windbreaks.	3	Within five years of adoption of the Plan	Ongoing	$0 Integrated into existing sustainability programs activities	Assist with prioritising resources such as grant funding. Establish landholder communication network.
23	Implement a pilot windbreak replacement program for farmers and koalas utilising mutually beneficial species (including consideration of use of alternative eucalypt species for windbreaks). Note that this initiative is underway – 85% funded by a Federal Government grant	1	Within one year of adoption of the Plan	N/A	$15,000	Support provision of koala friendly windbreaks on the Plateau that also recognise landholder requirements.
24	Undertake the active restoration of a pilot site to restore or enhance koala habitat. Note that this initiative is underway – 85% funded by a Federal Government grant	1	Within four years of adoption of the Plan	N/A	$85,000	Demonstrate habitat restoration outcomes available. Enhance koala habitat.

Communication and education						
25	'Launch' the plan utilising a mix of activities 26 – 31, as well as through a formal recognition of the local koala populations in Ballina Shire.	1	Within four months of adoption of the Plan	N/A	See estimates for actions 28-33	Provide a formal starting point for collaboration on koalas in Ballina Shire. Encourage communication within and between Council and the community.
26	Develop and implement an integrated communication program to inform and educate the community about threats to koalas and their habitat.	1	Within one year of adoption of the Plan	4 years – to align with survey and evaluation work	$1,500	Enhance a collaborative approach to koala awareness and management in Ballina Shire.
27	Provide the Comprehensive Koala Plan of Management and associated maps and information on Council's website.	1	Within one month of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Ensure access and availability of information. Encourage communication within and between Council and the community.
28	Write to all landholders subject to the CKPoM advising of the Plan and providing key information about koalas in the shire.	1	Within two months of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Inform landholders of the status of koalas in the shire and the CKPoM.

29	Prepare a fact sheet explaining the implications of the Plan in relation to development proposals and assessment.	1	Within three months of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Provide a simple explanation of plan requirements with regard to koalas. Ensure access to information.
30	Develop, in partnership with rural industries on the Plateau, development of a Voluntary Code of Practice for managing koalas on agricultural land.	A	Where resources become available	N/A	$5,000	Consider windbreak management and options for the longer term to support koala populations. Work collaboratively with landholders.
Road and traffic management						
31	Collaborate with NSW Roads and Maritime Service in relation to sharing of information and opportunities to enhance outcomes for the shire's koala population.	1	Within one month of adoption of the Plan	Ongoing	$0 Integrated into existing sustainability programs activities	Implement koala road safety measures across the road network, both regional and major roads. Keep community informed regarding road construction/use and koalas. Proactively collaborate on achievement of positive outcomes for koala management.

32	Apply the following for roads within the *koala planning area*,: a. audit existing koala road safety measures b. develop an integrated program of works for the implementation of a 'toolbox' for koala road safety measures to target vehicle strike black spots on Council managed roads. c. Utilise 'toolbox' in design and construction of roads within the Ballina Koala Planning Area.	2	Within one year of adoption of the Plan	N/A	$15,000 (audit and plan)	Provide a suite of tools for use on local and regional roads, to minimise road hazards for koalas (e.g. speed reduction, signage, lighting, road verge maintenance, exclusion fencing and underpasses).
33	Integrate consideration of the objectives of this plan and associated planning provisions into Council's planning for, and construction of, road infrastructure.	1	Within three months of adoption of the Plan	Ongoing	$0 Integrated into existing sustainability programs and civil engineering activities	Apply suitable assessment method in relation to implications of works and their potential for impact on koalas
34	Implement an advisory signage program in key koala habitat areas.	1	Within one year of adoption of the Plan	N/A	$5,000	Improve road user awareness of koala population. Reduce incidence of road strike.

Dog management						
34	Apply the following in relation to dog management within the *koala planning area*: a. identify areas where koalas are at a high risk of contact with unrestrained or roaming domestic dogs. b. target compliance in these areas in accordance with the provisions of the *Companion Animals Act* 1998. c. undertake an education program on responsible pet ownership with respect to new dog owners and dog owners in high risk areas. d. apply controls for domestic dogs at home as per Chapter 7, Part 4 of the Ballina Development Control Plan. e. review existing dog exercise areas and ensure that use of these areas are compatible with the objectives of this Plan. f. consider the impacts of dogs in existing properties and rental properties and community education and compliance program in relation to these.	2	Within one year of adoption of the Plan	N/A	$2,000	Minimise risk and incidence of koala mortality from dog attacks. Enhance community understanding of the koala population in the shire.
36	Liaise with North Coast Local Land Services with regard to wild dog and fox management issues to improve Council understanding on these issues.	2	Within one year of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Improve Council and community understanding of domestic and wild dog management in relation to wildlife.

Koala health and welfare						
37	Support a genetic study of koala populations in the Ballina, Lismore and Byron areas to establish the relationships between. Note that this initiative is underway – funded by the NSW Roads and Maritime Service.	1	Within one year of adoption of the Plan	N/A	Unknown	Ascertain genetic characteristics and linkages between populations and movement corridors to aid future planning for koala populations.
38	Provide access to public land containing koala food trees for leaf harvest by koala care organisations.	2	Within two years of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs and open space management activities	Demonstrate community and Council commitment to the koala population. Support local volunteer efforts. Provide a feed source to support koala care activities.
39	Consult with Friends of the Koala and other like groups regarding: a. provision of records to the Atlas of NSW Wildlife. b. standardising and improving the quality of data provided to the Atlas. c. information sharing and community education opportunities.	3	Within three years of adoption of the Plan	At time of monitoring surveys	$0 Integrated into existing sustainability programs activities	Ensure best possible information held in Atlas to inform Federal, State and Local Government decision-making. Utilise information to engage community about koala population.

Bushfire management						
40	Provide mapping of *preferred and core koala habitat* as a GIS layer to the Rural Fire Service and the Bushfire Risk Management Plan Committee	2	Within two years of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Ensure best possible information held by RFS to inform decision-making.
41	Write to the Minister and the responsible Department with regard to the 10/50 Bushfire Management regulations and their impact on koala habitat	1	Within three months of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Indicate potential impacts on koala (and other) habitat of 10/50 regulation.
42	Consult with the Rural Fire Service and the Bushfire Risk Management Plan Committee regarding: a. updating the Bushfire Risk Management Plan for Ballina LGA to take into account the location and significance of *preferred and core koala habitat* b. providing a GIS layer that maps fire history within the Ballina LGA c. development and implementation of best practice fire management guidelines in relation to koala habitat by brigades located within the Ballina LGA.	2	Within two years of adoption of the Plan	N/A	$0 Integrated into existing sustainability programs activities	Ensure best possible information held by RFS and to inform decision-making. Support consideration of koala management in bushfire planning.

Funding						
43	Provide annual financial support to koala welfare groups.	2	Within one year of adoption of the Plan	Ongoing	$2,500	Support provision of specialist management to sick and injured koalas.
Economic development and tourism						
44	Investigate feasibility of koala-based ecotourism opportunities within the shire.	A	As resources become available	N/A	$15,000+	Identify economic development opportunities associated with the koala population.
45	Establish a brand, in conjunction with Lismore, for 'Koala Country' to enhance opportunities for accommodation and other tourism providers to leverage interest.	3	Within five years of adoption of the Plan	Ongoing	$5,000	Provide a point of interest for visitors to the area and a reason to visit hinterland areas. Support economic development opportunities associated with the koala population.

46	Establish an information display at appropriate locations to share information about the Important Koala Population in the shire.	2	Within two years of adoption of the Plan	N/A	$10,000	Identify importance of local population and vegetation supporting that population. Provide information to the community. Encourage communication and information sharing.

Dictionary

In this Comprehensive Koala Plan of Management, the following definitions apply:

"**accredited person"** means a person with experience or qualifications in koala management.

"Assessment Report" means "Koala Habitat Assessment Report" for a development as detailed in Section 4.2 of this Plan.

"building envelope" means an area of land designated for construction of a dwelling, buildings and ancillary infrastructure as well as any land required to be cleared for a bushfire asset protection zone (inner zone), ancillary gardens and landscaping.

"Comprehensive Koala Plan of Management" means a plan of management prepared in accordance with *State Environmental Planning Policy 44 – Koala Habitat Protection*.

"core koala habitat" means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. This is the same meaning as that defined by *State Environmental Planning Policy 44 – Koala Habitat Protection*.

"development" means:

(a) the use of land, and
(b) the subdivision of land, and
(c) the erection of a building, and
(d) the carrying out of a works, and
(e) the demolition of a building or works, and
(f) any other act, matter or thing referred to in section 26 (of the *Environmental Planning & Assessment Act 1979*) that is controlled by an environmental planning instrument, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition.

This is the same meaning as that defined by the *Environmental Planning & Assessment Act 1979.*

"development application" or **"DA"** means an application for consent under Part 4 of the *Environmental Planning & Assessment Act 1979* to carry out development but does not include an application for a complying development certificate. This is the same meaning as that defined by the *Environmental Planning & Assessment Act* 1979*.*

"development footprint" means the land that is likely to be impacted by any "small impact development", including any asset protection zone and ancillary infrastructure.

