



CAMPBELLTOWN CITY COUNCIL

Draft

**COMPREHENSIVE KOALA PLAN
OF MANAGEMENT**

PART 1: THE CKPoM

**Prepared for Campbelltown City Council
under *State Environmental Planning Policy
No. 44 – Koala Habitat Protection***

by

Australian Koala Foundation

with

Campbelltown City Council

January 2003

savethekoala.com



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COMPREHENSIVE KOALA PLAN OF MANAGEMENT

PART 1: THE CKPoM

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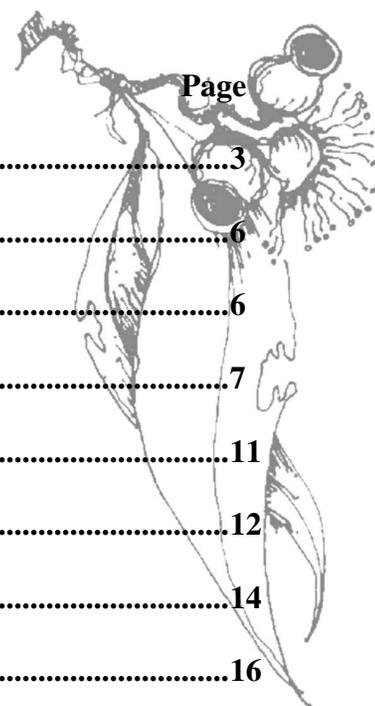
January 2003

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1 INTRODUCTION

The Campbelltown City Council Comprehensive Koala Plan of Management (CKPoM) consists of two parts. The CKPoM (Part 1) includes a brief synopsis for each of the management topics (chapters) that are detailed in the accompanying CKPoM Resource Document (Part 2), together with specified management actions.

The Campbelltown City Council CKPoM has been prepared for the Campbelltown Local Government Area (LGA) in accordance with *State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44)* and accompanying guidelines, including Circular No. B35 (Department of Planning 1995) and NSW National Parks and Wildlife Service (NPWS) draft 'Procedures for preparing comprehensive plans of management for Koalas under SEPP 44' (Lunney *et al.* 1997). The Draft Port Stephens Koala Management Plan (Callaghan, J., Leathley, S & Lunney, D 1994), as referred to in SEPP 44, together with subsequent joint work by the Australian Koala Foundation (AKF), NSW National Parks and Wildlife Service and Port Stephens Council to complete the draft Port Stephens Council CKPoM (1999), have provided models for preparing the Campbelltown City Council CKPoM. The Campbelltown City Council CKPoM was preceded by the Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1998).

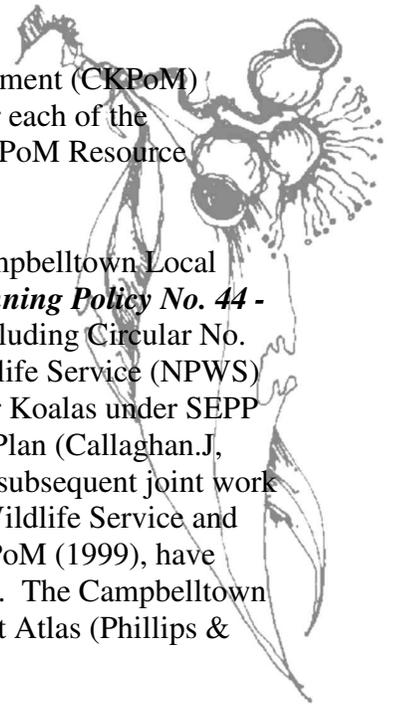
The Campbelltown City Council CKPoM is consistent with the National Koala Conservation Strategy (ANZECC 1998), in seeking to conserve Koalas by identifying and protecting existing habitat and incorporating Koala conservation into local government planning processes (Lunney *et al.* 1998).

The Campbelltown City Council CKPoM has been prepared in accordance with the following principal aim of SEPP 44:

"...to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free living populations over the present range and to reverse the current trend of population decline."

Once the Campbelltown City Council CKPoM has been approved by both Council and the Director General of Urban Affairs and Planning (now planningNSW), it will supersede the requirements of SEPP 44 with respect to the investigation of potential and core Koala habitat and the requirement for preparation of Individual Koala Plans of Management (IKPoMs). Compliance with the Campbelltown City Council CKPoM will constitute compliance with SEPP 44 for relevant matters in the Campbelltown LGA. However, where an Individual KPoM has already been approved in conjunction with a development application and it conflicts with the provisions of the CKPoM, the Individual KPoM shall prevail.

The *Native Vegetation Conservation Act 1997* (NVC Act) provides for the preparation of Regional Vegetation Management Plans (RVMPs). Section 27 (2) of the NVC Act requires that "in preparing a draft Regional Vegetation Management Plan, if any part of the land to which the plan is intended to apply is core Koala habitat within the meaning of *State Environmental Planning Policy No 44 – Koala Habitat Protection*, the plan must make



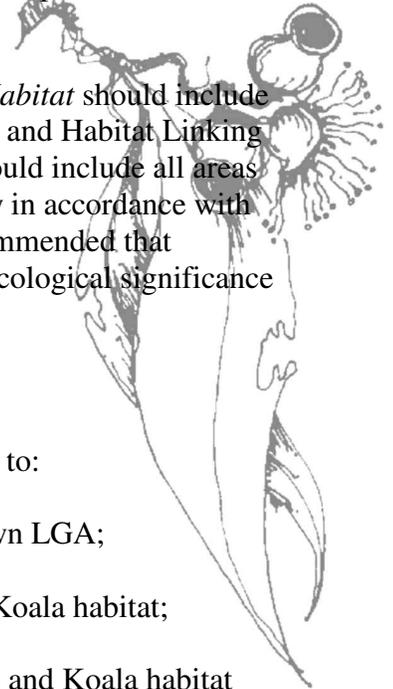
provision, consistent with any guidelines under that Policy, for appropriate protection and management with respect to that habitat.”

For the purposes of the NVC Act, it is recommended that *Core Koala Habitat* should include all areas of Preferred and Supplementary Koala Habitat, Habitat Buffers and Habitat Linking Areas as defined in this CKPoM. Additionally, *Core Koala Habitat* should include all areas where site-specific assessments indicate moderate or high Koala activity in accordance with the Spot Assessment Technique (Phillips & Callaghan 1995). It is recommended that Preferred and Supplementary Koala Habitat be included in the highest ecological significance ranking within the future RVMP.

1.1 CKPoM Objectives

The principal objectives of the Campbelltown City Council CKPoM are to:

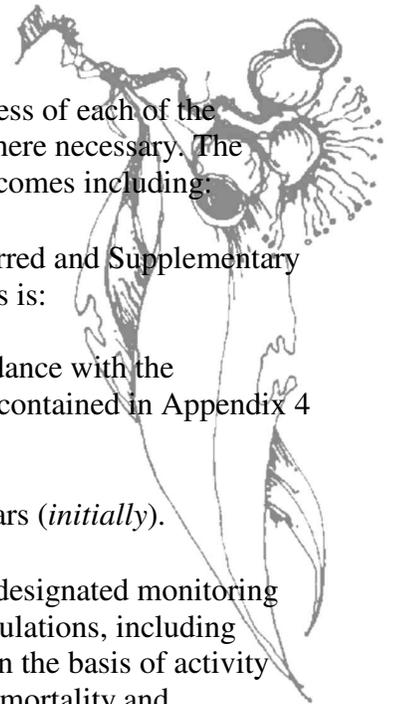
- ❖ Evaluate and rank Koala habitat throughout the Campbelltown LGA;
- ❖ Identify priority conservation areas and strategies to protect Koala habitat;
- ❖ Identify the principal threats that adversely impact on Koalas and Koala habitat within the Campbelltown LGA;
- ❖ Provide for the long-term survival of Koala populations within the Campbelltown LGA by devising conservation strategies to effectively address each of the threats impacting on Koalas and Koala habitat;
- ❖ Provide for the restoration of degraded Koala habitat areas;
- ❖ Promote a balanced approach to Koala conservation and development;
- ❖ Ensure that adequate detail is provided with Development Applications and rezoning Proposals in order to assess, minimise and effectively ameliorate likely impacts on Koala habitat;
- ❖ Provide guidelines and development standards to protect Koala habitat;
- ❖ Provide for effective public awareness and education programs concerning Koala conservation issues;
- ❖ Identify potential funding sources for implementation of the CKPoM;
- ❖ Facilitate targeted Koala conservation and management oriented research projects within the Campbelltown LGA; and
- ❖ Provide for the effective implementation and monitoring of the CKPoM.



1.2 Performance Indicators

The following performance indicators are designed to facilitate the success of each of the proposed actions and to allow the CKPoM to be assessed and refined where necessary. The performance indicators consist of a number of specific conservation outcomes including:

- The loss of Koala habitat within areas identified as Preferred and Supplementary Koala Habitat, Habitat Buffers and Habitat Linking Areas is:
 - i) minimised and restricted to that permissible in accordance with the performance standards for development applications contained in Appendix 4 of the CKPoM; and
 - ii) reduced in each successive year over the next five years (*initially*).
- The annual Koala population assessments undertaken at designated monitoring sites indicate that the majority of the surveyed Koala populations, including urban populations, are stable or increasing (determined on the basis of activity levels, evidence of successful breeding, signs of disease, mortality and survivorship, and population estimates), within 5 years from the adoption of the Campbelltown City Council CKPoM.
- Annual statistics indicate that Koala mortality due to collisions with motor vehicles is not on the increase, in conjunction with stable or increasing Koala population estimates in the vicinity of identified black spot areas.
- Annual statistics indicate that Koala mortality due to dog attacks is not on the increase, in conjunction with stable or increasing Koala population estimates in the vicinity of identified high-risk dog attack areas.
- An ongoing program is established for Koala habitat restoration activities in high priority areas according to the criteria outlined in the Habitat Restoration Chapter of the CKPoM Resource Document.



In addition to the conservation outcomes listed above, the CKPoM should be assessed in terms of implementation of each of the proposed actions. For example, the success of the habitat conservation strategy should be assessed initially by determining whether each of the habitat conservation measures had been implemented according to schedule.

The Monitoring Chapter of the CKPoM Resource Document outlines how the performance indicators will be used to monitor and refine the CKPoM.

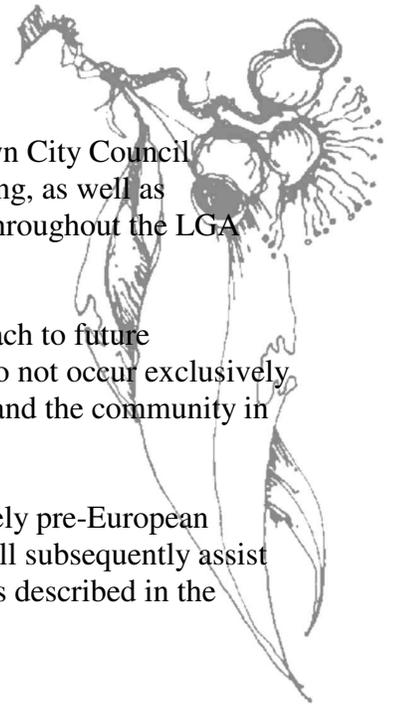
2 ECOLOGICAL HISTORY

2.1 Synopsis

The historical research undertaken in conjunction with the Campbelltown City Council CKPoM has provided a timeline for settlement, land use and land clearing, as well as information concerning major bushfires, floods and hunting of Koalas throughout the LGA since declaration of the town of Campbelltown in 1820.

This historical information emphasises the need for an integrated approach to future management of the local Koala population. Koalas and other wildlife do not occur exclusively in protected areas and thus it is essential to involve private landholders and the community in local Koala conservation and management initiatives.

The ecological history research has provided guidance regarding the likely pre-European vegetation of areas that have since been predominantly cleared. This will subsequently assist with the identification of land for potential habitat restoration projects as described in the CKPoM Resource Document.



3 KOALA HABITAT IDENTIFICATION

3.1 Synopsis

The identification of Koala habitat within the Campbelltown LGA has involved the preparation of an LGA-wide Koala Habitat Atlas by the Australian Koala Foundation (Phillips and Callaghan 1998), a scientific paper (Phillips & Callaghan 2000), and incorporation of outcomes from a community-based survey combined with Koala records from other sources. **This resulted in the preparation of a Koala Habitat Map for the Campbelltown LGA that has identified and ranked Koala habitat into three categories: Preferred Koala Habitat, Supplementary Koala Habitat and Marginal Koala Habitat.**

A **Koala Habitat Planning Map** (Figure 1) was derived from the Koala Habitat Map by adding 100m Habitat Buffers to all Preferred Koala Habitat and incorporating computer-generated Habitat Linking Areas involving patches of Preferred Koala Habitat. The Koala Habitat Planning Map provides the basis for identifying the areas considered to warrant the highest level of habitat protection including all Preferred Koala Habitat and Habitat Buffers. Supplementary Koala Habitat, Habitat Linking Areas and Marginal Koala Habitat also require protection, although to a lesser degree.

The field surveys and analysis together with the subsequent scientific paper (Phillips & Callaghan 2000) confirmed the following tree species as being preferentially utilised by Koalas in the Campbelltown LGA: Grey Gum *Eucalyptus punctata* and Blue-leaved Stringybark *E. agglomerata*, particularly when occurring in association with either shale benching or outcropping shale deposits including those on the plateau tops. ***These two tree***

species constitute the preferred Koala food trees for the Campbelltown LGA and provide the basis for the Koala habitat model and associated mapping.

In addition to protecting areas of significant Koala habitat, preferred Koala food trees warrant protection wherever they occur within the LGA. For the purposes of this CKPoM individual preferred Koala food trees are afforded protection within all categories of Koala habitat.

Koalas are also known to utilise a number of other Eucalyptus and non-eucalyptus tree species within the Campbelltown LGA including Turpentine *Syncarpia glomulifera*, which was identified by Phillips and Callaghan (2000) as receiving the most significant use by Koalas amongst the non-eucalyptus tree species. Turpentine *S. glomulifera* also warrants protection wherever it occurs within the LGA.

The procedure undertaken to identify Koala tree species and habitat preferences within the Campbelltown LGA are detailed in chapters 4 and 5 of the CKPoM Resource Document.

4 HABITAT CONSERVATION MEASURES

4.1 Synopsis

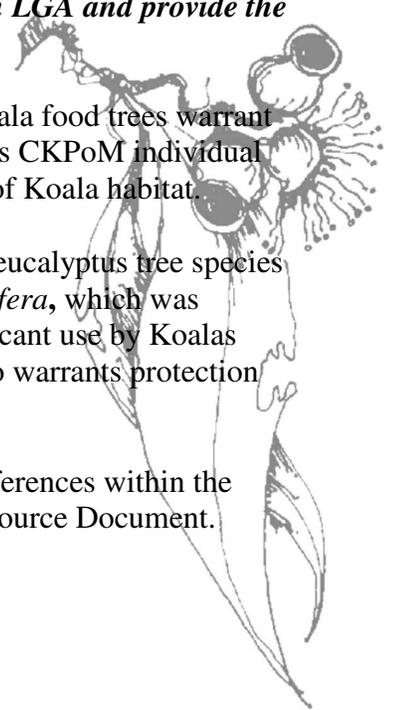
An effective strategy to conserve Koala habitat is essential to provide for the long-term survival of the Koala population within the Campbelltown LGA. Such a strategy will need to involve the integration of a range of conservation measures including regulatory (legislative) and incentives-based approaches, in conjunction with effective community education.

The Habitat Conservation Chapter of the CKPoM Resource Document details the range of conservation measures proposed for application in the Campbelltown LGA.

Proposed regulatory measures include: the rezoning of selected areas to an Environmental Protection (Significant Habitat) Zone; the provision of performance standards for assessment of rezoning proposals and development applications; guidelines for Koala habitat assessment and information that must be supplied to accompany development applications and rezoning proposals; and the development of clauses for application to existing Interim Development Orders (IDOs) and Local Environmental Plans (LEPs), or inclusion in a future LGA-wide LEP, to protect preferred Koala food tree species wherever they occur and to require consent for any proposed *development* or *activity* within Preferred Koala Habitat, Koala Habitat Buffers, Supplementary Koala Habitat or Koala Habitat Linking Areas.