"diameter at breast height over bark" or **"dbhob"** is the diameter of a tree measured 1.4 metres above the ground.

"EP&A Act" means the Environmental Planning and Assessment Act 1979.

"greenfield site" means land that is substantially undeveloped (except for agricultural use) that has not been previously developed for an urban and/or residential land use.

"ha" means hectares.

"infrastructure" means all structures associated with the construction of a single dwelling, dual occupancy and/or secondary dwelling and includes gardens, landscaping, water tanks, on-site waste water management systems, any access route, road or driveway; but excludes farm dams.

"koala habitat" means "core koala habitat" and/or "preferred koala habitat".

"koala movement corridor" means an area or tract of land that is used, or could be used, by koalas when moving between different areas of their home range or habitat. These areas may include cleared land; but do not include "koala habitat".

"koala planning area" means the land to which this Plan applies as described and mapped in this Plan.

"**koala management precincts**" means land within the Southern (Bagotville/Meerschaum Vale/Wardell) precinct, the Plateau precinct or the East Ballina precinct as described and mapped in this Plan.

"land" includes:

(a) the sea or an arm of the sea,
(b) a bay, inlet, lagoon, lake or body of water, whether inland or not and whether tidal or non-tidal, and
(c) a river, stream or watercourse, whether tidal or non-tidal, and
(d) a building erected on the land.

This is the same meaning as that defined by the *Environmental Planning & Assessment Act 1979.*

"Ballina DCP" means Ballina Development Control Plan.

"Ballina LEP" means the Ballina Local Environment Plan 2012.

"LGA" means local government area.

"mm" means millimetre.

"no-build zone" means a designated area of land where the construction of dwellings, buildings and the like are precluded.

"PoM" means plan of management.

"**potential koala habitat**" is defined in SEPP 44, and referred to in Section 3.5. This plan preferentially refers to preferred koala habitat as the term which recognises the diverse nature of vegetation communities. Potential koala habitat is considered to be that which meets the definition as provided in "preferred koala habitat".

"preferred koala habitat" means any area identified as either Primary, Secondary Class A, B or C koala habitat as defined in the table below.

Vegetation	Category	Definition
Vegetation classified as Preferred Koala Habitat	Primary	Vegetation associations and/or communities wherein "primary food tree species" comprise the dominant or co-dominant (i.e. ≥ 50%) overstorey tree species.
	Secondary A	Vegetation associations and/or communities wherein "primary food tree species" are sub-dominant components of the overstorey tree species and usually (but not always) growing in association with one or more "secondary food tree species".
	Secondary B	Vegetation associations and/or communities wherein "primary food tree species" are absent, habitat dominated or co-dominated by "secondary food tree species" only.
	Secondary C	Vegetation associations of communities wherein primary food tree species are absent and one or more secondary food tree species present as sub-dominant components only.
Other Vegetation	Other	Native vegetation associations and/or communities within which "preferred koala food trees" are absent.
	Unknown	Vegetation for which there is insufficient data available to enable classification. This includes both individual trees and clumps of trees which are unmapped owing to the resolution of the mapping. These trees may be verified as *koala habitat* by a Koala Habitat Assessment.

"preferred koala food tree" or **"food tree"** means any of the following tree species:

	Common Name	Scientific Name
Primary food tree species	Forest red gum*	*E. tereticornis*
	Tallowwood#	*E. microcorys*
	Swamp mahogany	*E. robusta*
Secondary and/or supplementary food tree species	White mahoganies	*E. acmeniodes/carnea*
	Blackbutt	*E. pilularis*
	Red Mahogany	*E. resinifera*
	Blackwood	*Acacia melanoxylon*
	Forest Oak	*Allocasuarina torulosa*
	Pink Bloodwood	*Corymbia intermedia*
	Brush Box	*Lophostemon confertus*

* includes the naturally occurring *E. tereticornis* x *E. robusta* hybrid referred to as *E. patentinervis* (Bale, 2003).
# on medium and high and nutrient soil landscapes, where occurring on low to medium soil landscapes, functions as a secondary koala food tree species.

"receiving land" means the area of land receiving the benefit of food tree compensation measures and/or habitat compensation measures.

"RG-bSAT" means Regularised Grid-based Spot Assessment Technique.

"SEPP 44" means State Environmental Planning Policy 44 – Koala Habitat Protection.

"stadia survey" means stadiametric survey, the recording of the precise location and species identity of all "preferred koala food trees" on a site, and is to be carried out by a registered surveyor and an appropriately qualified ecologist.

"study area" means the "subject site" and any additional areas that are likely to be directly and/or indirectly impacted by a "large impact development", including any asset protection zone, ancillary and off-site works.

"subject site" means the allotment(s) to which a development application applies.

"suitably qualified person" means a person with a graduate qualification in ecology, environmental management, forestry or similar from a recognised university and with experience in flora and fauna identification, survey and management, including experience in conducting koala surveys. Where such person has less than five years experience, they shall be under the supervision of a suitably qualified person according to this definition. A Council Officer may meet these criteria.

"the Plan" or **"this Plan"** means the "Comprehensive Koala Plan of Management for Ballina".

"TSC Act" means the Threatened Species Conservation Act 1995.

"tree" means a perennial plant with a woody self supporting stem or trunk/s having a height of more than 3 metres and a trunk circumference of more than 300 millimetres when measured from 1 metre above ground level. This is the same meaning as that defined in the Ballina Development Control Plan Chapter 1 – Administration, Appendix 2 – Dictionary.

"tree protection zone" means the area above and below the ground and at a given distance from the trunk set aside to protect a tree's roots and crown from development activity.

"VMP" means vegetation management plan.

"VCA" means voluntary conservation agreement.

References

Bellingen Shire Council. 2014. *DRAFT Comprehensive Koala Plan of Management – Bellingen Shire Council Coastal Area.*

Biolink Ecological Consultants. November 2013. *Koala Habitat and Population Assessment: Ballina Shire Council.* Report to Ballina Shire Council.

Biolink Ecological Consultants. 2014. *DRAFT Byron Coast Comprehensive Koala Plan of Management.*

Bale, C.L. 2003. Eucalypts and Angophoras of the North Coast New South Wales. Department of Botany, University of New England, Armidale.

Department of Environment and Climate Change NSW. 2008. *Recovery plan for the koala (Phascolarctos cinereus)*.

Department of Planning. 1995. Circular B35 – State Environmental Planning Policy no. 44 – Koala Habitat Protection.

Lismore City Council. 2013. Comprehensive Koala Plan of Management for south-east Lismore.

Morand D.T., 1994, *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* report, NSW Department of Land and Water Conservation, Sydney.

Morand D.T., 2009, *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Ed. 2 map, NSW Department of Environment, Climate Change and Water, Sydney.

Phillips, S. 2000. Tree species preferences of the Koala Phascolarctos cinereus as a basis for the delineation of management areas for recovery planning in New South Wales. Unpublished report to the NSW Koala Recovery Team.

Phillips, S., and Callaghan, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas (*Phascolarctos cinereus*). *Australian Zoologist* 35(3), 774 – 790.

Phillips, S., Hopkins, M., and Warnken, J. 2011 (submitted). Splines in the sand: modelling the distribution of koala populations across the landscape in order to provide greater certainty for conservation and management purposes. Submitted to *Wildlife Research*.

Phillips, S., and Allen, C. 2014. Strzelecki Ranges Koala Survey. Report to NSW Office of Environment & Heritage.

Tweed City Council. 2014. DRAFT Tweed Coast Comprehensive Koala Plan of Management.

Appendix 1

Approved Individual Koala Plans of Management within Ballina Shire

BSC DA No.	DoP File No.	Address	Lot(s)/DP(s)
2007/893		1 Bundaleer Road, Broken Head	Lot 1 DP 259078

Appendix 2

Methodology for sampling and assessment of koala habitat in Ballina Shire.

To provide an appropriately standardised approach to identifying potential, preferred and/or core koala habitat, the following process is recommended.

A. Land should be identified in relation to the habitat mapping held by Council as a GIS layer as to its status for koala habitat.

Where land is identified as core koala habitat or within a vegetation corridor connected to core koala habitat, particularly in the Southern KMP, it should be regarded as koala habitat.

Should there be uncertainly as to the above or a desire for further clarification, Steps B and C can be used, at the discretion either of the proponent or of Council.

B. An assessment of habitat according to the definition of potential koala habitat given in SEPP 44.

With respect to ensuring an assessment suitable for Ballina Shire, the following guidelines should be followed.

Vegetated land should be reviewed for the presence of preferred koala food trees by a person qualified and experienced in tree identification. Where areas of native vegetation occur such that variables of soil type, aspect, elevation and species are similar, and where there is a component of at least 15% of the total number of trees consisting of swamp mahogany, forest red gum and/or tallowwood, this area should be defined as being preferred koala habitat.

Note that the same parcel of land may display different vegetation communities, and that, whilst it may be contiguous with other vegetation communities, each vegetation community should be considered discretely to ensure that koala habitat is correctly identified and managed. A vegetation community which occurs partly on one parcel and partly on another should be reviewed with respect to habitat determination as if the community was held contiguously, to reduce the potential for incremental destruction of habitat.