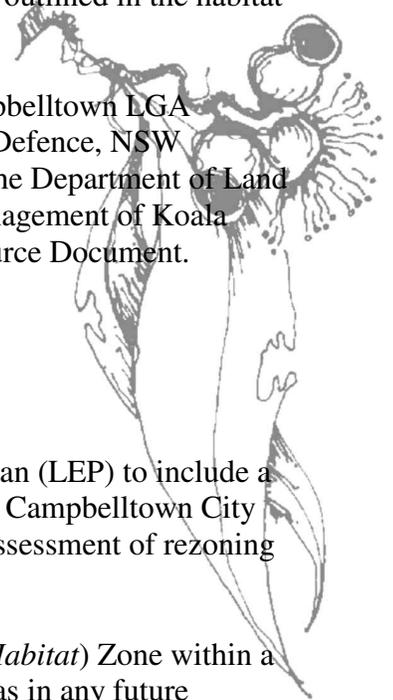
Performance standards for rezoning proposals and development applications, and guidelines for Koala habitat assessment are addressed in the Development Assessment Chapter.

Incentives-based habitat conservation measures recommended for consideration include: Voluntary Conservation Agreements, Voluntary Conservation Zonings, Management Agreements and Wildlife Refuges. Potential incentives schemes that could be employed to encourage landholders to voluntarily conserve Koala habitat include: management grants, rate



rebates, development incentives and transferable development rights, as outlined in the habitat Conservation Chapter in the CKPoM Resource Document.

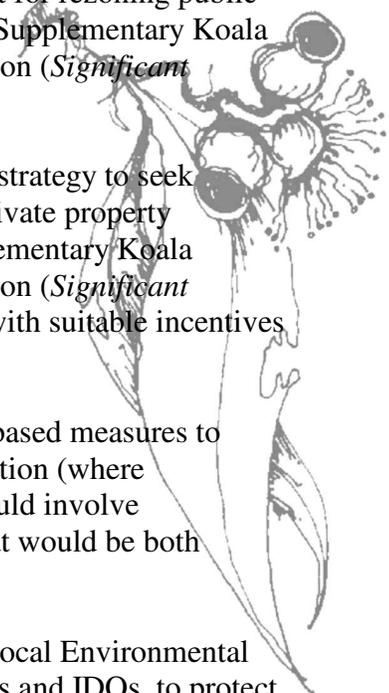
A number of land management agencies have land holdings in the Campbelltown LGA including Campbelltown City Council, Commonwealth Department of Defence, NSW National Parks & Wildlife Service, planningNSW, Sydney Water, and the Department of Land and Water Conservation. The potential role of such agencies in the management of Koala habitat in the Campbelltown LGA is discussed in chapter 4 of the Resource Document.



4.2 Actions

Campbelltown City Council

- i) Council prepare a *Draft* LGA-wide Local Environmental Plan (LEP) to include a clause (as per Appendix 1), to activate the provisions of the Campbelltown City Council CKPoM including the performance standards for assessment of rezoning proposals and development applications.
- ii) Council include an Environmental Protection (*Significant Habitat*) Zone within a future *Draft* LGA-wide Local Environmental Plan, as well as in any future individual LEPs (see Appendix 2 for Environmental Protection (*Significant Habitat*) Zone objectives).
- iii) Council prepare an LGA-wide *Draft* Local Environmental Plan, or an amending clause to apply to the relevant existing LEPs or IDOs, to rezone areas of Koala habitat (including both Council lands and private property as specified below and indicated on Figure 2) to Environmental Protection (*Significant Habitat*) Zone. It may be appropriate to undertake this in conjunction with vi) below.
 - ❖ Areas of Preferred Koala Habitat, Habitat Buffers, Supplementary Koala Habitat, and Preferred Habitat Linking Areas that coincide with lands zoned 'Rural' and 'Special Uses' at Wedderburn (LEP 1; LEP 32), extending to include the Koala habitat on the western side of the Georges River (IDO 15).
 - ❖ Areas of Preferred Koala Habitat and Habitat Buffers that coincide with lands zoned 'Rural' at St Helens Park, east of Appin Road (Campbelltown Urban Area LEP 2002).
 - ❖ Areas of Preferred Koala Habitat, Habitat Buffers, Supplementary Koala Habitat, and Preferred Habitat Linking Areas that coincide with lands zoned 'Open Space' in the following areas: adjacent to the Georges River at Macquarie Fields (Campbelltown Urban Area LEP 2002) and Long Point (IDO 13); Minto Heights and Kentlyn (IDO 13); St Helens Park, east of Appin Road (IDO 28; Campbelltown Urban Area LEP 2002); and Wedderburn (LEP 1; LEP 32).

- 
- iv) Council consult with public authorities to seek their support for rezoning public lands containing Preferred Koala Habitat, Habitat Buffers, Supplementary Koala Habitat or Habitat Linking Areas to Environmental Protection (*Significant Habitat*) Zone.
 - v) Council develop and implement a community consultation strategy to seek support for voluntary conservation zonings of additional private property containing Preferred Koala Habitat, Habitat Buffers, Supplementary Koala Habitat or Habitat Linking Areas to Environmental Protection (*Significant Habitat*) Zone. This should be undertaken in conjunction with suitable incentives schemes.
 - vi) Council investigate the potential introduction of incentive-based measures to encourage voluntary conservation, management and restoration (where appropriate) of Koala habitat on private property. This should involve consultation with property owners to identify incentives that would be both feasible for Council and appealing to land holders.
 - vii) Council include a clause within a future LGA-wide *Draft* Local Environmental Plan, or as an amending clause to the relevant existing LEPs and IDOs, to protect preferred Koala food tree species including individual specimens of *Eucalyptus punctata* and *E. agglomerata* wherever they occur.
 - viii) Council include a clause within a future LGA-wide *Draft* Local Environmental Plan, or as an amending clause to the relevant existing LEPs and IDOs, requiring consent for any proposed *development* or *activity* within Preferred Koala Habitat, Koala Habitat Buffers, Supplementary Koala Habitat or Koala Habitat Linking Areas.
 - ix) Council in liaison with UWSM, NSW National Parks and Wildlife Service and Australian Koala Foundation, prepare specific management and community education strategies to minimise threats to Koalas and Koala habitat in Kentlyn, Minto Heights, St Helens and Wedderburn, if the first monitoring report indicates the need for finer-scale management in these areas.
 - x) Council demonstrate best-practice management of Koala habitat by applying the provisions of the Campbelltown City Council CKPoM in conjunction with all Council development and land management activities.

NSW National Parks and Wildlife Service

- xi) The NSW National Parks and Wildlife Service undertake to investigate and negotiate potential Conservation Agreements and Wildlife Refuges, where appropriate for the conservation of Koala habitat.

- xii) The NSW National Parks and Wildlife Service continue to investigate and pursue the Wedderburn Koala Reserve proposal.
- xiii) The NSW National Parks and Wildlife Service undertake to investigate and if appropriate, to promote nomination of significant Koala habitat areas within the Campbelltown LGA for addition to the Register of the National Estate.
- xiv) The NSW National Parks and Wildlife Service note the Campbelltown City Council CKPoM in the state-wide Koala Recovery Plan, currently in preparation under the *Threatened Species Conservation Act 1995*.

PlanningNSW

- xv) PlanningNSW include identified Koala habitat in the Campbelltown LGA in future Regional Environmental Planning in consultation with Campbelltown City Council.

Department of Defence (Army)

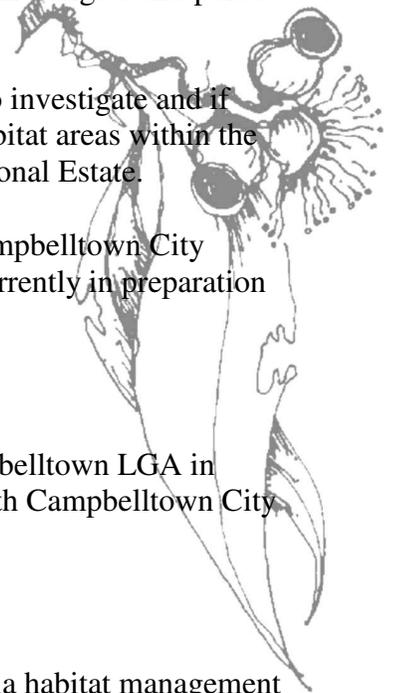
- xvi) Department of Defence (Army) develop guidelines for Koala habitat management on Department of Defence lands in the Campbelltown area in consultation with Campbelltown City Council, NSW National Parks and Wildlife Service and UWSM.
- xvii) Department of Defence (Army) continue to report any Koala records for the Campbelltown area to UWSM and NSW National Parks and Wildlife Service.

Sydney Water

- xviii) Sydney Water develop guidelines for the management of Koala habitat on Sydney Water lands in the Campbelltown area in consultation with Campbelltown City Council, NSW National Parks and Wildlife Service and UWSM.

Private Land Holders

- xix) Private land holders conserve and manage Koala habitat on private lands to the greatest extent possible.
- xx) Private land holders restore degraded areas of former Koala habitat on private lands wherever possible.
- xxi) Private land holders ensure that appropriate procedures and consultation have been undertaken, and any necessary approvals obtained, prior to commencing any *development* or *activity* likely to effect the environment of Koalas on private land. This extends to any proposed land clearing or removal of individual preferred Koala food trees.



5. DEVELOPMENT ASSESSMENT

5.1 Synopsis

The development assessment process refers to the procedure by which development and land use is assessed and regulated. This procedure represents an important means by which Council can regulate development to ensure the protection and effective management of Koala habitat in the Campbelltown LGA. Assessment guidelines have been established to standardise the treatment of issues relating to the management of Koalas and Koala habitat within the development assessment process.

Preferred Koala Habitat and Habitat Buffers require the highest level of protection possible. Supplementary Koala Habitat and Habitat Linking Areas also require a high level of protection, though generally less than for Preferred Koala Habitat and Habitat Buffers (see chapter 5 of the CKPoM Resource Document). Preferred Koala food trees require protection wherever they occur in the Campbelltown LGA.

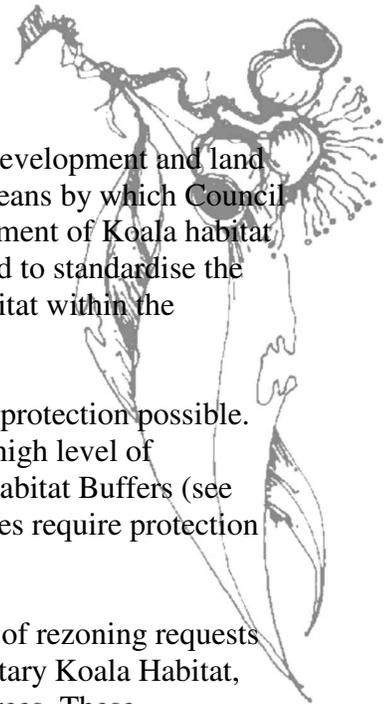
Performance standards have also been prepared to guide the assessment of rezoning requests pertaining to land that contains or is adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas, and/or preferred Koala food trees. These performance standards are contained in Appendix 3 of this CKPoM.

Performance standards have also been prepared to guide the assessment of development applications pertaining to land that contains or is adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas, and/or preferred Koala food trees. These performance standards are contained in Appendix 4 of this CKPoM.

Guidelines for Koala habitat assessment were developed to provide the information necessary to support a rezoning proposal under Part 3, or a development application under Part 4 of the *Environmental Planning and Assessment Act 1979*. The Guidelines for Koala Habitat Assessments in the Campbelltown LGA are presented in Appendix 5 of this CKPoM.

5.2 Actions

- i) Council adopt and apply the performance standards for assessment of rezoning proposals (Appendix 3).
- ii) Council adopt and apply the performance standards for assessment of development applications (Appendix 4).
- iii) Council adopt and promote the Guidelines for Koala Habitat Assessment (Appendix 5).
- iv) Council include information regarding the presence of Koala habitat on section 149 certificates.



6 HABITAT RESTORATION

6.1 Synopsis

In the absence of careful management, the remaining Koala habitat areas have the potential to become further degraded and fragmented to the detriment of Koalas and other native species. Existing land management strategies and practices rarely relate specifically to the restoration of Koala habitat. Consequently, a management strategy is considered necessary to identify principal impacts associated with land degradation and to outline opportunities to optimise Koala habitat quality within the Campbelltown LGA. Furthermore, as the resources for restoration works are finite, it is essential that areas be prioritised to ensure the maximum possible benefit of habitat restoration efforts to Koala conservation.

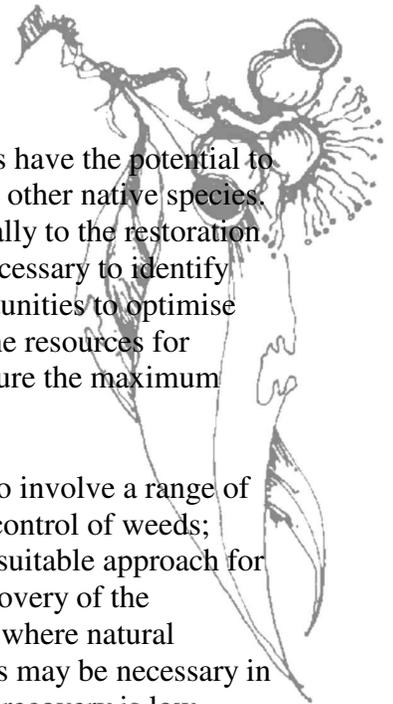
Koala habitat restoration projects in the Campbelltown LGA will need to involve a range of activities including revegetation (plantings), assisted regeneration (*e.g.* control of weeds; fencing to exclude livestock) and reconstruction. Selection of the most suitable approach for different sites will depend upon the specific requirements to achieve recovery of the vegetation communities. Regeneration techniques are most appropriate where natural recovery potential is high, whilst more intensive reconstruction activities may be necessary in more heavily cleared and disturbed areas where the potential for natural recovery is low (Greening Australia 1999). Habitat reconstruction as defined by Saunders and Hobbs (1995) involves recreating the ecological requirements of the target species. For Koalas this will include revegetation with suitable trees for food, shelter and social interaction. However, Saunders and Hobbs (1995) maintain that habitat reconstruction means more than simply replanting vegetation. It also involves facilitating the restoration of other ecosystem components and processes that are vital to ecosystem function (see the Habitat Restoration Chapter in the CKPoM). Thus, the restoration of Koala habitat should ideally involve more than simply replanting suitable species of trees. Habitat restoration projects should also involve measures to ameliorate impacts from relevant threatening processes.

Major impacts on Koalas within the Campbelltown LGA include habitat destruction, degradation and fragmentation, urban expansion, feral animals and bushfires. These factors, together with others such as roaming domestic dogs, traffic and weed infestation can collectively lead to the localised extinction of Koala populations.

Koala Habitat Destruction, Degradation and Fragmentation

Clearing of Native Vegetation was listed in September 2001 as a 'Key Threatening Process' in NSW under the *Threatened Species Conservation Act 1995*.

Habitat destruction and degradation has devastating effects on populations of native wildlife including Koalas. As well as potential death or injury to Koalas during habitat clearing, habitat destruction and degradation are likely to increase pressure on adjacent habitat as remaining animals are confined to smaller areas, with individuals forced to live under sub-optimal conditions.



Over the forty years following settlement of the Campbelltown district, native vegetation was continually cleared for growing wheat and other cereals. By 1839 the Campbelltown area had been subject to extensive clearing of land for agriculture (Benson & Howell 1990).

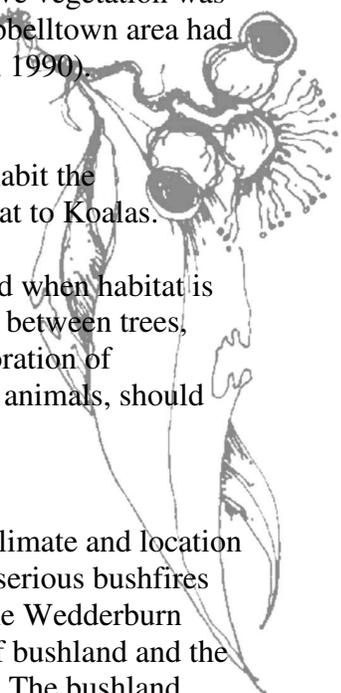
Feral Animals

Feral animals including dogs, foxes, cats, goats and others are known to inhabit the Campbelltown LGA. Feral dogs and foxes are considered a significant threat to Koalas.