This means that the mapping of a nominal 15% of trees on one property being used as the standard for assessing preferred koala habitat is incorrect and is not considered to meet the intent of the SEPP.

C. Sampling for a koala population should be undertaken using a standardised sampling tool.

Appendix 2a provides a standard methodology utilised by neighbouring Councils. The example provided is much larger than most holdings within the Koala Management Precincts. However, the methodology mirrors that which was used to prepare and then refine the Koala Habitat Study and associated mapping (referred to above in Point A).

For the purposes of this Plan, the methodology should be undertaken by a *suitably qualified person* with relevant experience and training in both the application and interpretation of the RG-bSAT approach.

The following provides summary and important information for use in the RG-bSAT approach:-

a) All development proposals must be accompanied by a koala habitat assessment report and koala activity report.
b) The koala habitat assessment report must be prepared by a *suitably qualified person* with relevant experience and training in both the application and interpretation of the RG-bSAT approach (Appendix 4).

c) Any land with vegetation identified as preferred koala habitat and/or contains one or more species of preferred koala food trees must be assessed as detailed in Table 4.

d) Any RG-bSAT grid cell where koala activity is categorised as greater than 10% on erosional or residual soils[2] within the koala planning area or greater than 22.52% on coastal soils must be classified as core koala habitat within the meaning of SEPP 44;

e) Where there are historic koala records within a 2.5km radius of the study area that relate to koala sightings for any two of the three most recent koala generations then this land is to be classified as core koala habitat within the meaning of SEPP 44.

f) Where core koala habitat is identified, the requirements of Table 6 must be met in reports accompanying a development proposal.

g) Where preferred koala habitat is identified, the requirements of Table 5 must be met in reports accompanying a development proposal.

Table 4 Regularised Grid-based Spot Assessment Technique (RG-bSAT) Grid Cell Sampling Intensities for Various Land Areas

Area of study area	Initial RG-bSAT sampling intensity	Detailed RG-bSAT sampling intensity
>1 ha but <15 ha	150 m x 150 m	75 m x 75 m
15–50 ha	250 m x 250 m	125 m x 125 m
>50 ha	350 m x 350 m	175 m x 175 m

Vegetation communities that otherwise contain preferred koala food tree species but wherein significant koala activity is not recorded should be mapped as preferred koala habitat.

[2] Residual soils referred to are the Wollongbar Soil Landscape. Erosional soils referred to are the Rosebank, Bangalow and Billinudgel Soil Landscapes. Reference should be made to "Soils Landscapes of the Lismore-Ballina 1:100 000 Sheet".

Appendix 2(a)

Sampling and assessment of koala habitat using the Spot Assessment Technique and the Regularised Grid-based Spot Assessment Technique

The SAT and RG-bSAT approach (Phillips & Callaghan 2011) is a standardised sampling tool. For the purposes of this Plan, it is intended that this assessment be undertaken by a suitably qualified person with relevant experience and training in both the application and interpretation of the RG-bSAT approach. The sampling principles of RG-bSAT, key elements of data analysis and modelling of associated koala activity data are currently the subject of a separate publication (Phillips et al., submitted).

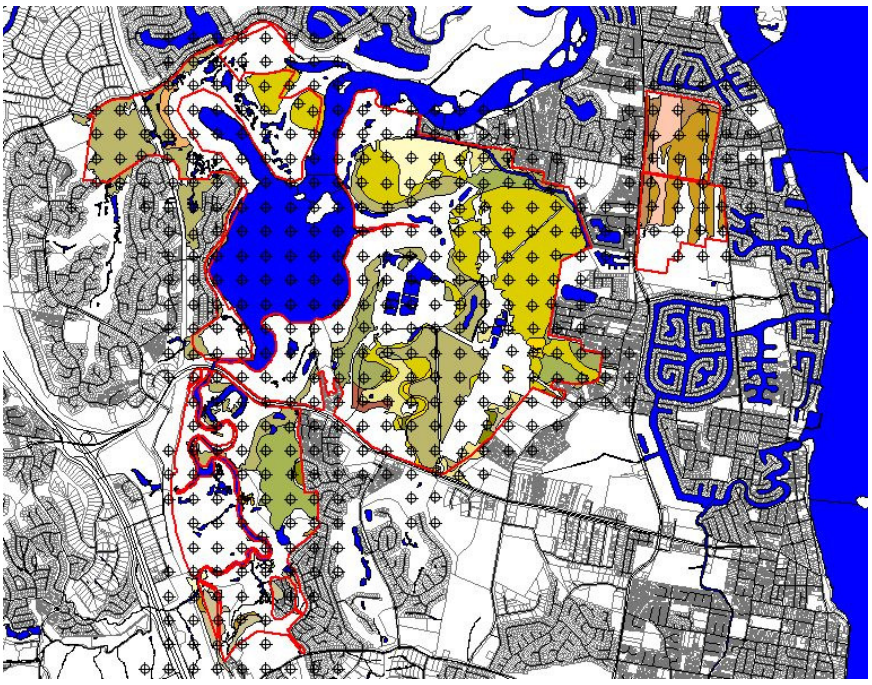
Following is a step-by-step account of how to work with the RG-bSAT approach using a notional 1500 hectare study site.

Step 1

Determine appropriate sampling intensities for the site to be assessed using Table 2 in this Plan.

Step 2

a. Overlay a map/aerial photo of the *study area* with a square grid the dimensions of which correspond to the "high sampling intensity" detailed in Table 2.



b. Then, use the resulting grid-cell intersections to identify those points that fall upon areas of land wherein 30 trees of any species that have a dbhob ≥ 100mm could theoretically

be sampled within a radius approximately equal to that of 50% of the sampling intensity being utilised (e.g. 75m = 38m radius, 125m = 73m etc). The map/aerial photo should look like the diagram below (⌖ indicate sampling site locations).

c. Disregard any potential field sites that fall within areas such as water bodies or areas that do not have measurable forest cover.

Step 3

a. Preliminary sampling of the *study area* should be undertaken at intervals commensurate with the "initial sampling intensity" sites specified in Step 1.

b. Sampling is to be undertaken at each sampling point using the Spot Assessment Technique (SAT) (Phillips & Callaghan, 2011). For the:-

i. Southern KMP
Resulting koala activity levels at each field site are then interpreted as significant if greater than 10% on erosional or residual soil landscapes (Morand, 1994) or greater than 22.52% if on low-lying aeolian or alluvial or swamp landscapes (Morand, 1994). For any of the "initial sampling intensity" sites that returned significant activity levels, sampling utilising the "detailed sampling intensity" (Table 2) surrounding these sites should also be undertaken.

ii. Plateau KMP
Resulting koala activity levels at each field site are interpreted as significant is greater than 10% on the residual or erosional soil landscapes within the Plateau KMP. For any of the "initial sampling intensity" sites that returned significant activity levels, sampling utilising the "detailed sampling intensity" (Table 2) surrounding these sites should also be undertaken.

c. It is not necessary to sample the "detailed sampling intensity" sites between any two sites that have recorded significant koala activity as defined in b above. The contours will be assumed to be constant.

d. If no "Medium (normal) use" or "High use" sites are detected, no further assessment of the site is required.

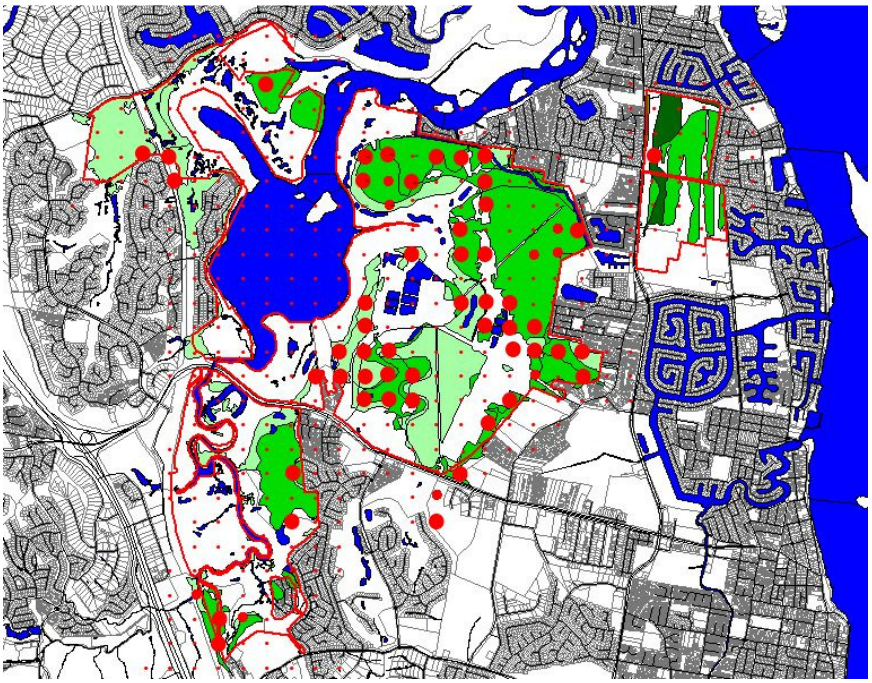
Step 4

a. In the absence of a suitable spatial modelling technique such as splining, all SAT sites wherein significant koala activity has been recorded must become the central point of a grid cell, the size of which must be commensurate with sampling intensity as follows.