The impact of feral animals such as dogs and foxes on Koalas is exacerbated when habitat is fragmented, as Koalas are forced to spend more time on the ground moving between trees, thus making them more vulnerable to predation (Hume 1990). Hence, restoration of fragmented habitat, in conjunction with measures aimed at controlling feral animals, should help to reduce impacts on Koalas.

Bushfires

Bushfires are a regular occurrence in the Campbelltown LGA. Due to the climate and location of the area and a likely high incidence of arson, the area often succumbs to serious bushfires which burn rapidly and often over large areas of land (Longhurst 1997). The Wedderburn area in particular is highly susceptible to wildfires due to the high density of bushland and the type of vegetation present (predominantly sclerophyllous trees and shrubs). The bushland adjoining the Georges River is also a potentially high-risk area with the Military Reserve to the east. Many fires have reportedly traveled from the Military Reserve and crossed the Georges River (Campbell 1996).



6.2 Actions

Identification and Prioritization of Habitat to be Restored

- i) Council prepare a prioritised list of Koala habitat areas for restoration, in liaison with the UWSM and AKF, using criteria detailed in the Habitat Restoration Chapter of the CKPoM Resource Document. The computer-modelled map of Habitat Linking Areas should be used as a guide to identifying priority areas of mainly cleared or degraded lands for potential restoration (Figure 3).
- ii) Council prepare a 'Koala Habitat Restoration Plan' for the LGA based upon the list of priority areas identified in i).

Budget and Resource Requirements

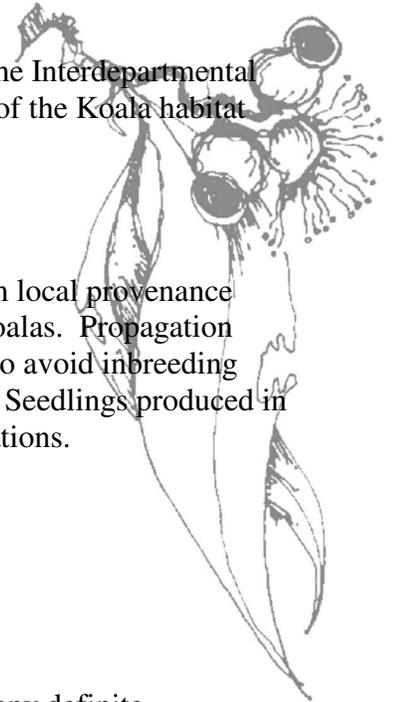
- iii) Council should liaise with relevant land management agencies, determine budget and resource requirements, seek funding, and identify suitable community and Landcare groups or schools prepared to undertake or assist with Koala habitat restoration projects. Organisations such as Greening Australia, Green Corps, and Green Reserves may also be able to assist.

Coordination of Habitat Restoration Projects

- iv) One Campbelltown City Council Officer, under the guidance of the Interdepartmental Committee, should be made responsible for overall coordination of the Koala habitat restoration program.

Nursery Stock

- v) Nursery stock for restoration programs should be propagated from local provenance seed harvested from individual trees that have been utilised by Koalas. Propagation material to be collected from a range of well-spaced parent trees to avoid inbreeding and ensure potential for reproduction (Greening Australia 1999). Seedlings produced in nurseries should be labeled with species name and collection locations.



7 TRAFFIC MANAGEMENT

7.1 Synopsis

The available data set for the Campbelltown area is too small to permit any definite conclusions with respect to Koala fatalities and traffic speed. However, data analyses undertaken in conjunction with the Port Stephens Council CKPoM (1999) suggested that the greater the speed of the vehicle, the less the likelihood of a Koala surviving a collision. However, collisions at any speed are often fatal and the most important consequence of slower speed is possibly a reduced likelihood of collisions.

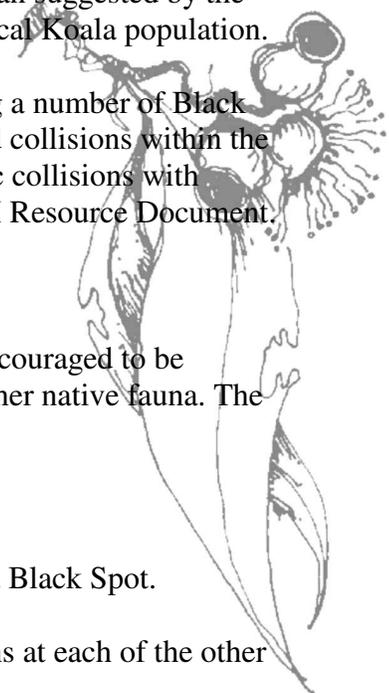
Other factors, in addition to traffic speed, are considered likely to influence the chance of Koalas being hit while attempting to cross a road. Such factors include: features of the roadside environment; the width of the cleared zone between the road edge and adjacent trees; the width of gravel shoulders; the presence of roadside drains; the height of roadside vegetation; the degree of habitat disturbance in adjacent areas; and the nature of any roadside lighting. These factors may affect driver ability to see a Koala before it attempts to cross onto the roadway, and to subsequently avoid a collision.

Twenty-one of the 584 people (3.6%) who responded to the Campbelltown Community-based Koala Survey (1997) reported having seen a Koala dead on a road within the Campbelltown LGA. A total of 16 records of Koalas killed by cars were marked on a map covering the Campbelltown LGA, along with 2 records of Koalas spotted on roads (these records include those supplied by the University of Western Sydney UWSM). Mapped records of Koalas killed, hit or spotted on roads included one in 1989, one in 1994, one in 1995, five in 1996, four in 1997 and two in 1998. A further two were undated.

All of the above records of traffic collisions with Koalas in the Campbelltown LGA reportedly resulted in the death of the Koalas involved.

The significance of the impact of road fatalities is likely to be greater than suggested by the data due to the low density and estimated small size of the remaining local Koala population.

The Koala road fatality records have been used as a basis for identifying a number of Black Spot Areas, Conflict Areas, and Potential Problem Areas for Koala road collisions within the Campbelltown LGA (Figure 4). A number of measures to reduce traffic collisions with Koalas are discussed in the Traffic Management Chapter in the CKPoM Resource Document.



7.2 Actions

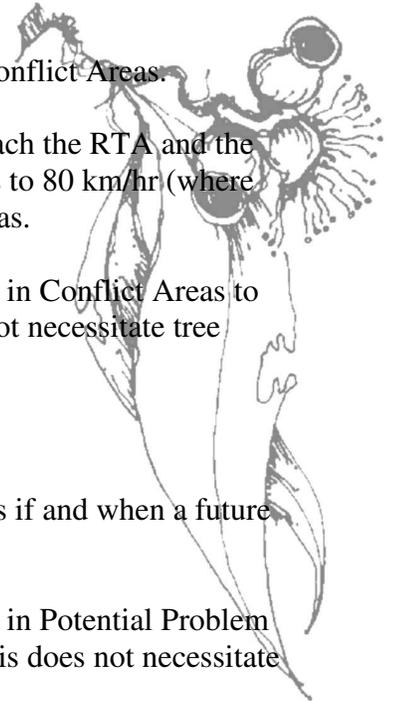
Campbelltown City Council and the Roads and Traffic Authority are encouraged to be proactive in attempting to reduce the impacts of roads on Koalas and other native fauna. The following management strategy is recommended:

Black Spot Areas

- i) Council maintain 'Koala Fatality' signs at the Wedderburn Koala Black Spot.
- ii) Council install 'Koala Warning' signs and 'Injured Wildlife' signs at each of the other identified Black Spot Areas.
- iii) Following consultation with the community, Council will approach the RTA and the NSW Police Department to support the reduction of speed limits to 60 km/hr (where the present limit is greater) at each of the identified Black Spot Areas.
- iv) Council instigate a program of regular roadside slashing of grass in Black Spot Areas to minimise the height of roadside ground cover, where this does not necessitate tree removal including regrowth.
- v) Council approach the local electricity company (Integral Energy), to investigate possible installation of street lighting at identified Black Spot Areas.
- vi) Council investigate the possibility of providing a 1m wide painted strip (with rumble strips) across the roadway at the start and end of each designated Koala Black Spot Area to further alert drivers, in addition to signage.
- vii) Council undertake a media campaign to inform the public about Black Spot Areas. This campaign could be undertaken in conjunction with the dog management campaign and to coincide with the Koala breeding season.

Conflict Areas

- viii) Council install 'Koala Warning' signs at each of the identified Conflict Areas.
- ix) Following consultation with the community, Council will approach the RTA and the NSW Police Department to support the reduction of speed limits to 80 km/hr (where the present limit is greater) at each of the identified Conflict Areas.
- x) Council instigate a program of regular roadside slashing of grass in Conflict Areas to minimise the height of roadside ground cover, where this does not necessitate tree removal including regrowth.



Potential Problem Areas

- xi) Council install 'Koala Warning' signs at Potential Problem Areas if and when a future Koala collision is reported for any of the identified areas.
- xii) Council instigate a program of regular roadside slashing of grass in Potential Problem Areas to minimise the height of roadside ground cover, where this does not necessitate tree removal including regrowth.

8 DOG MANAGEMENT

8.1 Synopsis

There are currently over 15,500 registered dogs in the Campbelltown LGA, with the actual number likely to be considerably greater when unregistered dogs are taken into account. Irresponsible dog ownership results in substantial numbers of uncontrolled, roaming domestic dogs within parts of the LGA. Roaming domestic dogs, particularly large dogs and dog packs, pose a significant threat to Koalas and other fauna that occupy habitat near urbanised areas.

The Campbelltown community-based Koala survey (plus UWSM records) produced 4 reports of dog attacks on Koalas in the LGA, which included a mother and joey. All four of these Koalas reportedly died as a result of the attacks.

The Dog Management Chapter of the CKPoM Resource Document discusses a number of management strategies available to Council including regulation under the *Companion Animals Act 1998* and community education to promote responsible dog ownership. The recommended actions for implementation are presented below.

8.2 Actions

Litigation

- i) Council should prosecute the owner or person in charge of any dog that attacks or chases a Koala under the provisions of the *Companion Animals Act 1998*, whenever evidence can be obtained that is likely to result in a conviction.

Policing

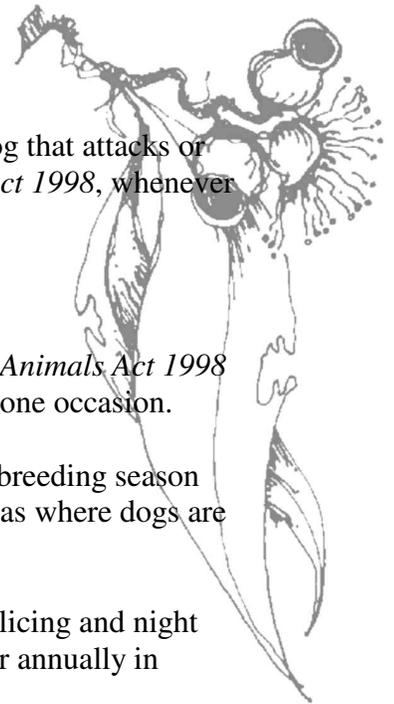
- ii) Council invoke the 'dangerous dog provisions' of the *Companion Animals Act 1998* where a dog has attacked, killed or chased a Koala, on more than one occasion.
- iii) Council examine the feasibility of night patrols during the Koala breeding season (August to February). If feasible, patrols will be conducted in areas where dogs are considered likely to pose a significant threat to Koalas.
- iv) Council undertake a media campaign to accompany additional policing and night patrols in identified problem areas. These campaigns should occur annually in conjunction with the Koala breeding season.

Education

- v) Council develop suitable educational material to raise awareness of the threat to Koalas from roaming domestic dogs and to promote responsible dog ownership.
- vi) Council publicise any successful prosecutions against dog owners under the *Companion Animals Act 1998*.

Dog Exercise Areas

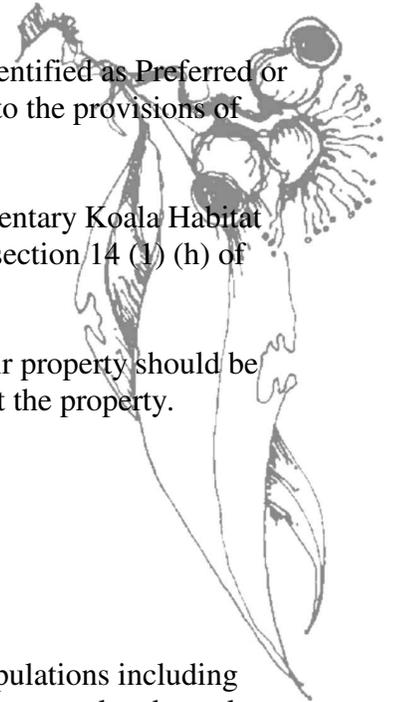
- vii) Council ensure that all designated off-leash dog exercise areas within the LGA do not conflict with identified Preferred or Supplementary Koala Habitat.
- viii) Council ensure that all public reserves are effectively sign-posted regarding dog exercise provisions.



Local Companion Animal Management Plans

The following special conditions are considered appropriate for areas identified as Preferred or Supplementary Koala Habitat and should be incorporated by Council into the provisions of any Local Companion Animal Management Plans for the LGA:

- ix) Designation of public places which contain Preferred or Supplementary Koala Habitat as “Wildlife Protection Areas”, where dogs are prohibited under section 14 (1) (h) of the *Companion Animals Act 1998*.
- x) Dog owners that become aware of the presence of a Koala on their property should be encouraged to restrain or confine their dog until the Koala has left the property.



9 FERAL ANIMAL MANAGEMENT

9.1 Synopsis

The Campbelltown LGA is known to contain a range of feral animal populations including wild dogs, foxes, cats, rabbits and goats. It is probable that feral animals currently adversely affect land administered by each of the principal land management agencies, as well as private property.

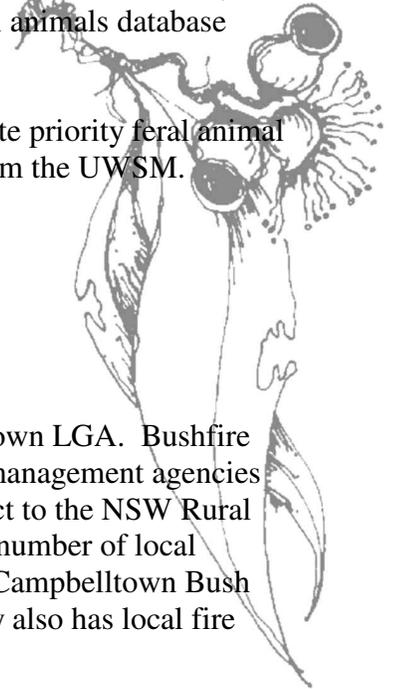
The principal land management agencies within the Campbelltown LGA include Campbelltown City Council, Sydney Water, planningNSW, Department of Land and Water Conservation, NSW National Parks and Wildlife Service, and the Department of Defence (Army).

The Campbelltown Community-based Koala Survey (1997) provided a total of 385 recorded sightings of wild or roaming dogs (109), foxes (157) and cats (119). From the range of feral animal species known to occur within the Campbelltown LGA, feral dogs are considered likely to have the most significant direct impact on Koalas, and therefore warrant the highest management priority for the CKPoM.

9.2 Actions

- i) Council establish a Feral Animal Management Committee (or sub-committee) with representation from Council and each of the other principal land management agencies within the LGA, together with the Rural Lands Protection Board and the UWSM.
- ii) The Feral Animal Management Committee develop and oversee implementation of a Feral Animal Management Plan that would identify and address Koala-specific feral animal management issues, together with a suitable community education strategy.

- iii) Council establish and promote a phone line for ongoing reporting of feral animals (as well as roaming domestic dogs), and develop and maintain a feral animals database linked to Council's Geographic Information System (GIS).
- iv) The Feral Animal Management Committee encourage and promote priority feral animal research projects by Undergraduate and Postgraduate students from the UWSM.



10 BUSHFIRES

10.1 Synopsis

Bushfire represents a significant threat to wildlife within the Campbelltown LGA. Bushfire management features prominently in the policies and practices of land management agencies within the Campbelltown LGA. This is particularly the case with respect to the NSW Rural Fire Service, which has considerable fire fighting resources including a number of local Volunteer Bushfire Brigades that operate under the coordination of the Campbelltown Bush Fire Management Committee. The Australian Army base at Holsworthy also has local fire fighting resources.