- For 75m sampling intersections, the grid cell size will be 75m x 75m (0.56ha)
- For 125m sampling intersections, the grid cell size will be 125m x 125m (1.56ha)
- For 175m sampling intersections, the grid cell size will be 175 x 175m (3.06ha)

b. The map/aerial photo should now look like the diagram below (red circles indicate sampling site locations, and the centre of grid cells referred to in (a) above, with size graduations as appropriate to the soil landscape being sampled. The size of the cells should indicate "Low use"(•), "Medium (normal) use"(•) and "High use" sites(●)).

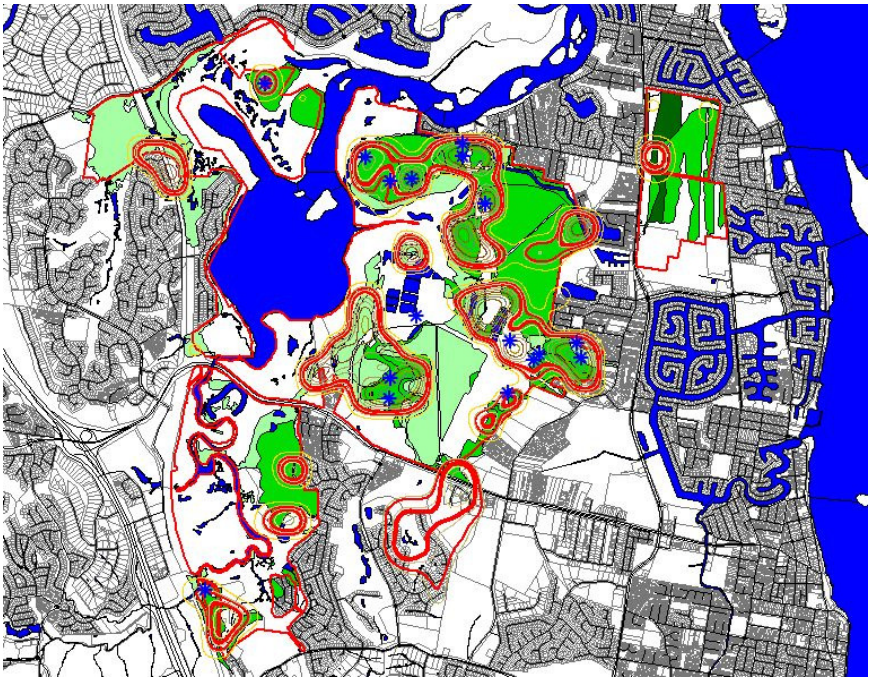
c. All areas within a grid cell identified that returned significant koala activity levels as defined by b above must be regarded as *core koala habitat* for the purposes of this plan.



Step 5

a. Koala activity data should then be interpolated to cover the assessment area using a suitable spatial modelling technique such as splining (see Phillips *et al.*, 2011, in review).

b. The map/aerial photo should now look like the diagram below. The model below was created using lightly weighted thin plate splining techniques to delineate the boundaries (red lines) of areas of *core koala habitat*.



Final result from Regularised Grid Spot Assessment Technique

The *Spot Assessment Technique*: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*

Stephen Phillips[1] and John Callaghan[2]

Australian Koala Foundation

GPO Box 2659 Brisbane, Queensland 4001, Australia

[1]Current Address: Biolink Ecological Consultants PO Box 3196 Uki NSW 2484 Australia.

[2]Current Address: Gold Coast City Council PO Box 5042 Gold Coast MC 9729 Australia.

Corresponding author: Stephen Phillips, Biolink Ecological Consultants, PO Box 3196, Uki, NSW 2484 Australia (Tel: +61 2 66795593; Fax +61 2 66795523; email steve@biolink.com.au).

ABSTRACT

In order to more effectively conserve Koalas, the National Koala Conservation and Management Strategy 2009 – 2014 promotes the need for reliable approaches to the assessment of Koala habitat. This work describes a point-based, tree sampling methodology that utilises the presence/absence of Koala faecal pellets within a prescribed search area around the base of trees to derive a measure of Koala activity. Confidence intervals associated with Koala activity data from 405 randomly selected field plots within which faecal pellets were recorded have been utilised to assign threshold values for three population density/habitat biomes in eastern Australia. Subject to the need for a precautionary approach to data interpretation in areas that support naturally occurring, low-density Koala populations, the approach is expected to assist field-based assessments by researchers, land managers and others interested in clarifying aspects of habitat utilisation by free-ranging Koalas, especially where identification of important areas for protection and management is required.

Key words: Spot Assessment Technique, Koala, *Phascolarctos cinereus*, SEPP 44.

Introduction

The primary aim of the National Koala Conservation and Management Strategy 2009 – 2014 (NKCMS) is to conserve the Koala (*Phascolarctos cinereus*) by retaining viable populations in the wild throughout the species' natural range (Natural Resource Management Ministerial Council (NRMMC) 2009). In order to assist this aim, Action 1.06 of the NKCMS promotes the need for development of standard monitoring/habitat assessment protocols as a means of addressing the issue of inconsistency and disagreement over how koala populations should be surveyed and mapped (NRMMC 2009).

The primary responsibility for conservation of free-ranging *P. cinereus* populations rests with State, Territory and Local Government authorities. In this regard State Government authorities in New South Wales and Queensland have enacted specific planning policies and/or strategic planning measures to assist *P. cinereus* conservation efforts. However, the ability of such approaches to achieve their stated conservation objectives is impeded in part by the lack of standardised and reproducible methods that can be applied to the task of *P. cinereus* habitat/population assessment in the first instance.

In this paper we present a technique that we believe contributes to the need for a reliable approach to objectively assessing aspects of habitat use by *P. cinereus*. An unreviewed progenitor to this work (Phillips and Callaghan 1995) was originally circulated to a limited audience following the Australian Koala Foundation's 1995 conference on the status of Koalas, its purpose at that time to promulgate an approach that could potentially assist field-based assessments by ecological consultants, land managers and others interested in quantifying aspects of habitat utilisation by free-ranging *P. cinereus*. The purpose of this paper is to further refine the initial approach in the light of feedback and additional field studies and in so doing, formally supersede the earlier work.

Background to the approach

Traditionally, knowledge relating to habitat utilisation by free-ranging *P. cinereus* has been primarily reliant on opportunistic observations or radio-tracking data (Robbins and Russell 1978; Martin 1985; Hindell *et al.* 1985; Hindell and Lee 1987; 1988; White and Kunst 1990; Reed *et al.* 1990; Hasegawa 1995; Melzer and Lamb 1996; Pieters and Woodhall 1996). In other instances, emphasis has been placed on benign indicators such as accumulated faecal pellet counts (Moon 1990; Munks *et al.* 1996; Pahl 1996) and scratch marks. However, all of these approaches can be problematic. Firstly, existing models for determining tree preferences by free-ranging *P. cinereus* (Hindell *et al.* 1985) require a number of assumptions to be met which do not appear to hold in heterogeneous forest communities (Phillips 1999; Ellis *et al.* 2002). Secondly, while careful analysis of accumulated faecal pellet counts can elucidate issues of *P. cinereus* abundance (Sullivan *et al.* 2002, 2004), such

counts have proved to be of limited value when used to infer the importance of various tree species (Munks *et al.* 1996; Pahl 1996). The ability to census and interpret faecal pellet deposits can also be influenced by other variables including visibility, tree morphometrics and insect activity (Achurch 1989; Jones 1994; Melzer *et al.* 1994; Pahl 1996; Ellis *et al.* 1998; Sullivan *et al.* 2003). Scratch marks on trees are also an unreliable indicator of habitat use – they cannot be detected on some species whereas others retain them for long periods of time - nor is it always possible to confidently distinguish scratches made by *P. cinereus* from those of other arboreal animals.

Studies of free-ranging *P. cinereus* populations have established that those in stable breeding aggregations arrange themselves in a matrix of overlapping home range areas (Lee and Martin 1988; Faulks 1990; Mitchell 1990). Home range areas vary in size depending upon the quality of the habitat (measurable in terms of the density of preferentially utilised food tree species) and the sex of the animal (males tend to have larger home range areas than females). Long-term fidelity to the home range area is generally maintained by adult *P. cinereus* in a stable population (Mitchell 1990; Phillips 1999, Kavanagh *et al.* 2007). An additional feature of *P. cinereus* home range use is the repeated use of certain trees, some of which may also be utilised by other members of the population (Faulks 1990; Mitchell 1990; Phillips 1999; Ellis *et al.* 2002).