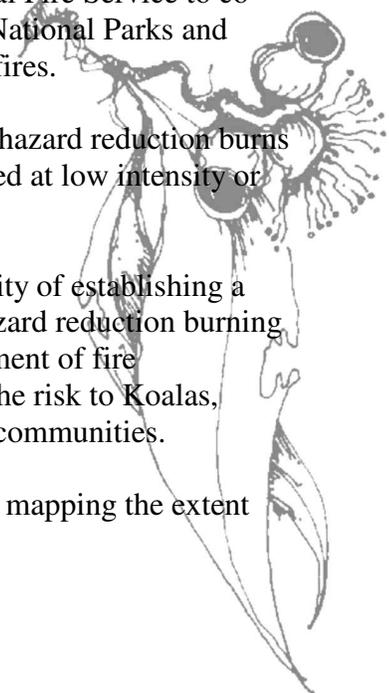
The Campbelltown Bush Fire Management Committee was established under the *Rural Fires Act 1997* and includes representatives from land management and emergency service agencies. The committee is responsible for the preparation of Bush Fire Risk Management Plans and Plans of Operations for the Campbelltown LGA. The *Rural Fires Act 1997* provides for consideration of impacts on fauna and flora and the environment in conjunction with the preparation of Bush Fire Risk Management Plans. In accordance with the *Rural Fires Act 1997*, Bush Fire Management Committees are required to have regard to the principles of ecologically sustainable development.

The Bushfires Chapter of the CKPoM Resource Document contains information concerning the potential impacts of bushfire hazard reduction programs on Koala habitat.

10.2 Actions

- i) Council encourage the Campbelltown Bushfire Management Committee to thoroughly consider including areas of Preferred and Supplementary Koala Habitat and vegetated Habitat Buffers and Habitat Linking Areas in any Bushfire Risk Management Plan or Plan of Operations prepared by the Committee.
- ii) Council ensure that adequate consultation occurs with NPWS and/or UWSM, land management agencies and the NSW Rural Fire Service concerning any hazard reduction proposals, to assist in determining if Koalas or Koala habitat are likely to be significantly affected.

- iii) Council encourage land management agencies and the NSW Rural Fire Service to cooperate with licensed fauna welfare organisations and the NSW National Parks and Wildlife Service concerning fauna welfare issues following bushfires.
- iv) Council encourage land management agencies to ensure that any hazard reduction burns in areas known to support Koalas and Koala habitat are maintained at low intensity or managed in such a way as to minimise risks to resident Koalas.
- v) Council, in conjunction with the UWSM, investigate the possibility of establishing a research program concerning potential longer term impacts of hazard reduction burning on Koala habitat. This research would contribute to the development of fire management strategies that best meet objectives for minimising the risk to Koalas, whilst conserving Koala habitat and associated plant and animal communities.
- vi) Council utilise satellite imagery whenever possible as a means of mapping the extent and intensity of bushfires and monitoring post-fire regrowth.



11 EDUCATION

11.1 Synopsis

Public education is an important component of initiatives to conserve the Koala population within the Campbelltown LGA. Public education programs should seek to promote a sense of stewardship and increase awareness of the plight of the local Koala population.

Methods of disseminating information to the general public could take the form of information brochures, sign posting, environmental education programs, local council telephone hold recordings and use of the local media. Combination of a range of methods is recommended as the most suitable approach.

11.2 Actions

Information Brochures

- i) Council prepare an information brochure in conjunction with the UWSM, Australian Koala Foundation and NSW National Parks and Wildlife Service concerning the Campbelltown Koala population with options for people to contribute to Koala conservation.

Environmental Education

- ii) Council liaise with the UWSM, the local branch of the Sydney Metropolitan Wildlife Service (SMWS) and the National Parks Association to establish the feasibility of developing a Koala-based education program for school and community groups.

The NSW Department of Education should be consulted to ensure that any educational material produced is compatible with the Environmental Education Curriculum.

The UWSM has prepared a video for schools on how to protect Koalas and has provided a Koala reference collection for the Council Library.

The AKF has produced educational material and information kits for primary and secondary schools, as well as for the general public.

Telephone Hold Recordings

- iii) Council provide information concerning Koala conservation and other environmental issues on their telephone hold recordings.

Liaising with Local Media

- iv) Council develop a program to ensure that relevant Koala information is regularly provided to local media. This program should be conducted in conjunction with the UWSM and support the existing UWSM media program.

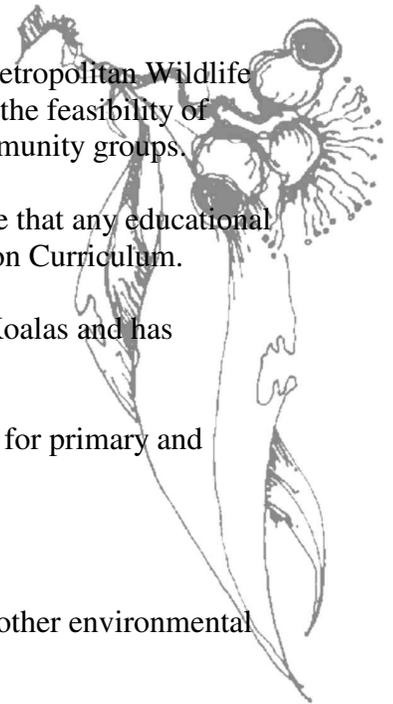
12 FUNDING

12.1 Synopsis

The ability of this CKPoM to meet the identified objectives will be partly dependent upon funding to implement the recommendations. Funding can be sought from a number of sources including State and Federal Government grants, Council revenue, and private or corporate sponsorship. Appropriate funding sources need to be identified for implementation of the recommendations of this plan that require financial input.

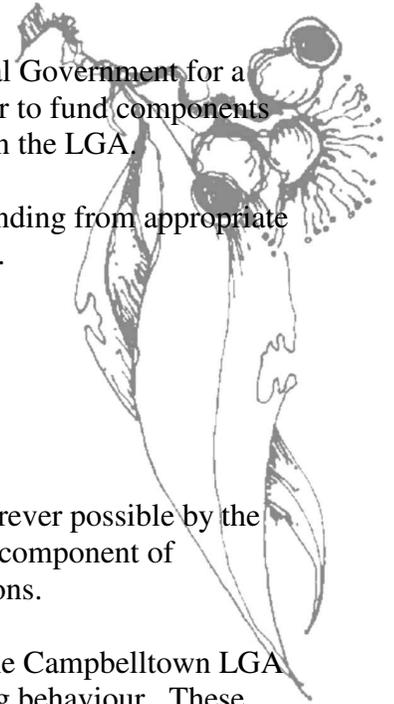
Funding could be sought from a number of State and Commonwealth Government schemes such as Environmental Trust Grants, Commonwealth Natural Heritage Trust and the Eco-tourism Grants Program. Potential funding options are outlined in the Funding Chapter of the CKPoM Resource Document.

The CKPoM Implementation Committee as described in the Implementation Chapter of the CKPoM should be chiefly responsible for investigating and seeking funding for management actions.



12.2 Actions

- i) Council consider making a submission to the Department of Local Government for a special variation to the general rate (Environmental Levy) in order to fund components of the CKPoM as well as other environmental management within the LGA.
- ii) The CKPoM Implementation Committee seek and co-ordinate funding from appropriate sources to implement CKPoM actions that require financial input.



13 RESEARCH

13.1 Synopsis

Koala Management practice and decision making should be guided wherever possible by the outcomes of rigorous scientific research. In addition, research is a vital component of programs to monitor and evaluate the effectiveness of management actions.

A number of Koala research projects have already been undertaken in the Campbelltown LGA concerning tree species preferences, habitat utilisation and home-ranging behaviour. These projects include ongoing research undertaken through the UWSM.

Limitations on both financial and staff resources, as well as increasing threats to Koalas, accentuate the importance of directing research into areas where information is lacking and where results are likely to be most useful for evaluating, monitoring and improving Koala habitat and population management initiatives.

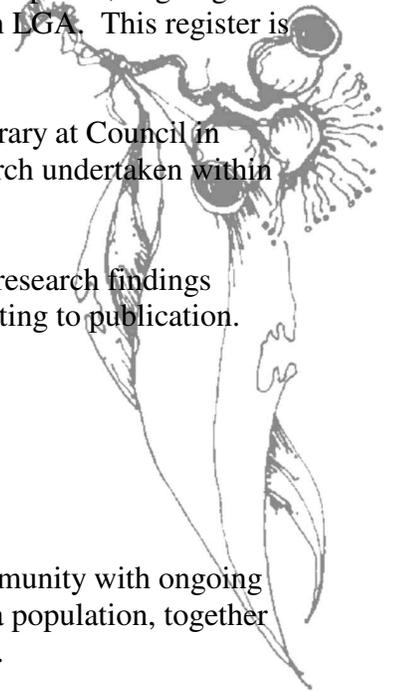
13.2 Actions

- i) The CKPoM Implementation Committee identify and prioritise potential Koala research projects on the basis of their application to Koala habitat and population management, as well as implementation and monitoring of the CKPoM. The identification of potential research projects should be accompanied by investigation of possible funding sources.

A number of potential Koala research projects have been outlined in the Research Chapter of the CKPoM Resource Document.

- ii) The CKPoM Implementation Committee identify and promote potential final year or postgraduate University student research projects from the nominated project list.
- iii) The CKPoM Implementation Committee liaise with those undertaking Koala research in order to facilitate the involvement of interested volunteers in any suitable projects.

- iv) The CKPoM Implementation Committee maintain a register of completed, ongoing and proposed future Koala research projects within the Campbelltown LGA. This register is to be kept at Council in liaison with UWSM.
- v) The CKPoM Implementation Committee maintain a reference library at Council in liaison with UWSM of all reports concerning Koala related research undertaken within the LGA.
- vi) Researchers, including postgraduate students, seek to make their research findings readily available, subject to intellectual property rights issues relating to publication.



14 MONITORING

14.1 Synopsis

The monitoring program will provide researchers, planners and the community with ongoing information regarding the size, distribution and health of the local Koala population, together with feedback on the effectiveness of alternative management strategies.

An ongoing monitoring program will be implemented in conjunction with adoption of the CKPoM. As part of this program a number of performance indicators will be identified to provide a means to determine the level to which the key outcomes have been achieved and to quantify the success or failure of the measures specified within the CKPoM. The monitoring program will also include a procedure to be followed should the CKPoM fail to meet the identified performance indicators. A funding proposal for the monitoring program also needs to be specified. It is intended that the CKPoM will be regularly reviewed with the potential for periodic amendment of the measures employed where necessary to reflect the findings of the ongoing monitoring program.

The monitoring program will require the commitment and support of Campbelltown City Council. It is proposed that the responsibility for co-ordinating the monitoring program be assigned to a suitably qualified Council Officer, in liaison with the UWSM.

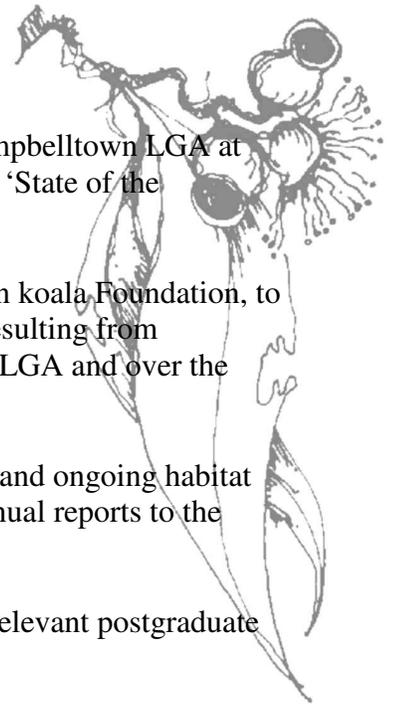
This program will aim to periodically update the status of the Koala population and the available Koala habitat within the Campbelltown LGA. The status of the Koala population will be assessed on the basis of estimated Koala numbers, evidence of breeding activity, records of mortality and the distribution of Koalas within the LGA. The program will seek to record changes in the amount and quality of available Koala habitat, as well as changes in the habitat utilisation. The impact of threatening processes upon the Koala populations will be monitored to determine the level of success or failure of the measures within the CKPoM. The relative significance of each threatening process will need to be regularly assessed to ensure resources are continually focused on the highest priorities.

Further details concerning the monitoring program are provided in the Monitoring Chapter of the CKPoM Resource Document.

14.2 Actions

Koala Habitat Monitoring

- i) Council purchase the latest available satellite imagery for the Campbelltown LGA at four-year intervals to assist with reviews of the CKPoM and with 'State of the Environment' reporting.
- ii) Council interpret these images, in consultation with the Australian koala Foundation, to identify changes in the extent of each category of Koala habitat resulting from incremental habitat loss, degradation or fragmentation within the LGA and over the longer term, with ongoing habitat restoration activities.
- iii) Council maintain a detailed register of incremental habitat losses and ongoing habitat restoration activities as identified in ii) above, for inclusion in annual reports to the CKPoM Implementation Committee.
- iv) Council provide satellite imagery to the UWSM if requested for relevant postgraduate research projects.
- v) Council maintain a register of potential discrepancies in the vegetation mapping, investigate these and make revisions where necessary in consultation with the AKF.
- vi) AKF revise the Koala habitat mapping in conjunction with future refinements to the vegetation mapping, on a consultancy basis for Council.



Koala Population Monitoring

- vii) Council liaise with UWSM to undertake additional advertising for the UWSM Koala Hotline each spring for reporting of Koala sightings throughout the LGA.
- viii) The UWSM, with input from SMWS and Council, continue to maintain a Koala records database that will contribute to the LGA-wide monitoring program.
- ix) Council co-ordinate annual transect-based Koala searches of designated sites.
- x) Council establish and annually assess a series of monitoring sites within the LGA using the AKF Spot Assessment Technique in consultation with AKF and UWSM.

Population Viability Analysis

- xi) Council liaise with the UWSM regarding the potential for developing a Population Viability Analysis model for the Campbelltown Koala population as a component of the monitoring program.

Threatening Processes

- xii) Council maintain a register of dog attacks and traffic collisions with Koalas.

Funding

- xiii) The CKPoM Implementation Committee, in conjunction with Council, shall seek to acquire the necessary funding, assistance, resources and sponsorship to implement the monitoring program.

Reporting

- xiv) Council report annual findings of the ongoing monitoring program to the CKPoM Implementation Committee.
- xv) Council incorporate updates on the status of the Koala within the LGA and the actions taken to implement the CKPoM into annual 'State of the Environment' reporting.

Review and Amendment

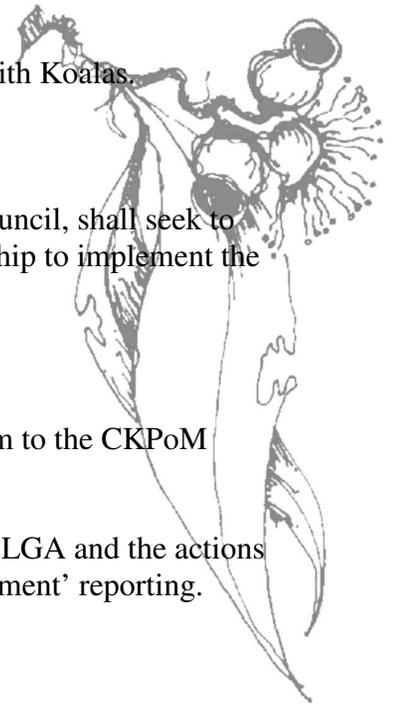
- xvi) The CKPoM Implementation Committee review the CKPoM every 12 months. This will include reviewing the Performance Indicators, the monitoring program, the extent to which the proposed actions have been implemented, and their apparent effectiveness.
- xvii) Any proposed amendments to the CKPoM will be determined by the CKPoM Implementation Committee in consultation with the General Manager of Campbelltown City Council, the Australian Koala Foundation and the Director-General of NSW National Parks and Wildlife Service. Amendments to the CKPoM will require approval from both Council and planningNSW before being formally adopted.

15 IMPLEMENTATION

15.1 Synopsis

The ongoing support and involvement of stakeholders will be vital throughout the implementation of the CKPoM. This will particularly require the support of Campbelltown City Council, the NSW National Parks and Wildlife Service, the UWSM, land management agencies and the local community.

An Implementation Committee will be established under Section 77 of the *Local Government Act 1993* to oversee and co-ordinate the implementation of the CKPoM. Core members of the CKPoM Implementation Committee should include representatives from Campbelltown City Council (CCC), University of Western Sydney Macarthur (UWSM), NSW National Parks and Wildlife Service (NPWS), Sydney Metropolitan Wildlife Services Inc. (SMWS), D'harawal Traditional Descendants Council (Sweet Water People) (DTDC), National Parks Association



(NPA), Department of Land and Water Conservation (DLWC), Department of Defence (DD) and Sydney Water (SW). A Councillor should be invited to chair the CKPoM Implementation Committee.

The Implementation Committee should convene as soon as possible following formal approval and adoption of the Campbelltown City Council CKPoM. The Implementation Committee should regularly review the CKPoM and propose revisions where necessary to improve performance. Refer to the Implementation Chapter of the CKPoM Resource Document for further details.

15.2 Actions

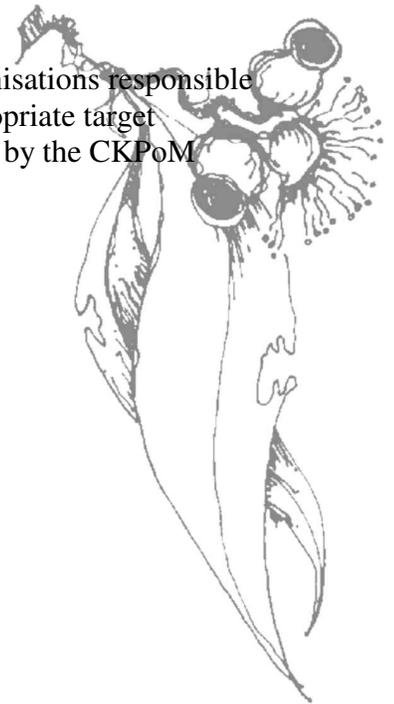
- i) A CKPoM Implementation Committee be established. Core members will include a Councillor to chair the Committee, an Officer from each of Campbelltown City Council (CCC), University of Western Sydney Macarthur (UWSM), NSW National Parks and Wildlife Service (NPWS), Sydney Metropolitan Wildlife Services Inc. (SMWS), D'harawal Traditional Descendants Council (Sweet Water People) (DTDC), National Parks Association (NPA), Department of Land and Water Conservation (DLWC), Department of Defence (DD) and Sydney Water (SW).
- ii) The CKPoM Implementation Committee should invite representatives from other agencies and organisations to participate as required.
- iii) The CKPoM Implementation Committee should meet at least quarterly in the first year and as often as considered necessary by the Committee thereafter.
- iv) Campbelltown City Council shall provide the CKPoM Implementation Committee with the necessary administrative support.
- v) The CKPoM Implementation Committee shall produce an Annual Report to address the following: progress with implementation of the CKPoM; outcomes from the monitoring program and apparent effectiveness of the CKPoM; current research projects; and any recommended amendments to the CKPoM.
- vi) The first full review of the performance of the CKPoM shall be undertaken by Council and the Implementation Committee twelve months after adoption of the CKPoM. The Review Report should recommend any necessary amendments to the CKPoM and should be submitted to the General Manager of Campbelltown City Council and the Director-General of planningNSW for consideration and public exhibition.

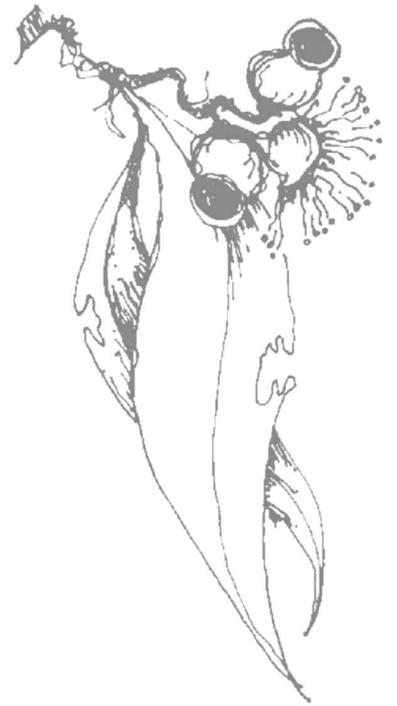
16 ACTION PLAN

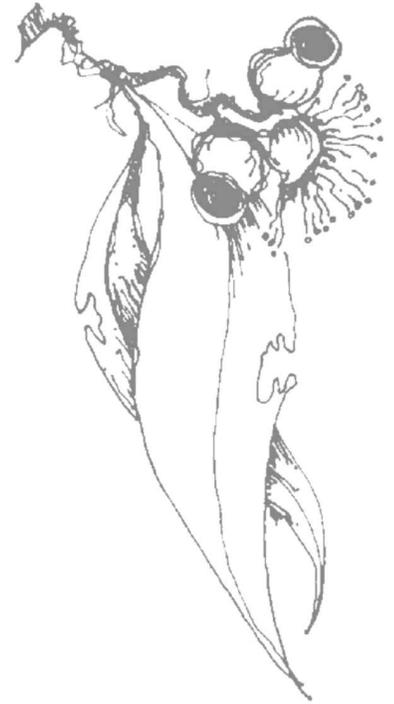
The following Action Plan lists the CKPoM actions, identifies the organisations responsible for implementation, and assigns an initial priority of each action. Appropriate target completion dates for each action should be determined as a first priority by the CKPoM Implementation Committee during their initial meetings.

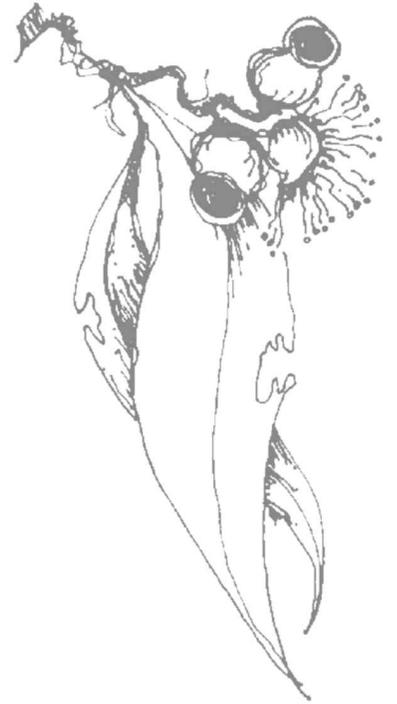
The following abbreviations are used in the table below:

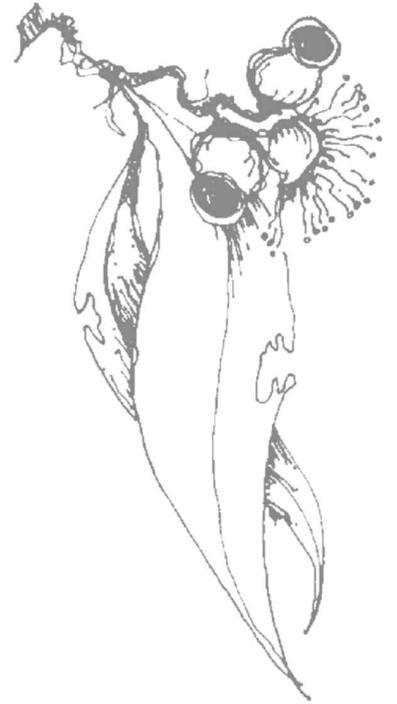
- CCC** = Campbelltown City Council
- CKPoMIC** = CKPoM Implementation Committee
- AKF** = Australian Koala Foundation
- NPWS** = NSW National Parks and Wildlife Service
- UWSM** = University of Western Sydney Macarthur
- DLWC** = NSW Department of Land and Water Conservation
- DD** = Department of Defence (Holsworthy Army Base)
- SW** = Sydney Water
- PLH** = Private Land Holders
- SMWS** = Sydney Metropolitan Wildlife Services
- RFS** = NSW Rural Fire Service
- FAMC** = Feral Animal Management Committee

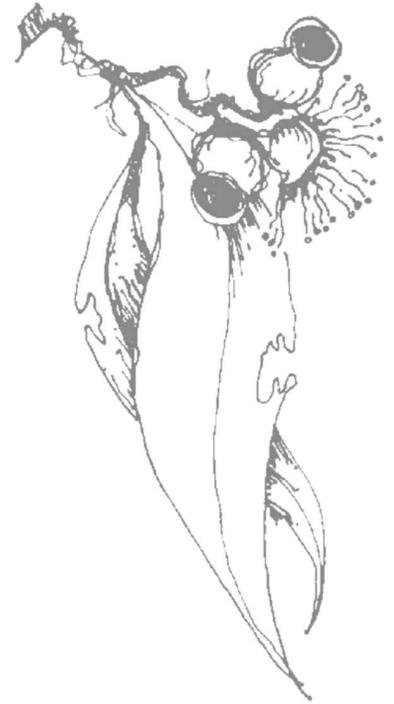












17 REFERENCES

Australian New Zealand Environment and Conservation Council (1998). National Koala Conservation Strategy. Australian New Zealand Environment and Conservation Council (ANZECC), Environment Australia, Canberra.

Callaghan, J., Leathley, S. & Lunney, D., (1994). Port Stephens Koala Management Plan (Draft for Public Discussion). NSW National Parks & Wildlife Service, Port Stephens Council & Hunter Koala Preservation Society, Raymond Terrace.

Campbell, N., (1996). A History of Bush Fire Brigades in the Campbelltown District. Grist Mills. Vol. 9 No. 3. Campbelltown City Council.

Benson, D. & Howell, J. (1990) Taken for Granted: The bushland of Sydney and its suburbs Kangaroo Press (with the Royal Botanic Gardens). Sydney.

Greening Australia (NSW Inc). (1999). Management Principles to Guide the Restoration and Rehabilitation of Indigenous Vegetation. Prepared by the Technical Sub-committee of the Greening Australia NSW Board. Greening Australia.

Hume, I.D., (1990). Biological basis for the vulnerability of Koalas to habitat fragmentation. Pp 32-35 in *Koala Summit: Managing Koalas in New South Wales*. D. Lunney, C.A. Urquhart and P. Reed (eds.). NSW National Parks and Wildlife Service, Hurstville.

Longhurst, K., (March 21, 1997). Personal Communication.

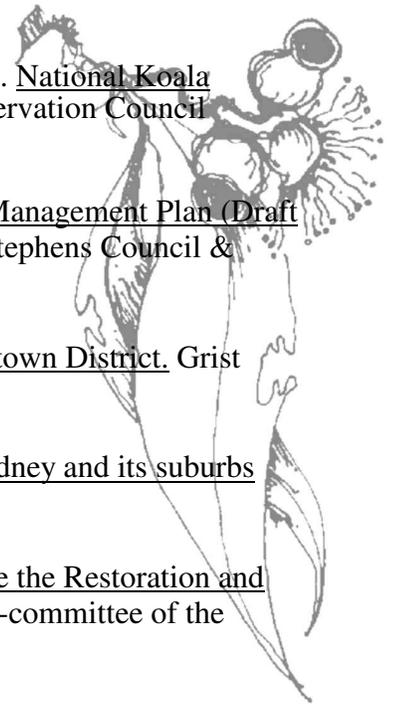
Lunney, D., Phillips, S., Callaghan, J. and Coburn, D. (1998). Determining the distribution of Koala habitat across a Shire as a basis for conservation: a case study from Port Stephens, New South Wales. *Pacific Conservation Biology* 4: 186-96.

Lunney, D., Krockenberger, A., Curtin, A. and Matthews, A., (1997). Procedures for preparing Comprehensive Koala Plans of Management under State Environmental Planning Policy 44 - Koala Habitat Protection. Draft prepared for the Department of Urban Affairs and Planning.

Phillips, S. & Callaghan, J. (2000). Tree species preferences of Koalas (*Phascolarctos cinereus*) in the Campbelltown area south-west of Sydney, New South Wales. *Wildlife Research* 27: 509-516.

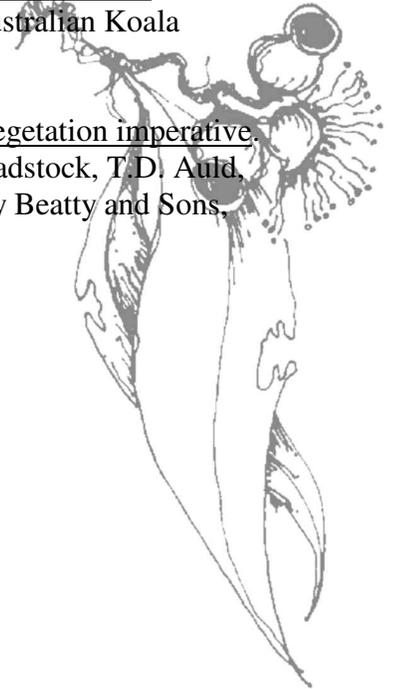
Phillips, S. & Callaghan, J., (1998). Koala Habitat Atlas: Campbelltown Local Government Area. Australian Koala Foundation, Brisbane.

Phillips, S & Callaghan J., (1995). The Spot Assessment Technique for Determining the Significance of Habitat Utilisation by Koalas. Australian Koala Foundation, Brisbane.



Port Stephens Council (2002). Port Stephens Council Comprehensive Koala Plan of Management (CKPoM). Prepared by Port Stephens Council with the Australian Koala Foundation.

Saunders, D.A. and Hobbs, R.J., (1995). Habitat reconstruction: the revegetation imperative. Pp 104-112 in *Conserving Biodiversity: Threats and Solutions*. R.A. Bradstock, T.D. Auld, D.A. Keith, R.T. Kingsford, D. Lunney and D.P. Sivertsen (eds.). Surrey Beatty and Sons, Chipping Norton.



Appendix 1

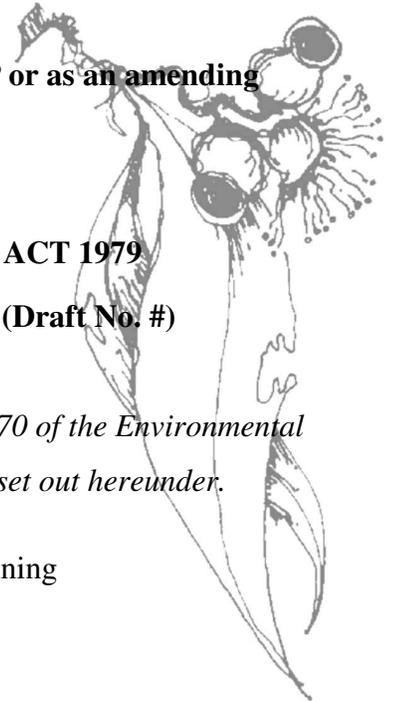
Proposed clause for inclusion in a Campbelltown LGA-wide LEP or as an amending clause applying to existing LEPs and IDOs

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 CAMPBELLTOWN LOCAL ENVIRONMENTAL PLAN (Draft No. #)

I, the Minister for Urban Affairs and Planning, in pursuance of section 70 of the Environmental Planning and Assessment Act 1979, make the local environmental plan set out hereunder.

Minister for Urban Affairs and Planning

Sydney, 2002.



Citation

1. This plan may be cited as Campbelltown Local Environmental Plan (No.#).

Land to which this plan applies

2. *This plan applies to all land within the local government area of Campbelltown.*

Objectives

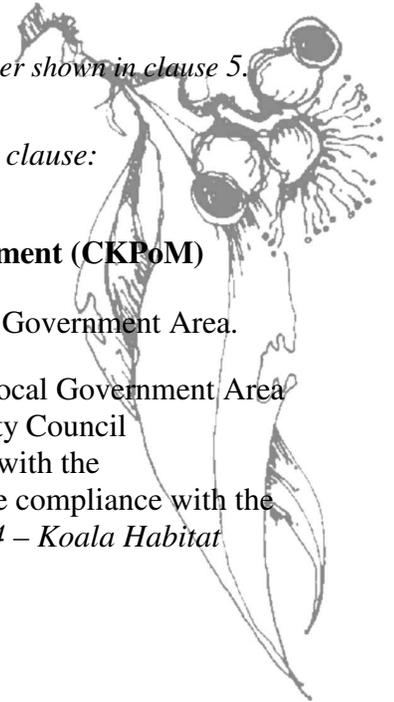
3. *This plan aims to activate the provisions of the Campbelltown City Council Comprehensive Koala Plan of Management (CKPoM) and thereby to provide for long-term conservation of the local Koala population.*

Relationship to other environmental planning instruments

4. *This plan amends existing Campbelltown LEPs and IDOs in the manner shown in clause 5.*
5. *Existing LEPs and IDOs are amended by inserting the following clause:*

Campbelltown City Council Comprehensive Koala Plan of Management (CKPoM)

- (1) This clause applies to all land in the Campbelltown Local Government Area.
- (2) All development applications within the Campbelltown Local Government Area must comply with the provisions of the Campbelltown City Council Comprehensive Koala Plan of Management. Compliance with the Comprehensive Koala Plan of Management will constitute compliance with the provisions of *State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44)*.