Given the preceding considerations, it follows that areas being utilised by socially stable/resident *P. cinereus* populations must also be characterised by a higher rate of faecal pellet deposition (see Lunney *et al.* 1998). For the purposes of this paper, we propose the term "areas of major activity" to describe such localities, regarding them as synonymous with the term "*Core Koala Habitat*" (in so far as this term relates to the presence of a "*resident population of koalas*") as defined by the NSW Government's *State Environmental Planning Policy No. 44 (Koala Habitat Protection)*, as well as being a fundamental element of "Koala Habitat Areas" as defined by the *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006 – 2016* (Environment Protection Agency/Queensland National Parks and Wildlife Service 2006).

The Spot Assessment Technique

The Spot Assessment Technique (SAT) is a truncated form of the methodology originally developed by the Australian Koala Foundation for purposes of the Koala Habitat Atlas project (Sharp and Phillips 1997; Phillips *et al.* 2000; Phillips and Callaghan 2000). The Atlas approach is probability-based and utilises a binary variable (presence/absence of faecal pellets within a prescribed search area around the base of trees) to determine tree species preferences, along with a commensurate measure of *P. cinereus* "activity" (number of trees with faecal pellets divided by total number of trees in the plot) within a 40m x 40m ($1600m^2$) plot. Given that the selection of Atlas field plots is primarily based on stratification and replication using soil landscape and vegetation association data in the first instance, the data presented for the purposes of this paper reflects a random selection of field sites within which *P. cinereus* faecal pellets were recorded. The SAT approach arose from observations of consistency within the four smaller (20m x 20m) sub-quadrats that otherwise comprise Atlas field plots and the consequent realisation that a smaller plot size essentially provided the same empirical outcomes in terms of both tree species/faecal pellet associations and activity *per se*. However, the number of trees sampled in a smaller site is critical in terms of ascribing meaningful variance to the activity estimate hence we have adopted this measure as the more important variable for the purposes of the technique. Thus, in order to establish a meaningful confidence interval for the activity level of a given SAT site, a minimum of thirty (30) trees must be sampled. For assessment purposes, a tree is defined as "*a live woody stem of any plant species (excepting palms, cycads, tree ferns and grass trees) which has a diameter at breast height (dbh) of 100 mm or greater*" (Phillips *et al.* 2000); in the case of multi-stemmed trees, at least one of the live stems must have a dbh of 100 millimetres or greater in order to qualify.

Table 1 provides a data summary from Atlas field plots undertaken across a variety of habitat types and landscapes utilised by *P. cinereus* in eastern Australia. To this end, while we consider significant differences between mean activity levels from low and medium - high density *P. cinereus* populations of the eastern seaboard to reflect real differences in habitat carrying capacity (Table 1 - Southeast Forests/Campbelltown *vs* Port Stephens/Noosa: Levene's test: $F = 0.086$, $P > 0.05$; $t = -7.877$, $P < 0.001$), we speculate that similar differences between medium - high density populations of the eastern seaboard and those from more western areas (areas generally receiving less than 600mm of rainfall annually) (Port Stephens/Noosa *vs* Pilliga/Walgett – Levene's test: $F = 0.925$, $P > 0.05$; $t = -4.743$, $P < 0.001$) more likely reflect differences in faecal pellet longevity as a consequence of aridity than they do habitat quality *per se*. This said, we acknowledge that there are also likely to be both low and medium-high density populations in western areas of the species' range, the differentiation of which will require further investigation and evaluation.

Applying the SAT

The SAT involves a radial assessment of *P. cinereus* "activity" within the immediate area surrounding a tree of any species that is known to have been utilised by the species, or otherwise considered to be of some importance for *P. cinereus* conservation and/or management purposes. In the field the technique is applied as follows:

1. Locate and uniquely mark with flagging tape a tree (the centre tree) that meets one or more of the following selection criteria:

Table 1. Mean activity levels and related measures of central tendency (expressed as percentage equivalents) associated with habitat utilisation by Koalas from six areas in eastern Australia. Data relates to sites within which faecal pellets were recorded and has been pooled to reflect three major categories of activity which correspond to naturally occurring low and med-high density populations of the tablelands and areas east of the Great Dividing Range, and those of more western areas respectively. Koala densities for the east coast, low density category are arbitrarily defined at ≤ 0.1 Koalas/ha. (Data sources: [1]South-east Forests Conservation Council, unpub. data; [2]Phillips and Callaghan 1997; [3]Phillips and Callaghan 2000; [4]Phillips *et al.* 1996; [5]Phillips **et al.** 2000; [6]AKF, unpub.data; [7]Phillips 1999; [8,9]AKF unpub. data).

Area	Pop. Density	No. sites	No. trees	A/level	SD	SE	99% CL
East Coast							
S/E Forests[1]	Low	111	2979	11.85	6.84	0.65	1.70
Campbelltown[2,3]	Low	20	1194	6.52	4.72	1.06	3.02
Pooled		131	4173	11.03	6.82	0.60	1.56
East Coast							
Port Stephens[4,5]	Med - high	76	3847	23.65	23.63	2.71	7.16
Noosa[6]	Med - high	63	1647	32.55	22.05	2.78	7.38
Pooled		139	5494	27.68	23.27	1.97	5.16
Western Slopes & Plains							
Pilliga[7,8]	Med - high	98	3656	42.52	22.78	2.30	6.05
Walgett[9]	Med - high	37	990	38.01	27.66	4.55	12.37
Pooled		135	4646	41.28	24.19	2.08	5.44

a. a tree of any species beneath which one or more *P. cinereus* faecal pellets have been observed and/or

b. a tree in which a *P. cinereus* has been observed and/or

c. any other tree known or considered to be potentially important for *P. cinereus*, or of interest for other assessment purposes.

2. identify and uniquely mark the 29 nearest trees to the centre tree,

3. undertake a search for *P. cinereus* faecal pellets beneath each of the 30 marked trees based on a cursory inspection of the undisturbed ground surface within a distance of 100 centimetres around the base of each tree, followed (if no faecal pellets are initially detected) by a more thorough inspection involving disturbance of the leaf litter and ground cover within the prescribed search area.

Strict adherence to the 100 cm search area is a fundamental component of the SAT methodology. As detailed in Appendix 1, it is this distance that both optimises the probability of success in terms of actually finding faecal pellets, while at the same defining a workable search area. Any lesser search area and the probability of success will be significantly reduced (Figure 2 in Appendix 1 refers) such that the mean activity levels and associated activity level thresholds applicable to the approach cannot be justifiably applied.

In terms of search effort, an average of approximately two person minutes per tree should be dedicated to the faecal pellet search. In practice, more time will be spent searching beneath larger trees than smaller trees. For assessment purposes, the search should be concluded once a single faecal pellet has been detected or when the maximum search time has expired, whichever happens first. This process should be repeated until each of the 30 trees in the site has been assessed. Where the location of faecal pellets falls within overlapping search areas due to two or more trees growing in close proximity to each other, both should be scored for pellet(s). For more detailed reporting purposes, information relating to the site's location (UTM co-ordinates or Lat/Long), selection criteria, tree species assessed (and dbh), and the radial area searched (as measured by distance from the centre tree) should also be recorded. Faecal pellets should not be removed from the site unless some verification (i.e. that they are in fact *P. cinereus* faecal pellets) is necessary.

Calculation and interpretation of Koala activity levels

The activity level for a SAT site is simply expressed as the percentage equivalent of the proportion of surveyed trees within the site that had a *P. cinereus* faecal pellet recorded within the prescribed search area. For example, given a sample of 30 trees, 12 of which had one or more faecal pellets recorded – the resulting activity level would be determined as 12/30 = 0.4 = 40 per cent.

From the data sets presented in Table 1, we opted for a precautionary approach by proposing use of mean activity levels ± 99 per cent confidence intervals to define the limits of "normal" *P. cinereus* activity. Based on the threshold values that result, three categories of activity – "low", "medium(normal)" and "high" can thus be determined for each of the three area/population density categories detailed in Table 2. Subject to qualifications regarding the need for a cautious approach to low activity levels in some instances (see below), where the results of a SAT site returns an activity level within the low use range, the level of use by *P. cinereus* is likely to be transitory. Conversely, where a given SAT site returns an activity level within the prescribed range for medium (normal) to high use - the level of use is indicative of more sedentary ranging patterns and is thus within an area of major activity.

Table 2. Categorisation of Koala activity into Low, Medium (normal) and High use categories based on use of mean activity level ± 99 per cent confidence intervals (nearest percentage equivalents) from each of the three area/population density categories indicated in Table 1.

Activity category	Low use	Medium (normal) use	High use
Area (density)			
East Coast (low)	-	≥ 3.33% but ≤ 12.59%	> 12.59%
East Coast (med – high)	< 22.52%	≥ 22.52% but ≤ 32.84%	> 32.84%
Western Plains (med – high)	< 35.84%	≥ 35.84% but ≤ 46.72%	> 46.72%

A precautionary approach to activity levels in low use areas.

Ideally, SAT site activity levels should only be interpreted in the context of location-specific habitat utilisation data (e.g. Lunney *et al.* 1998; Phillips *et al.* 2000; Phillips and Callaghan 2000; Phillips and Hopkins 2009). Low activity levels recorded in what might otherwise be med-high carrying capacity *P. cinereus* habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances including logging, mining, fire, agricultural activities and/or urban development. Such considerations should not necessarily detract from the potential importance of such habitat for longer-term conservation, particularly if preferred koala food trees are present and populations of *P. cinereus* are known to occur in the general area. Ideally, any determination of the importance of activity levels in such instances should be informed by a broader, soil-based understanding of tree preferences (e.g. Phillips and Hopkins 2009), and in conjunction with an understanding of ecological history (e.g. Knott *et al.* 1998; Seabrook et al 2003).