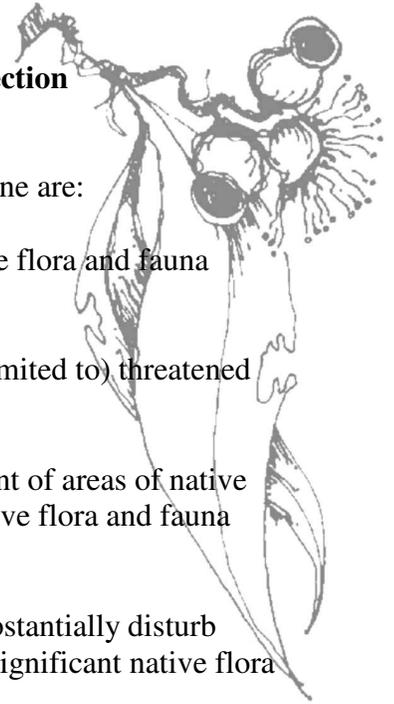


Appendix 2

Recommended Objectives for Environmental Protection (Significant Habitat) Zone

The objectives of the Environmental Protection (Significant Habitat) Zone are:

- a) to protect the habitat of threatened or otherwise significant native flora and fauna species including (but not limited to) Koalas;
- b) to protect biological diversity (biodiversity) including (but not limited to) threatened species, populations and ecological communities;
- c) to provide for the restoration and effective long-term management of areas of native vegetation and associated linking areas, for the protection of native flora and fauna species and the maintenance of biological diversity;
- d) to prohibit developments and activities that would destroy or substantially disturb native vegetation and/or the habitats of threatened or otherwise significant native flora and fauna species; and
- e) to limit developments and activities to those that are compatible with conservation of the natural environment and based upon the principles of ecological sustainability.



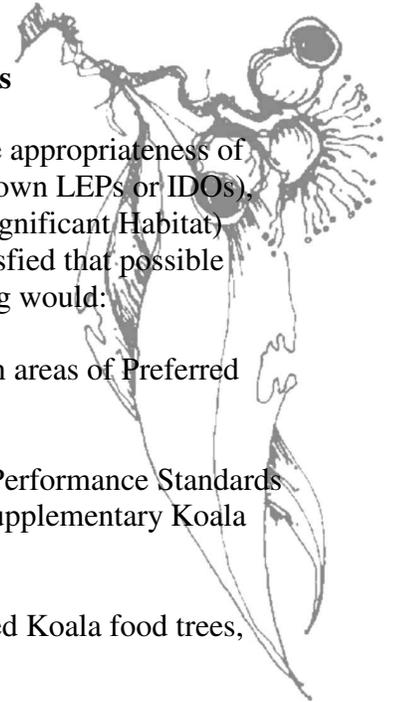
Appendix 3

Performance Standards for Rezoning Proposals

Consideration is to be given to the following matters when assessing the appropriateness of rezoning requests (here rezoning refers to any amendment to Campbelltown LEPs or IDOs), **other than** those that propose rezoning to Environmental Protection (Significant Habitat) Zone. Prior to approving any rezoning proposal, Council should be satisfied that possible future development or activity in accordance with the requested rezoning would:

- i) not allow for an intensification of landuse or development within areas of Preferred Koala Habitat or Habitat Buffers;
- ii) allow for only *low impact development* (i.e. consistent with the Performance Standards for Development Applications in Appendix 4) within areas of Supplementary Koala Habitat and Habitat Linking Areas;
- iii) be unlikely to result in the removal of any individuals of preferred Koala food trees, where ever they occur on the site; and
- iv) not result in development which would sever Koala movement across the site. This should include consideration of the need for maximising tree retention and for minimising the likelihood of impediments to safe/unrestricted Koala movement.

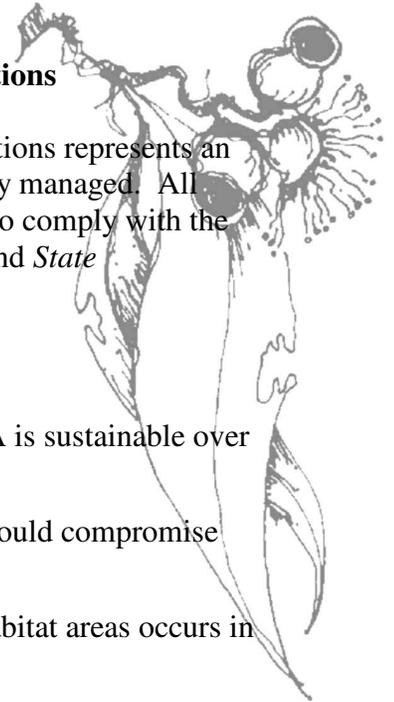
The required information to support a rezoning request must include an investigation of the site by an appropriately qualified person in accordance with the Guidelines for Koala Habitat Assessment as presented in Appendix 5 of this CKPoM.



Appendix 4

Performance Standards for Development Applications

Regulation of development via the assessment of Development Applications represents an important means by which Koala habitat can be protected and effectively managed. All Development Applications in the Campbelltown LGA will be required to comply with the following performance standards in order to comply with the CKPoM and *State Environmental Planning Policy No. 44 – Koala Habitat Protection*.



The aims and objectives of the performance standards are as follows:

- i) To ensure that the Koala population in the Campbelltown LGA is sustainable over the long-term.
- ii) To protect Koala habitat areas from any development which would compromise habitat quality or integrity.
- iii) To ensure that any development within or adjacent to Koala habitat areas occurs in an environmentally sensitive manner.
- iv) To ensure that acceptable levels of investigation are undertaken, considered and approved prior to any development within or adjacent to Koala habitat areas.
- v) To encourage Koala habitat restoration.
- vi) To maintain connectivity between areas of Preferred and Supplementary Koala Habitat and minimise threats to safe Koala movements between such areas.
- vii) To ensure that development does not further fragment habitat areas either through the removal of habitat or habitat linking areas or through the imposition of significant threats to Koalas.
- viii) To provide guidelines and standards to minimise impacts on Koalas during and after development, including any monitoring requirements.
- ix) To provide readily understandable advice to proponents preparing Development Applications and for Council Officers involved in the assessment of applications.

All Development Applications in the Campbelltown LGA must demonstrate that they are consistent with the above objectives. All subdivisions must demonstrate that their design is consistent with the above objectives.

The performance standards contained in this appendix require an understanding of Koala habitat types within the Campbelltown LGA. The distribution of the following habitat categories are shown on the CKPoM map entitled “Koala Habitat Planning Map”. Hard copies of this map are available from Campbelltown City Council.

The performance standards listed below apply to the following categories of Koala habitat:

Preferred Koala Habitat is considered to constitute the most important category of Koala habitat in the Campbelltown LGA and hence warrants the highest level of protection.

Supplementary Koala Habitat is also considered very important for conservation of the Koala population in the Campbelltown LGA and thus also requires protection, although with less restrictions on development than for Preferred Koala Habitat.

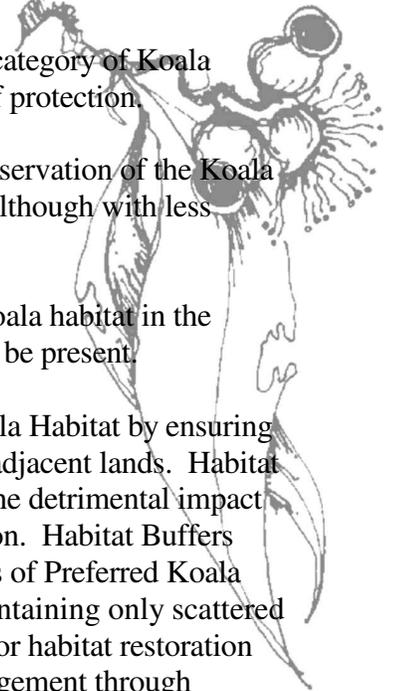
Marginal Koala Habitat is considered the least important category of Koala habitat in the Campbelltown LGA, although scattered Preferred Koala Food Trees may be present.

Habitat Buffers can contribute to the long-term survival of Preferred Koala Habitat by ensuring that incompatible *development* or *activities* do not occur on immediately adjacent lands. Habitat Buffers may afford protection to Preferred Koala Habitat by minimising the detrimental impact of “edge effects” such as nutrient impacts, wind damage and weed invasion. Habitat Buffers provide for the likely extension of significant Koala Activity beyond areas of Preferred Koala Habitat. Even Habitat Buffers that extend over Mainly Cleared Land containing only scattered trees can perform this latter function. Such areas should be considered for habitat restoration projects where appropriate. Habitat Buffers warrant protection and management through performance standards equivalent to those for Supplementary Koala Habitat.

Habitat Linking Areas may provide opportunities for the successful movement of Koalas (*e.g.* dispersal and recruitment of sub-adults) between breeding populations or into areas of vacant Preferred or Supplementary Koala Habitat. Habitat Linking Areas may also be used as part of established Koala home ranges, depending upon factors such as the vegetation associations and/or species of scattered trees they contain and their location relative to other habitat areas. Development may be permitted within Habitat Linking Areas provided it retains any scattered Preferred Koala Food Trees that may be present and does not compromise the safe use of such areas by Koalas. Habitat Linking Areas warrant protection and management through performance standards equivalent to those for Supplementary Koala Habitat. They should be considered for restoration projects where appropriate.

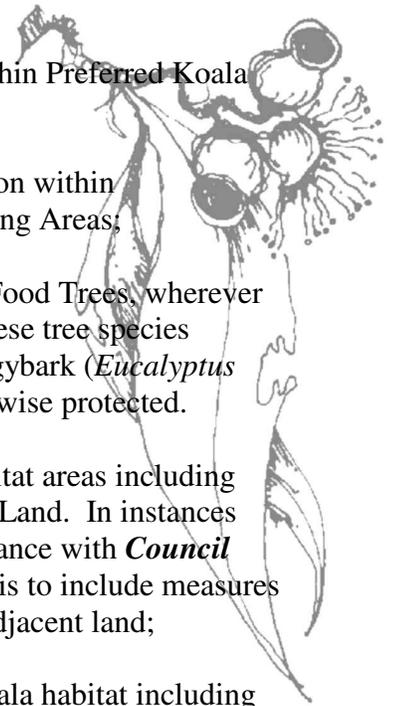
Performance Standards

The following standards apply to all developments proposed on sites that contain or are adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas. For the purposes of these standards, native vegetation is defined as any of the following types of indigenous vegetation: trees (including saplings and shrubs), understorey plants, groundcover or plants occurring in a wetland (as per Sections 4 and 6 of the *Native Vegetation Conservation Act 1997*).

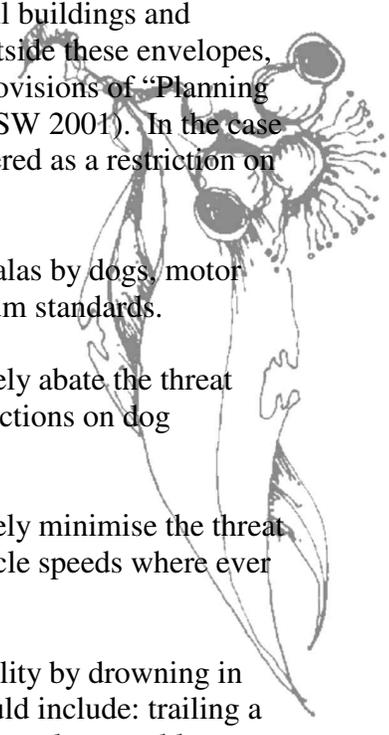


Proposed *development* or *activity must:*

- a) Not result in the removal or degradation of native vegetation within Preferred Koala Habitat;
- b) Maximise retention and minimise degradation of native vegetation within Supplementary Koala Habitat, Habitat Buffers and Habitat Linking Areas;
- c) Not result in the removal of any individuals of Preferred Koala Food Trees, wherever they occur on a development site. In the Campbelltown LGA these tree species include Grey Gum (*Eucalyptus punctata*) and Blue-leaved Stringybark (*Eucalyptus agglomerata*). Turpentine *Syncarpia glomulifera* should be likewise protected.
- d) Make provision, where appropriate, for restoration of Koala habitat areas including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land. In instances where Council approves the removal of Koala habitat (in accordance with **Council Waive Provisions** below), and where circumstances permit, this is to include measures which result in a “*net gain*” of Koala habitat on the site and/or adjacent land;
- e) Make provision for long term management and protection of Koala habitat including both existing and restored habitat;
- f) Not compromise the potential for safe movement of Koalas across the site. This should include maximising tree retention generally and minimising the likelihood that the proposal would result in the creation of barriers to Koala movement, such as would be imposed by certain types of fencing. The preferred option for minimising restrictions to safe Koala movement is for there to be no fencing (of a sort that would preclude Koalas), associated with dog free developments within or adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas. Suitable fencing for such areas could include:
 - i) fences where the bottom of the fence is a minimum of 300 mm above ground level so as to allow Koalas to move underneath;
 - ii) fences that facilitate easy climbing by Koalas; for example, sturdy chain mesh fences, or solid style fences with timber posts on both sides at regular intervals of approximately 20m; or
 - iii) open post and rail or post and wire (preferably not barbed wire).



However, where the keeping of domestic dogs has been permitted within or adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas, fencing of a type that would effectively contain dogs (and which would ideally also preclude Koalas) should be restricted to the designated building envelope. Fences that are intended to preclude Koalas should be located away from any trees that could allow Koalas to cross the fence.

- 
- g) Be restricted to identified ‘building envelopes’ which contain all buildings and infrastructure. Generally there will be no clearing on the site outside these envelopes, other than that which may be required in accordance with the provisions of “Planning for Bushfire Protection” (NSW Rural Fire Service & planningNSW 2001). In the case of applications for subdivision, such envelopes should be registered as a restriction on the title, pursuant to the *Conveyancing Act 1919*; and
- h) Include measures to effectively minimise the threat posed to Koalas by dogs, motor vehicles and swimming pools by adopting the following minimum standards.
- i) The development must include measures that effectively abate the threat posed to Koalas by dogs through prohibitions or restrictions on dog ownership. Restrictions on title may be appropriate;
 - ii) The development must include measures that effectively minimise the threat posed to Koalas from traffic by restricting motor vehicle speeds where ever appropriate to 40 kph or less; and
 - iii) The development must reduce the risk of Koala mortality by drowning in backyard swimming pools. Appropriate measures could include: trailing a length of stout rope (minimum diameter of 50mm) secured to a stable poolside fixture, in the swimming pool at all times; designing the pool in such a way that Koalas can readily escape; or enclosing the pool with a fence that precludes Koalas. This last option should include locating the fence away from any trees that Koalas could use to cross the fence.
- i) Council may approve the removal or lopping of Preferred Koala Food Trees that are diseased or considered dangerous to persons or property.

Council Waive Provisions

Council may waive the provisions of a), b) and c) above **only** for the purposes of establishing a building envelope and associated works, and **only if** the proponent can demonstrate that:

1. The building envelope and associated works **cannot** be located so as to avoid the removal of native vegetation within Preferred or Supplementary Koala Habitat, Habitat Buffers, or Habitat Linking Areas, or the removal of Preferred Koala Food Trees;
2. The location of the building envelope and associated works **minimises** the need to remove native vegetation as per 1 above;
3. In the case of subdivision proposals, they are designed so as to **retain and enhance** Koala habitat on the site and are consistent with the objectives of this Appendix; and

4. Koala survey methods as per Section 5 of the Guidelines for Koala Habitat Assessment in Appendix 5 of the CKPoM have been used to determine the most appropriate location for the building envelope and associated works (so as to minimise impacts on habitat and any Koalas that may utilise the site).