Low activity levels are also associated with low-density *P. cinereus* populations. Stable, low-density *P. cinereus* populations occur naturally in some areas (Melzer and Lamb 1994; Jurskis and Potter 1997; Phillips and Callaghan 2000; Ellis *et al.* 2002; Sullivan *et al.* 2006). The density of *P. cinereus* in such areas generally reflects the absence of "primary" food tree species and reliance by the population on "secondary" food tree species only (Phillips and Callaghan 2000; Phillips 2000). While secondary food tree species will return significantly higher levels of utilisation when compared to other *Eucalyptus* spp. in the area, their level of use (as determined by field survey) will invariably be both size-class and/or density dependent when compared to a primary food tree species (Phillips and Callaghan 2000; Phillips 2000; Moore and Foley 2005). Because the autecology of *P. cinereus* occupying habitat areas that do not naturally support one or more "primary" food tree species remains poorly understood at this point in time, again we advocate a precautionary approach whereby the presence of any activity in areas occupied by naturally occurring, low density populations should be regarded as ecologically meaningful for conservation and management purposes until proven otherwise.

Concluding comment

The SAT is intended for application in conjunction with land-use planning activities that require *P. cinereus* habitat to be assessed, especially where identification of important areas for protection and management is required. The technique is suitable for use in conjunction with stratified/random or systematic survey techniques but has proved especially powerful when applied at the landscape-scale using a regularised grid-based sampling design and appropriate spatial modelling techniques (see Phillips et al 2007; Phillips and Hopkins 2007; Phillips and Hopkins 2009; Allen et al 2010; Phillips *et al.* submitted); it is also suitable for long-term monitoring purposes. Further information and advice regarding application and use of the technique and its application to the tasks of koala management can be supplied if required.

In refining the SAT approach over the intervening time period since its initial inception and development, we have deliberately opted for efficiency (in terms of time) and reproducibility in the field, all the while mindful that it must remain a robust sampling tool capable of answering the critical questions associated with koala conservation biology.

Acknowledgments

We are indebted to the many individuals and organisations that have generously given their time, energy and support to Koala Habitat Atlas field projects over the years. The work of Maria Jones also played a pivotal role in development of the SAT approach, for which we thank her most graciously. We also appreciate the constructive criticism provided by colleagues who have reviewed various drafts of this paper, and others who use the technique; this revision has benefited greatly as a result.

References

Achurch, H.M. 1989. *Tree utilisation by Koala (Phascolarctos cinereus) populations with regard to their geographic distribution within close proximity to the city of Brisbane.* Honours Thesis, University of Queensland, St Lucia.

Allen, C., Saxon, M. and McDougall, K. 2010. *Summary report on surveys conducted in 2007-2009 for Koalas in the coastal forests of the Bermagui/Mumbulla area.* NSW Department of Environment, Climate Change and Water.

Ellis, W.A.H., Sullivan, B.J., Lisle, A.T. and Carrick, F.N. 1998. The spatial and temporal distribution of Koala faecal pellets. *Wildlife Research* **25:** 663–68.

Ellis, W. A. H., Melzer, A., Carrick, F. N. and Hasegawa, M. 2002. Tree use, diet and home range of the koala (*Phascolarctos cinereus*) at Blair Athol, central Queensland. *Wildlife Research* 29: 303 – 11.

Environment Protection Agency/Queensland National Parks and Wildlife Service. 2006. Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006 – 2016. Queensland Government – Environment Protection Agency.

Faulks, J. 1990. *The Ranging Behaviour of Koalas.* Honours Thesis, Southern Cross University (formerly University of New England, Northern Rivers), Lismore, NSW, Australia.

Hasegawa, M. 1995. *Habitat Utilisation by Koalas (Phascolarctos cinereus) at Point Halloran, Queensland.* Masters Thesis, University of Queensland, Australia.

Hindell, M.A., Handasyde, K.A. and Lee, A.K. 1985. Tree species selection by free-ranging Koala populations in Victoria. *Australian Wildlife Research* **12:** 137–44.

Hindell, M.A. and Lee, A.K. 1987. Habitat use and tree preferences of Koalas in a mixed eucalypt forest. *Australian Wildlife Research* **14:** 349–60.

Hindell, M.A. and Lee, A.K. 1988 Tree use by individual Koalas in a natural forest. *Australian Wildlife Research* **15:** 1–7.

Jones, M. 1994. The use of scats to assess koala habitats in northern New South Wales. Unpub. 3rd year Integrated Project, School of Resource Science and Management, Southern Cross University, Lismore, New South Wales.

Jurskis, V. and Potter, M. 1997. Koala Surveys, Ecology and Conservation at Eden. *Research Paper No. 34.* State Forests of New South Wales, Australia.

Knott, T., Lunney, D., Coburn, D. and Callaghan, J. 1998. An ecological history of Koala habitat in Port Stephens Shire and the Lower Hunter on the Central Coast of New South Wales, 1801 – 1998. *Pacific Conservation Biology* **4:** 354–68.

Lee, A. and Martin, R. 1988. *The Koala – A Natural History.* NSW University Press, Sydney, Australia.

Lunney, D., Phillips, S., Callaghan, J. and Coburn, D. 1998. A new approach to determining the distribution of Koalas and conserving their habitat: a case study from Port Stephens Shire on the central coast of New South Wales. *Pacific Conservation Biology* **4:** 186–96.

Martin, R.W. 1985. Overbrowsing, and Decline of a Population of the Koala, *Phascolarctos cinereus*, in Victoria I. Food Preference and Food Tree Defoliation. *Australian Wildlife Research* **12:** 355–65.

Melzer, A., Schneider, M. A. and Lamb, D. 1994. Insects associated with the faecal pellets of the Koala, *Phascolarctos cinereus* Goldfuss. *Australian Entomologist* 21(3): 69 – 70.

Melzer, A. and Lamb, D. 1994. Low density populations of the Koala (*Phascolarctos cinereus*) in Central Queensland. *Proceedings of the Royal Society of Queensland* **104:** 89–93.

Melzer, A. and Lamb, D. 1996. Habitat utilisation by a central Queensland Koala colony. Pp 17–26 in *Koalas – Research for Management* 17–26, edited by G. Gordon. World Koala Research Incorporated, Brisbane, Australia.

Mitchell, P. 1990. The home ranges and social activity of Koalas - a quantitative analysis. Pp 177–87 in *Biology of the Koala*, edited by A.K. Lee, K.A. Handasyde and G.D. Sanson. Surrey Beatty and Sons, Sydney, Australia.

Moon, C. 1990. Koala corridors: A case study from Lismore. Pp. 87–92 in *Koala Summit – Managing Koalas in New South Wales*, edited by D. Lunney, C.A. Urquhart and P. Reed. NSW National Parks and Wildlife Service, Sydney, Australia.

Moore, B. D. and Foley, W. J. 2005. Tree use by koalas in a chemically complex landscape. *Nature* **435:** 488 – 90.

Munks, S. A., Corkrey, R. and Foley, W.J. 1996. Characteristics of arboreal marsupial habitat in the semi-arid woodlands of northern Queensland. *Wildlife Research* **23:** 185–95.

Natural Resource Management Ministerial Council. 2009. *National Koala Conservation and Management Strategy 2009 - 2014.* Department of the Environment Environment, Water, Heritage and the Arts. Canberra.

Pahl, L. 1996. Koala and bushland survey of west and central Logan City. Pp. 82–92 in *Koalas - research for management*, edited by G. Gordon. World Koala Research Incorporated, Brisbane, Australia.

Phillips, S. S. 1999. Habitat utilisation by the Koala (*Phascolarctos cinereus*) – towards a new approach for effective conservation and management. PhD Thesis, School of Resource Science and Management, Southern Cross University, Lismore, Australia.

Phillips, S. S. 2000. Tree species preferences of the Koala *Phascolarctos cinereus* as a basis for the delineation of management areas for recovery planning in New South Wales. Report prepared for NSW Koala Recovery Plan.

Phillips, S. and Callaghan, J. 1995. The Spot Assessment Technique for determining the significance of habitat utilisation by Koalas. Addendum to *Proceedings of a conference on the status of the Koala in 1995.* Australian Koala Foundation, Brisbane, Australia.

Phillips, S. Callaghan, J. and Thompson, V. 1996. *The Koala Habitat Atlas - Project No. 6: Port Stephens Local Government Area.* Australian Koala Foundation, Brisbane, Australia.

Phillips, S. and Callaghan, J. 1997. *Koala Habitat Atlas, Project No. 5: Campbelltown Local Government Area.* Australian Koala Foundation: Brisbane.

Phillips, S., Callaghan, J. and Thompson, V. 2000. The tree species preferences of Koalas (*Phascolarctos cinereus*) inhabiting forest and woodland communities on Quaternary deposits in the Port Stephens area, New South Wales. *Wildlife Research* **27:** 1–10.