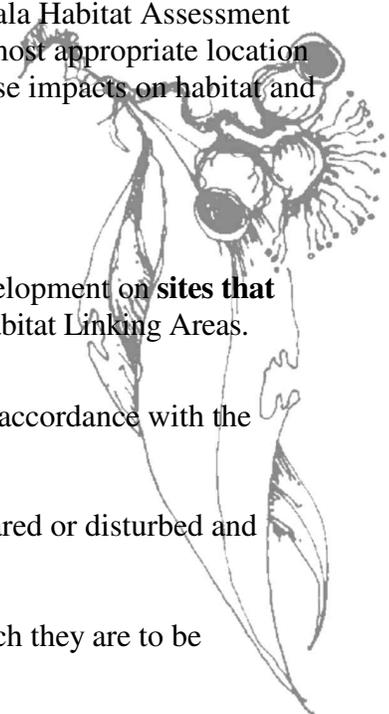
Information to Accompany Applications

The following information must be submitted with applications for development on **sites that contain** Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas.

- a. An assessment of Koala habitat, by a suitably qualified person, in accordance with the attached Guidelines for Koala Habitat Assessment (Appendix 5).
- b. Clear and precise details concerning which vegetation is to be cleared or disturbed and that which is to be retained.
- c. Details of any proposed building envelopes and the means by which they are to be enforced.
- d. Proposed measures to restore Koala habitat, including those that would result in a net gain of Koala habitat over time.
- e. Proposed measures to facilitate the safe movement of Koalas across the site including road designs and speed mitigation measures, fence construction details, landscaping proposals and swimming pool specifications.
- f. Proposed measures to mitigate the impacts on Koalas by dogs.
- g. Details of any proposed program to monitor Koalas and Koala habitat, during and following development activity on the site. Monitoring programs are not required for single lot developments, but are to be submitted with all applications for subdivision of land affecting Koala habitat.

The following information must be submitted with applications for development on **sites adjacent to** Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas.

- h. Proposed measures to mitigate the impacts of dogs on any Koalas that may occupy adjacent habitat. This should include such measures as education of dog owners, appropriate signs, or restrictions on dog ownership to reduce the likelihood of domestic dogs straying into adjacent Koala habitat.
- i. Proposed measures to mitigate the impact on Koalas from motor vehicles travelling to the site. This should include appropriate traffic control measures on roads that run through or adjacent to nearby Koala habitat and which would be subject to increased traffic volumes due to the development.



Appendix 5

Guidelines for Koala Habitat Assessments

The Guidelines for Koala Habitat Assessments in the Campbelltown LGA serve the following functions:

- provide the information necessary to support a rezoning proposal under Part 3 of the *Environmental Planning and Assessment Act 1979* (EP&A Act); and
- provide the information necessary to support a development application being considered under Part 4 of the EP&A Act.

In regard to the latter, application of these guidelines will also substantially contribute to consideration of the impact of a proposed development on Koalas or their habitat as required under s.5A of the EP&A Act.

The Guidelines for Koala Habitat Assessments **must** be carried out by a person or persons with qualifications and experience in tree species identification and, in the case of assessments of Koala habitat utilisation at Step 4, qualifications and experience in biological science and fauna survey. This should also include specific experience in conducting Koala surveys. A brief curriculum vitae for each person undertaking assessments according to these guidelines should be appended to the survey report.

Koala Habitat Assessment in the Campbelltown LGA should include the following steps as the minimum acceptable approach (see Figure A5.1 for a summary flow chart):

- 1. Preliminary Assessment;**
- 2. Vegetation Mapping;**
- 3. Koala Habitat Identification; and**
- 4. Assessment of the Proposal.**

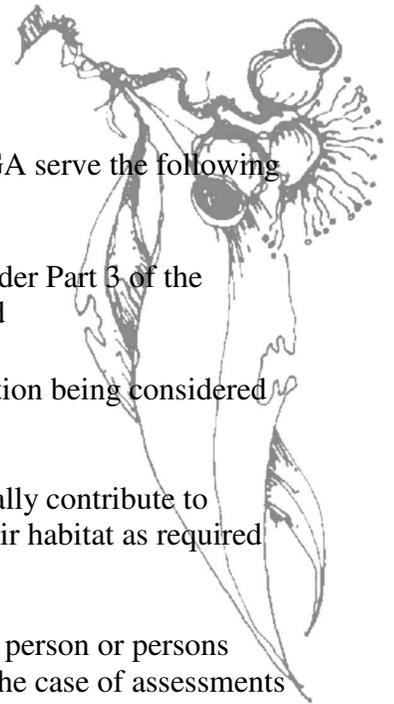
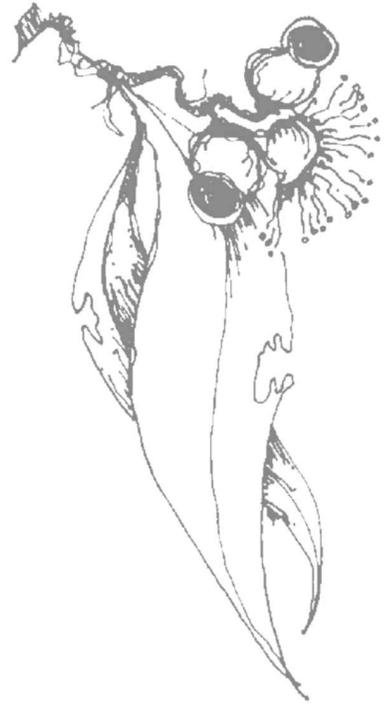


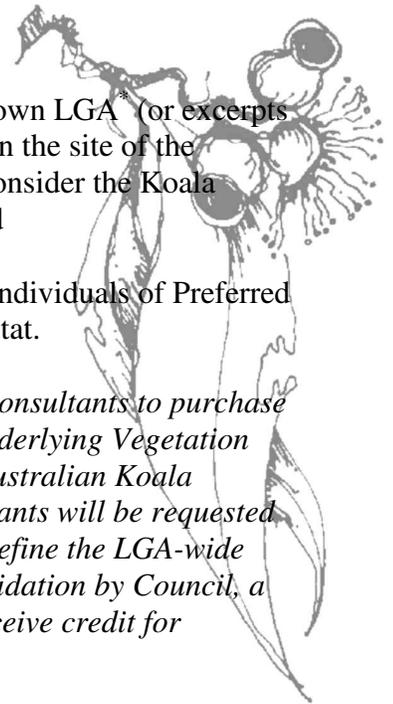
Figure A5.1 Goes Here



1. Preliminary Assessment must include the following:

- i) Reference to the Koala Habitat Planning Map for the Campbelltown LGA (or excerpts thereof) to make a preliminary assessment of the Koala habitat on the site of the proposed development (hereafter referred to as the site) and to consider the Koala habitat of the site in the broader local (and regional) context; and
- ii) An inspection of the site to determine whether the site contains individuals of Preferred Koala Food Trees outside areas mapped as Preferred Koala Habitat.

(Note: Data licensing agreements will be established to allow consultants to purchase relevant sections of the Koala Habitat Planning Map and the underlying Vegetation Map for such purposes. This mapping is jointly owned by the Australian Koala Foundation and Campbelltown City Council. Given that consultants will be requested to provide their site specific vegetation mapping to update and refine the LGA-wide Vegetation Map and Koala Habitat Planning Map following validation by Council, a credit system may be established whereby a consultant could receive credit for contributing to refinement of the LGA-wide maps).*



From this it should be determined if the site contains Preferred or Supplementary Koala Habitat, any Habitat Buffers, or Habitat Linking Areas (other than those that overlap with Mainly Cleared Land) according to the LGA-wide Koala Habitat Planning Map and/or if the site contains Preferred Koala Food Trees. If the site contains any of the above, it will be necessary to proceed to Step 2 Vegetation Mapping.

If the site only contains Habitat Linking Areas over Mainly Cleared Land according to the LGA-wide Koala Habitat Planning Map and has an area of more than 1hectare, or has, together with any adjoining land in the same ownership, an area of more than 1ha, then it will be necessary to proceed to Step 4 Assessment of the Proposal.

If the site **does not contain** any of the above mentioned habitat categories including Habitat Linking Areas over Mainly Cleared Land according to the Koala Habitat Planning Map, or it does contain Habitat Linking Areas but is less than 1 hectare in size, then no further Koala habitat assessment is required and consent for the proposed development (or rezoning) should not be withheld on Koala habitat grounds.

A minimum area of 1ha is used to specify whether these guidelines apply to land designated Habitat Linking Area over Mainly Cleared Land to preclude the need for Koala Habitat Assessments on small lots that have been developed previously. A number of areas in the Campbelltown LGA that are currently zoned Residential, have already been built on and overlap with Habitat Linking Areas over Mainly Cleared Land. Whilst Koalas are capable of travelling considerable distances between trees and could potentially use Habitat Linking Areas over Mainly Cleared Land to move between patches of Preferred or Supplementary Koala Habitat, it would not be practical to require landowners to undertake a Koala Habitat Assessment to accompany DAs that apply to small lots that

have already been developed. Furthermore, while Habitat Linking Areas over Mainly Cleared Land represent an important opportunity for Koala habitat restoration projects, these are likely to be most effective when carried out over more substantial areas.

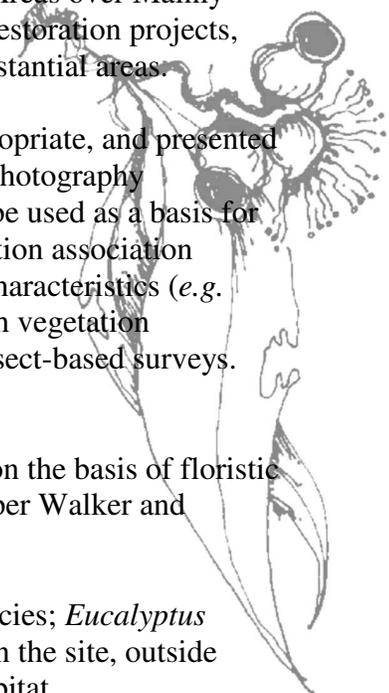
2. Vegetation Mapping should be undertaken at the largest scale appropriate, and presented in accompanying reports at A3 size. It is recommended that aerial photography (depending upon scale) complemented by detailed ground-truthing be used as a basis for such mapping. Ground-truthing must include verification of vegetation association boundaries, and systematic sampling of the floristic and structural characteristics (e.g. using methods specified by Walker and Hopkins (1990)) within each vegetation association using standard procedures such as quadrat-based or transect-based surveys. The vegetation mapping should accurately depict:

- i) The distribution of vegetation associations for the site (defined on the basis of floristic composition of the tallest stratum along with structural data, as per Walker and Hopkins 1990), plus a 100m area around the site; and
- ii) The location of all individuals of Preferred Koala Food Tree species; *Eucalyptus punctata* and *Eucalyptus agglomerata** where ever they occur on the site, outside vegetation associations already classified as Preferred Koala Habitat.

*(*Note: the field survey (Koala Habitat Atlas) identified Eucalyptus punctata and Eucalyptus agglomerata as the Preferred Koala Food Tree species within the Campbelltown LGA, particularly where they occur on higher nutrient soils such as shale deposits or outcrops (Phillips & Callaghan 1998, Phillips & Callaghan 2000). However, for the purposes of development assessment within the LGA it would be unrealistic to expect the importance of these two tree species to be accurately differentiated for a given area on the basis of substrate. Even where accurate soil mapping is available for a site, diminishment of these species where they apparently occur on lower nutrient substrates would fail to acknowledge their overall importance, as well as the potential occurrence of localised higher nutrient areas within broader soil landscapes).*

The boundaries of vegetation associations and the location of Preferred Koala Food Trees (outside of identified Preferred Koala Habitat) are to be accurately surveyed, such as by a stadia survey or by using differential GPS, in accordance with points i) and ii) above.

Once a site-specific Vegetation Map has been prepared in accordance with the above standards it should be compared to the LGA-wide Vegetation Map. If the site-specific Vegetation Map is consistent with the LGA-wide Vegetation Map (particularly as regards the mapping of vegetation associations that comprise Preferred or Supplementary Koala Habitat), then the LGA-wide Koala Habitat Planning Map and the site-specific map of Preferred Koala Food Trees will apply for the assessment of the proposal (see Step 3b Koala Habitat Identification). If there are inconsistencies between the site-specific and LGA-wide Vegetation Maps, it will be necessary to undertake the procedure for Koala Habitat



Identification outlined in Step 3a (*i.e.* production of a site-specific Koala Habitat Planning Map).

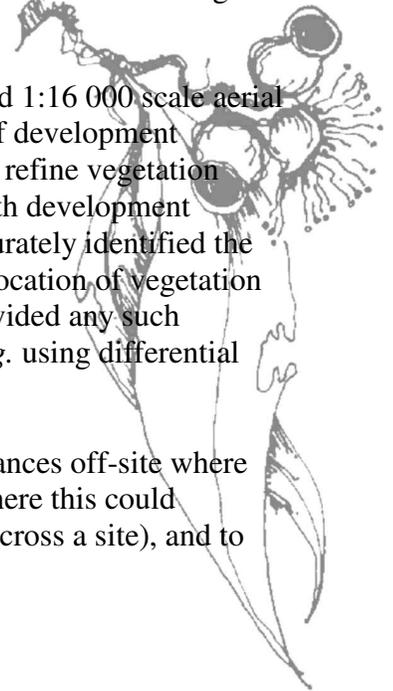
Because the LGA-wide Vegetation Map was prepared from 1:25 000 and 1:16 000 scale aerial photographs, there are limitations regarding accuracy for the purposes of development assessment for a given site. Thus, it is likely that there will be a need to refine vegetation association boundaries when mapped at a larger scale in conjunction with development assessment. In instances where the LGA-wide Vegetation Map has accurately identified the vegetation associations, but where there are inaccuracies regarding the location of vegetation association boundaries, it will be appropriate to proceed to Step 3b, provided any such inaccuracies are corrected. This must include surveying or mapping (*e.g.* using differential GPS) of any such boundaries.

Council staff also ask that consultants notify them of any suspected instances off-site where the LGA-wide Vegetation Map appears to be inaccurate (particularly where this could influence the location of Habitat Buffers and/or Habitat Linking Areas across a site), and to assess Koala habitat on the site accordingly.

3. Koala Habitat Identification

3a) This step should be applied in instances where the LGA-wide Vegetation Map does not accurately describe the nature of the vegetation on the site. This will require the following:

- i) Application of the definitions of Preferred and Supplementary Koala Habitat (as defined in Chapters 4 and 5 of the CKPoM Resource Document and outlined below), to the vegetation map to show the distribution of Koala habitat categories across the site and adjacent areas, where revisions were necessary;
- ii) Application of 100m Habitat Buffers to all Preferred Koala Habitat. Habitat Buffers should be differentiated on the basis of the respective habitat category with which they overlap (*e.g.* Habitat Buffer over Supplementary Koala Habitat or Habitat Buffer over Mainly Cleared Land); and
- iii) Approximation of Habitat Linking Areas between all patches of Preferred Koala Habitat and Supplementary Koala Habitat that occur within 800m of each other (as detailed in Chapter 5 of the CKPoM Resource Document and outlined below), where revision of the Koala Habitat Planning Map has been necessary. Habitat Linking Areas should also be differentiated on the basis of the habitat category with which they overlap (as per Habitat Buffers). Alternately, site inspections and survey work in conjunction with any Koala records for the general area that may be available from Council (to identify areas that are either in use by Koalas or that are considered to have the potential to be effectively used by Koalas) could be applied to identify suitable site-specific Habitat Linking Areas.



After a site-specific Koala Habitat Planning Map has been produced, proceed to Step 3b.

3b) This step should be applied after completing Step 3a or in instances where the LGA-wide Vegetation Map accurately describes the vegetation of the site (and where any inaccuracies regarding the location of vegetation association boundaries have been corrected). A site-specific map showing the location of individual Preferred Koala Food Trees, where they occur outside Preferred Koala Habitat, is also required at this step. If the relevant Koala Habitat Planning Map indicates that there is either Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas on the site, or if the site-specific map indicates the presence of Preferred Koala Food Trees, proceed to Step 4 Assessment of Proposal. If none of the above occur on the site, then consent should not be withheld on Koala habitat grounds.

4. Assessment of Proposal

The final step involves using the information produced from Steps 1 to 3 to assess the appropriateness of the proposal. This must involve reference to the Performance Standards for rezoning proposals and development applications as contained in Appendices 3 and 4. This step must also include a map showing the key elements of the proposal overlain on the Koala Habitat Planning Map, as revised if necessary. The assessment must also address the impacts of potential future development of the site in the broader context of a catchment area with an outer limit of 1km beyond the site boundary, with particular reference to any areas of Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas as shown on the Koala Habitat Planning Map.