Phillips, S. and Callaghan, J. 2000. Tree species preferences of a Koala (*Phascolarctos cinereus*) population in the Campbelltown area south-west of Sydney, New South Wales. *Wildlife Research* **27:** 569–75.

Phillips, S., Hopkins, M. and Callaghan, J. 2007. *Koala Habitat and Population Assessment for the Gold Coast City Local Government Area.* Final Report to Gold Coast City Council. Biolink Ecological Consultants.

Phillips, S. and Hopkins, M. 2007. *The utility of regularised, grid based sampling for the purposes of identifying areas being utilised by koalas (Phascolarctos cinereus) in the South-east forests of NSW – a Pilot Study.* Report to NSW Department of Environment and Climate Change. Biolink Ecological Consultants.

Phillips, S. and Hopkins, M. 2009. *Comprehensive Koala Plan of Management for eastern portion of Kempsey Shire Local Government Area, Vol II – Resource Study.* Prepared for Kempsey Shire Council. Biolink Ecological Consultants.

Phillips, S., Hopkins, M. and Warnken, J. Submitted. Splines in the sand: modelling metapopulation structure across heterogeneous landscapes to provide greater planning certainty for an arboreal marsupial (Koala *Phascolarctos cinereus* Goldfuss). *Landscape and Urban Planning.*

Pieters, C.W. and Woodhall, P.F. 1996. Daily movement patterns and habitat utilisation of Koalas (*Phascolarctos cinereus*) exposed to different levels of habitat modification. Pp. 23–28 in *Koalas - research for management*, edited by G. Gordon. World Koala Research Incorporated, Brisbane, Australia.

Reed, P.C., Lunney, D. and Walker, P. 1990. A 1986-1987 survey of the Koala *Phascolarctos cinereus* (Goldfuss) in New South Wales and an ecological interpretation of its distribution. Pp. 55–74 in *Biology of the Koala*, edited by A.K. Lee, K.A. Handasyde and G.D. Sanson. Surrey Beatty and Sons, Sydney, Australia.

Robbins, M. and Russell, E. 1978. Observations on Movement and Feeding Activity of the Koala in a Semi-natural Situation. Pp. 29–41 in *The Koala – Proceedings of the Taronga Symposium*, edited by T. Bergin. Zoological Parks Board of NSW, Sydney, Australia.

Seabrook, L. M., McAlpine, C. A., Phinn, S. R., Callaghan, J. and Mitchell, D. 2003. Landscape legacies: Koala habitat change in Noosa Shire, South-east Queensland. *Australian Zoologist* 32: 446-61.

Sharp, A. and Phillips, S. 1997. Koalas, Science and Conservation. Pp. 290–01 in *Saving Our Natural Heritage – The Role of Science in Managing Australia's Ecosystems*, edited by C. Copeland and D. Lewis. Halstead Press, Sydney, Australia.

Sullivan, B. J., Baxter, G. S. and Lisle, A. T. 2002. Low-density Koala (*Phascolarctos cinereus*) populations in the mulgalands of south-west Queensland. I. Faecal pellet sampling method. *Wildlife Research* 29: 455 – 62.

Sullivan, B. J., Baxter, G. S. and Lisle, A. T. 2003. Low-density Koala (*Phascolarctos cinereus*) populations in the mulgalands of south-west Queensland. III. Broad-scale patterns of habitat use. *Wildlife Research* 30: 583 – 91.

Sullivan, B. J., Baxter, G. S., Lisle, A. T., Pahl, L. and Norris, W. M. 2004. Low-density Koala (*Phascolarctos cinereus*) populations in the mulgalands of south-west Queensland. IV. Abundance and conservation status. *Wildlife Research* 31: 19 – 29.

White, N.A. and Kunst, N.D. 1990. Aspects of the ecology of the Koala in southeastern Queensland. Pp. 109–16 in *Biology of the Koala*, edited by A.K. Lee, K.A. Handasyde and G.D. Sanson. Surrey Beatty and Sons, Sydney, Australia.

APPENDIX

Some probabilistic aspects of the SAT approach

Over the years many individuals have contributed to development and refinement of the Koala Habitat Atlas methodology and its derivative progeny the Spot Assessment Technique.

In 1994, Southern Cross University student Maria Jones was set the task of examining the distribution of *P. cinereus* faecal pellets beneath trees used by the species. Thirty spatially independent Forest Red Gums *Eucalyptus tereticornis* were selected for assessment, each of which was confirmed to have been used by *P. cinereus* on the basis of one or more faecal pellets being observed beneath their respective canopies. Forest Red Gum was selected because it was known to be a preferred food tree throughout the range of *P. cinereus* in eastern Australia. Beneath each of these trees both the number and distribution of faecal pellets were recorded at 200 mm radial increments from the base, along with other data such as tree dbh and canopy configuration.

Collectively, Maria recorded 8,565 faecal pellets beneath (and sometimes beyond) the canopies of the 30 trees (mean dbh of sampled trees: 40.51cm ± 24.67(SD), range 95 – 895; mean no. faecal pellets tree^{-1}: 285.6 ± 341.8(SD), range 1 – 1433). From these data it was able to be demonstrated that (i) *P. cinereus* faecal pellets were not uniformly distributed beneath the tree canopy, but (ii) they occurred most commonly near the base of trees (Figure 1).

Given the problems of accumulated faecal pellet counts, one of us (SP) then asked of Maria's

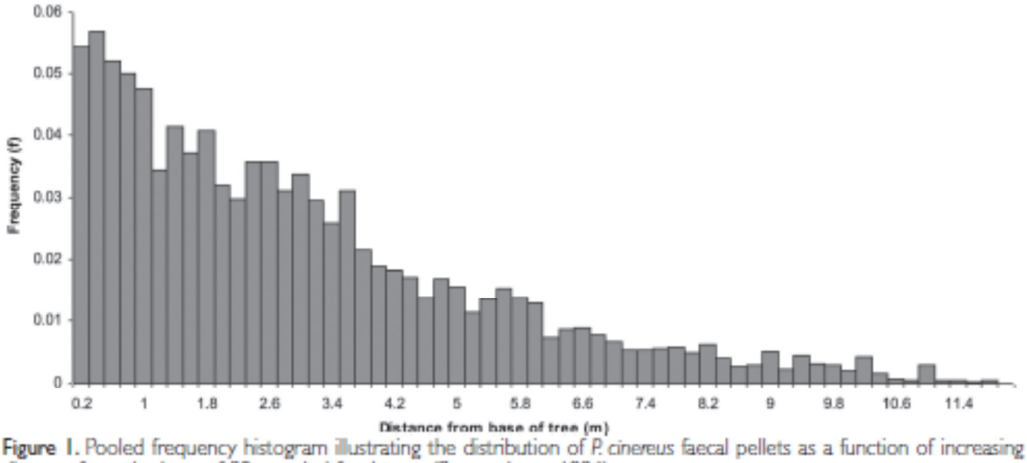


Figure 1. Pooled frequency histogram illustrating the distribution of *P. cinereus* faecal pellets as a function of increasing distance from the base of 30 sampled food trees (Source: Jones 1994).

APPENDIX I

data: "Given that each tree is a spatially independent replicate, what - on average - is the relationship between proportion (p) of the total faecal pellet count beneath each of the sampled trees as a function of distance from the base?" Figure 2 illustrates the answer to this question, demonstrating how the probability of success in terms of actually finding pellets can be related to the size of a radial search area. With this knowledge it then became a matter of looking for a search parameter that combined a meaningful probability of encountering one or more faecal pellets, yet also restricting the search to an area that could be efficiently worked. Further interrogation of the data established that, on average, the equivalent of 47% ± 12%(95% CI) of all *P. cinereus* faecal pellets will be located within a distance of 1m from the base of trees that have been utilized by the species. We figured the odds at that distance (i.e. ~50:50) were good. While a smaller search area (i.e. 0.6m) would clearly have increased search efficiency, the probability of finding pellets was almost halved! Conversely, increasing the search area beyond 1m resulted in not just minor increases in the probability of success but also substantively increased the search area in each instance.

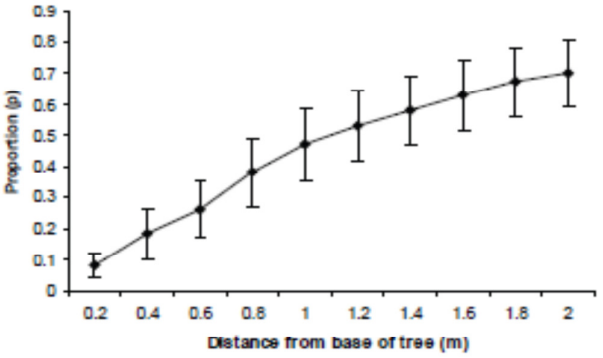


Figure 2. Mean proportional representation (± 95% Confidence Interval) of the total faecal pellet counts from beneath a sample of 30 trees known to have been utilised by *P. cinereus* (raw data sourced and re-analysed from Jones (1994)).

The results of the preceding analysis are generally in accord with the observations of other workers, Ellis et al (1998) also recording a disproportionately high density of pellets adjacent to the trunks of some trees utilized by *P. cinereus*, with approximately 18% of daily collection falling within a 1m x 1m area around the tree base. Sullivan et al (2002) used a 30cm search area around the base of trees, reporting a variable tendency (1.9 – 13.5%) for misclassification (i.e. recording absence when in fact pellets were actually present elsewhere beneath the canopy). Interestingly, the potential for such misclassification is strongly supported by Figure 2 which otherwise infers that the proportional representation of faecal pellets using a 30cm basal search area is very low (~10-15%).

Appendix 3

Principles for Integration of Koala Management into Local Regulatory Planning Framework

The following provides an overarching framework for the establishment of local planning provisions that reflect the objectives of this plan in relation to koala management and conservation.

a) Amend the Ballina Local Environmental Plan to reinsert a provision requiring consideration of natural areas and habitat in the development assessment process. Council's endorsed December 2011 provision that was deferred from the LEP due to the State Government E zone review is consistent with the intended outcomes of this plan (see below):

(1) The objective of this clause is to provide protection to the ecological, social and economic values of natural areas.

(2) This clause applies to land located within or adjoining land or water in any of the following zones:

(a) Zone E1 National Parks and Nature Reserves,

(b) Zone E2 Environmental Conservation,

(c) Zone E3 Environmental Management,

(d) Zone W1 Natural Waterways,

(e) Zone W2 Recreational Waterways.

(3) In determining whether to grant consent in relation to an application to carry out development on land to which this clause applies, the consent authority must be satisfied that the proposed development is sited, designed and managed to avoid or mitigate potential adverse impacts associated with the development in relation to the following matters:

(a) surface water and ground water quality and quantity, and

(b) terrestrial and aquatic flora and fauna, and

(c) ecological, habitat and biodiversity values, and

(d) access to public land, and

(e) declared aquatic reserves, marine parks, national parks or nature reserves, and

(f) soil erosion and sedimentation.

b) Amend the Ballina Shire Development Control Plan to insert provisions that:

- recognise identified koala habitat in the shire for planning purposes.
- identify suitable methods for the assessment of koala habitat and potential impacts of development on koalas.
- seek to avoid or mitigate of impacts on koala habitat.
- identify suitable provisions for the provision of compensatory habitat and offsets.
- recognise that koalas occupy and traverse a landscape that is broader than koala feed trees.
- support connectivity between koala habitat areas.
- avoid, minimise or mitigate the creation of barriers to safe koala movement.
- establish controls for the keeping of dogs in the Southern KMP .
- require assessment of proposals for the removal of individual or small numbers of koala feed trees in relation to impact on koalas.

These provisions would form the basis for the address of the LEP based provision set out under (a). Key parts of the DCP that could be amended include Chapters 2 (including section 3.3) and 2a.

Appendix 4

Basis for Offset Provisions

Background

This section details the provisions for the offsetting of impacts on koala habitat resulting from development activities. The provisions aim to provide a transparent framework for the planning and assessment of an offset proposal where there are unavoidable residual impacts from a proposed development activity.

The provisions are informed by the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Environmental Offsets Policy, the Lismore City Council Comprehensive Koala Plan of Management for south-east Lismore and the draft Comprehensive Koala Plan of Management for the Tweed Coast.

What are offsets?

Offsets are measures that compensate for residual adverse impacts of development on koalas or on the quantity, quality and connectivity of koala habitat. Offsets are only considered when all options to avoid or mitigate impacts on koalas and koala habitat have been considered and confirmed as unachievable.

What types of impacts require offsetting under the Plan?

While there are a range of potential impacts resulting from development proposals, this Plan only allows offsetting of Preferred Koala Habitat and Preferred Koala Food trees in the limited circumstances.

Other impacts such as increased impact from dogs, vehicles, fire or other recognised threats are required to be avoided or mitigated and are unable to be offset under the Plan.

What types of offsets are applicable under the Plan?

This plan requires the use of direct offsets resulting in a measurable conservation gain for koalas and koala habitat. The use of threat reduction measures or other compensatory measures (indirect offsets) are not acceptable under this Plan.

Offsetting is therefore limited to the creation of new koala habitat at a suitable location on the impact site, or an agreed offsite location, in accordance with Table 1 (over page).

A higher ratio is set for offsite offsetting to accommodate the greater risk and potentially lower value resulting from addressing impact at sites other than the impact site.

Council will not approve offsite offsets where suitable land is available on the same allotment (or adjacent allotment in the same ownership) as the proposed development.

What are the steps to use offsets under the Plan?

1. Ensure development proposal meets the requirements as per Section 5 of the Plan.
2. Describe any residual impact and ensure that it is allowable.
3. Develop and submit an offset proposal that is consistent with Table 1.

Calculating impacts and offsets for proposals

This Plan provides offset ratios to enable direct calculation of offsets based on the residual impact as either number of trees or area of habitat lost. As an example for calculation purposes, if the offset ratio is 1:5, five trees must be replanted for every one lost. Or in the case of habitat, five times the area of habitat lost must be restored.

The offset ratios have been developed to reflect the regional approach to offsets demonstrated by the Lismore CKPoM and the draft Tweed CKPoM. They also reflect the provisions of the scenario based application of the EPBC Act Offsets Policy.

The Important Population status of the koala in the Southern KMP is reflected in the relatively higher offset ratios required for development within this area. Fragmentation of existing habitat has already affected the population (Phillips, 2013) and therefore there is a focus within this precinct of consolidating existing habitat and increasing connectivity and habitat quality.

The offset ratios herein reflect the significant risk associated with further impact on existing habitat and use multiplication factors to address this risk relative to the impact. Further, the offset ratios required under the Plan have been developed to take into account the:

- extent of correlation of the offset with the impact
- conservation gain from the offset
- time delay involved in achieving the gain
- level of certainty of success
- suitability of the location
- risk associated with achievement of the offset
- required performance measures

Impact on:-	Preferred Koala Habitat – Southern KMP	Preferred Koala Habitat – East Ballina and Plateau KMP*	Preferred Koala Food Trees – East Ballina and Plateau KMP*
Offset ratio (onsite)	1:15	1:10	<100mm – 1:8 >100 - 250mm – 1:16
Offset ratio (offsite)	1:20	1:15	<100mm – 1:12 >100 - 250mm – 1:20
Clearing of trees over 250mm diameter at breast height in core koala habitat is not permitted.			

Table 1: Offset ratios by Koala Management Precinct and receiving site

Planning and offset proposal

Detailed planning is an integral part of developing an offset proposal. Offset proposals are required to be submitted as offset management plans and to be developed in consideration of the following principles.

The principles that underpin this policy are:

1. The primary objective of offset plantings must be to protect, enhance or create ecologically viable *koala habitat*.
2. Offsets, and particularly offsite offsets, must only be considered once all options to avoid, minimise and mitigate any adverse impacts have been exhausted.
3. Clearing must not be approved where the impact of clearing cannot be satisfactorily compensated.

4. Offset plantings, also called habitat compensation works, should lead to a net gain in the area of *koala habitat*, and an improvement in the condition of *koala habitat* within the Koala Management Precinct.
5. The *land* receiving compensation works ('*receiving land*') must be ecologically suitable and appropriate for protection, enhancement or creation of *koala habitat*.
6. An activity that leads to the loss of *koala habitat* (especially clearing) should only proceed once the management arrangements on the *receiving land* are legally secure **and** habitat plantings are at an appropriate size to support koalas.
7. Compensation works must not lead to permanent adverse environmental impacts and must not be used as a justification for granting approval to a DA where the adverse environmental impacts of a development are greater than the benefit to be obtained from the compensation works.
8. Management and monitoring of habitat compensation activities should be undertaken over an ecologically meaningful timeframe (for example, a minimum of five years and preferably longer).

How will the land be secured to ensure retention of habitat outcomes?

Security of tenure for offsite sites is required and is best achieved through legal mechanisms that are permanent and secure. Acceptable options are:

- Application of a restrictive covenant under Part 6(Division 4) of the *Conveyancing Act 1919* to ensure that all areas contributing to the offset are protected from future development (including clearing) and managed for the ongoing benefit of koalas and their habitat.
- Dedicating the area to Council (if acceptable to Council) where the land can be secured for conservation purposes and agreement regarding management funding is achieved.
- Other mechanisms including a conservation land title covenant under the Nature Conservation Act 2001 or a voluntary planning agreement between Council or the NSW Department of Planning and the Environment and the proponent.

Koala offset management plans

A koala offset management plan is required for each offset site involved in an offsets proposal. The plan should detail:-

- The impact and subsequent offset ratios that have been applied to formulate the offset proposal
- Objectives and outcomes for the offset site with specific relation to the impact site values and quality
- Mechanism to secure the offset site
- Details of proposed revegetation to meet the required offset
- Ongoing management and maintenance arrangements, including any timeframes
- Monitoring and reporting requirements
- Name and contact details of landholder/s
- Lot on plan property description
- Maps
- Any other supporting documentation.

The koala offset site management plan must be signed by all relevant parties to the land ownership and ongoing management arrangements.