Rezoning requests must satisfy the performance standards specified in Appendix 3 of the CKPoM. Development applications must satisfy the performance standards specified in Appendix 4 of the CKPoM.

5. Locating a Suitable Building Envelope

If an applicant requests that Council waive provisions a), b) and c) of Appendix 4 (and this is given approval), then the following additional survey work is required to identify the most suitable location for building envelopes and associated works.

An assessment of Koala habitat utilisation on the site must be undertaken by a suitably qualified person with experience in Koala surveys. A standard, reportable survey technique that allows habitat utilisation by Koalas to be quantified, such as the AKF's faecal pellet-based 'Spot Assessment Technique' (Phillips & Callaghan 1995) should be employed to identify the extent of any Koala Activity Levels across the site. When using the Spot Assessment Technique, the minimum density of spot assessment plots should be 1 plot per 1000m² of land that contains native trees within the areas where building envelopes and associated works could potentially be located. Plots sites should be located systematically using a grid approach, with precise locations for sites within grid cells selected to ensure maximum sampling of Preferred Koala Food Trees.

A survey must also be undertaken for Koalas involving day-time searches and spotlighting over the course of at least two days and evenings. The day surveys should include searches of the site for any heavily scratched trees that might be Koala home-range trees. Council should be contacted to obtain any existing Koala records for the specific site and the local area.

Wherever possible, building envelopes and associated works should be positioned away from areas that return evidence of Koala Activity or any suspected Koala home-range trees. Where this is not possible, building envelopes and associated works should be positioned in areas that return the lowest Koala Activity Levels.

6. Definitions:

Koala Activity

For the purposes of the above assessments “Koala Activity” means one (1) or more reliable Koala records or sightings (either recent or historical), and/or koala faecal pellet evidence.

Koala Activity Level

“Koala Activity Level” means as defined in Phillips & Callaghan 1995; Phillips & Callaghan 2000.

Preferred Koala Habitat

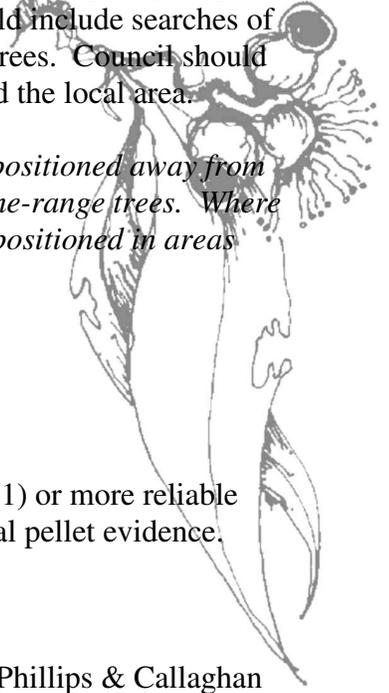
“Preferred Koala Habitat” means the combination of Secondary (Class A) and Secondary (Class B) Koala Habitat Atlas Categories:

Secondary (Class A) Koala Habitat

Approximately 2,423 hectares of Secondary (Class A) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities dominated or co-dominated by Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* growing on substrates *derived* from outcropping shale (both on bench formations and on plateau tops). This habitat category supports relatively high densities of either or both *E. punctata* and *E. agglomerata*; combined average density = 50 % +/- 6.6 %; n = 7 sites; range = 30-71 %.

Secondary (Class B) Koala Habitat

Approximately 2,197 hectares of Secondary (Class B) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities dominated or co-dominated by Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* growing on substrates *not derived* from shale. These substrates are derived principally from sandstone often with localised shale influence (including steep-sided gullies, gully bottoms and plateau tops). This habitat



category generally contains lower densities of either or both *E. punctata* and *E. agglomerata* (relative to Secondary Class A Koala Habitat); combined average density = 20 % +/- 1.5 %; n = 8 sites; range = 13-26 %.

Supplementary Koala Habitat

“Supplementary Koala Habitat” is equivalent to Secondary (Class C) Koala Habitat from the Koala Habitat Atlas:

Secondary (Class C) Koala Habitat

Approximately 4,448 hectares of Secondary (Class C) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities containing Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* as scattered trees or at low density (generally less than 10%), growing on substrates derived from shale.

Marginal Koala Habitat

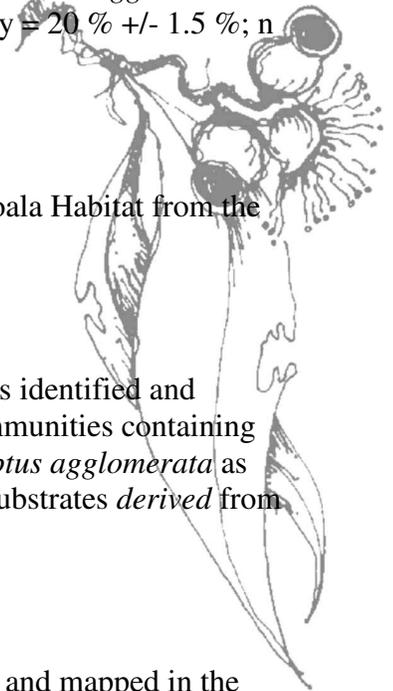
Approximately 6,814 hectares of Marginal Koala Habitat was identified and mapped in the Campbelltown LGA. This includes remaining forest or woodland communities containing eucalypt species, but with Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* often totally absent, or occurring as scattered trees or at low density (generally less than 10%), growing on substrates *not derived* from shale.

Habitat Linking Areas

The identification and effective management of Habitat Linking Areas is considered essential for effective conservation of Koala populations. They potentially provide opportunities for the safe movement of dispersing sub-adult Koalas between breeding populations or into areas of vacant habitat. Depending upon features such as the size and quality of the koala habitat they contain, Habitat Linking Areas may also provide opportunities for Koalas to establish home ranges either as extensions from active breeding aggregations, or as an alternative for those animals that may be unable to establish a home range within higher quality habitat. As Koalas are capable of travelling considerable distances between trees (Moon 1990; Prett 1991), Habitat Linking Areas that overlap with Mainly Cleared Land may still perform important functions. Such areas should also be considered for habitat restoration projects where appropriate.

Development may be permitted in Habitat Linking Areas provided it does not compromise their use by koalas. Therefore, Habitat Linking Areas should be subject to the same development standards as apply to Supplementary Koala Habitat and Habitat Buffers.

The process of establishing Habitat Linking Areas involved the use of Genamap-based GIS software to identify links wherever a temporary 500m buffer around Preferred and Supplementary Koala Habitat areas either joined or overlapped.





CAMPBELLTOWN CITY COUNCIL

Draft

**COMPREHENSIVE KOALA PLAN
OF MANAGEMENT**

PART 2: RESOURCE DOCUMENT

**Prepared for Campbelltown City Council
under *State Environmental Planning Policy
No. 44 – Koala Habitat Protection***

by

Australian Koala Foundation

with

Campbelltown City Council

January 2003

savethekoala.com



CAMPBELLTOWN CITY COUNCIL

Draft

**COMPREHENSIVE KOALA PLAN OF
MANAGEMENT**

PART 2: RESOURCE DOCUMENT

Authors: John Callaghan¹, Tim Curran¹ &
Jane Thompson¹, with Angela Taylor²

GIS Operations led by: Dave Mitchell¹

January 2003

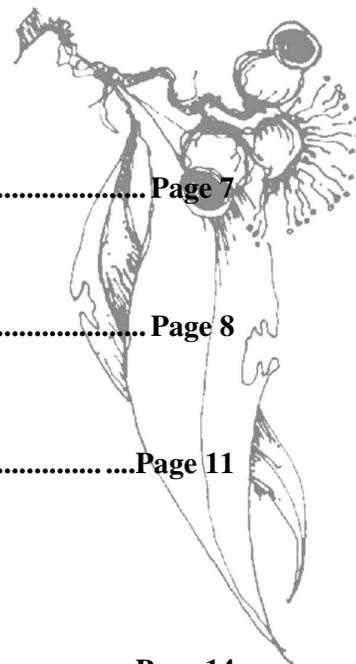
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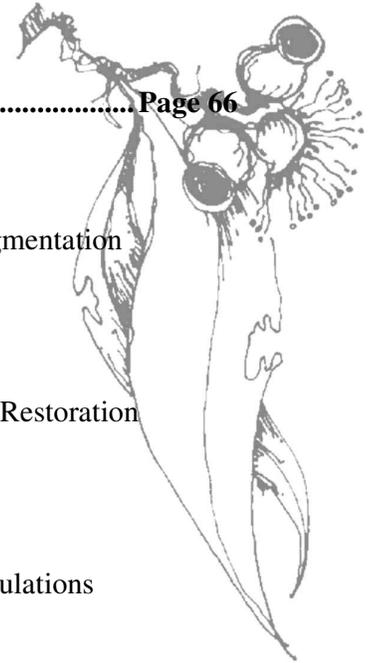


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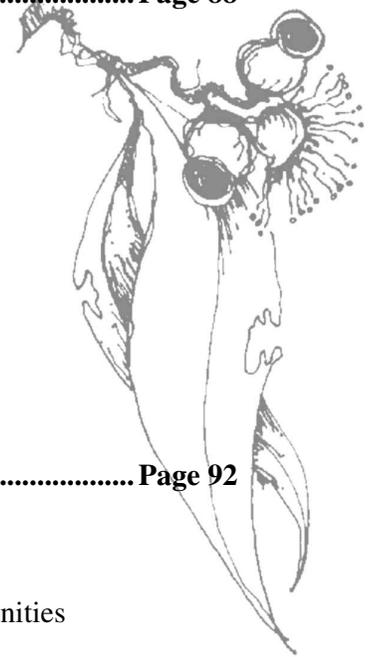
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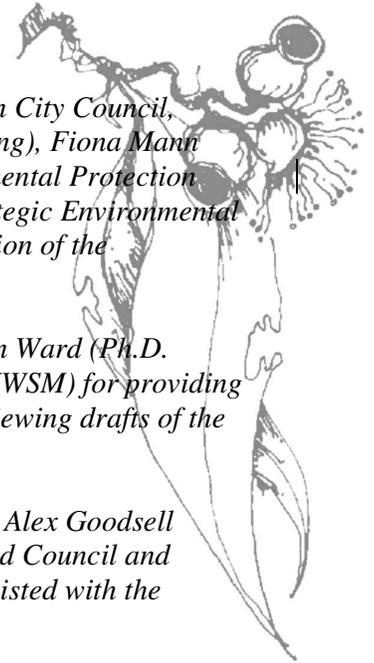
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Contributions of computer workstations and software for Koala Habitat Atlas preparation and GIS modeling purposes were made by Hewlett Packard and Genasys, respectively.



1. INTRODUCTION

1.1 Aims and Objectives

The Campbelltown City Council Comprehensive Koala Plan of Management (CKPoM) consists of two parts. The CKPoM (Part 1) includes a brief synopsis for each of the management topics (chapters) that are detailed in the accompanying CKPoM Resource Document (Part 2), together with specified management actions.

The Campbelltown City Council CKPoM has been prepared for the Campbelltown Local Government Area (LGA) in accordance with *State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44)* and accompanying guidelines, including Circular No. B35 (Department of Planning 1995) and **NSW National Parks and Wildlife Service** (NPWS) draft 'Procedures for preparing comprehensive plans of management for Koalas under SEPP 44' (Lunney *et al.* 1997). The Draft Port Stephens Koala Management Plan (Callaghan, Leathley & Lunney 1994), as referred to in SEPP 44, subsequent joint work by the Australian Koala Foundation (AKF), **NSW National Parks and Wildlife Service** and Port Stephens Council to complete the approved and adopted Port Stephens Council CKPoM (2001), and the draft Greater Taree City Council CKPoM (Callaghan, Curran, Thompson. & Floyd 2002) have provided models for preparing the Campbelltown City Council CKPoM. The Campbelltown City Council CKPoM was preceded by the Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1998).

Funding for the preparation of the Campbelltown comprehensive CKPoM has come from the Campbelltown City Council and the Australian Koala Foundation (AKF).

State Environmental Planning Policy No. 44 (Koala Habitat Protection) commenced operation on the 13th February, 1995. In general, the policy (hereafter referred to as SEPP 44):

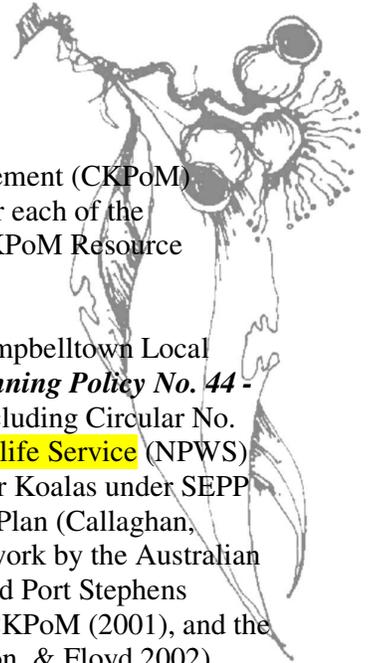
"... aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free living populations over the present range and to reverse the current trend of population decline."

Councils are encouraged by SEPP 44 to prepare comprehensive shire-wide Koala Plans of Management to facilitate processing of Development Applications and to satisfy the aims of the policy.

Procedures for the preparation of a comprehensive Koala Plan of Management have been provided by Lunney *et al* (1997) which states that a comprehensive CKPoM should:

1. identify present Koala populations and (if possible) past populations from historical records;
2. identify and map Koala habitat based on both Koala distribution and plant associations;
3. identify threatening processes and state actions to reverse Koala population decline; and
4. establish procedures to secure and manage Koala populations into the future.

The *Native Vegetation Conservation Act 1997* (NVC Act) provides for the preparation of



Regional Vegetation Management Plans (RVMPs). Section 27 (2) of the NVC Act requires that “in preparing a draft Regional Vegetation Management Plan, if any part of the land to which the plan is intended to apply is core Koala habitat within the meaning of *State Environmental Planning Policy No 44 – Koala Habitat Protection*, the plan must make provision, consistent with any guidelines under that Policy, for appropriate protection and management with respect to that habitat.”

Lunney *et al* (1997) note that “the adoption of a comprehensive CKPoM does not affect the proponent’s responsibility to consider whether a development or activity is likely to have a significant effect on a threatened species, including the Koala, endangered population or endangered ecological community, and where significant effect is likely, to produce a Species Impact Statement. Where an action is not covered by the EP&A Act, a Section 91 Licence may be required under the Threatened Species Conservation Act, 1995”.

In New South Wales the Koala is listed as ‘Vulnerable’ on Schedule 2 of the *Threatened Species Conservation Act 1995*.

1.2 Identification of Authors

This document has been prepared by the Australian Koala Foundation (AKF). The Principal authors are John Callaghan (*B.App.Sc.; Assoc.Dip.App.Sc.; AKF Chief Ecologist and Head of Conservation and Research*), Tim Curran (*B.Sc.Hons.; former AKF Field Biologist*) and Jane Thompson (*B.App.Sc.; AKF Research Officer*), with assistance from Angela Taylor (*Campbelltown City Council Strategic Environmental Officer*). GIS operations were led by Dave Mitchell (*AKF GIS Specialist*).

2. BACKGROUND

This management plan relates to Koalas and their habitat in the Campbelltown Local Government Area (the LGA) south-west of Sydney, New South Wales. The LGA falls within the latitudes 33⁰ 58’ and 34⁰ 10’ south and longitudes 150⁰ 44’ and 150⁰ 56’ east and is bounded to the southwest by the Nepean River, and by the Georges River to the northeast (see Figure 1). The LGA covers a total area of 311.66 square kilometres (31,166 hectares), approximately half of which has been predominantly cleared. The South-Western Freeway passes through the north western section of the LGA. The north western and western sections of the LGA have undergone intensive land clearing for rural and urban development.

2.1 Physical Environment

Topography and Geomorphology

The LGA consists predominately of sandstone and plateau landscapes, with the eastern and southern parts deeply dissected by steep sided gorges associated with O’Hares, Williams and Pheasants Creeks, and the Nepean, Woronora and Georges Rivers. Elevations within the study area range from approximately 100 metres above sea level in the gorges to 240 metres above sea level on the plateau.

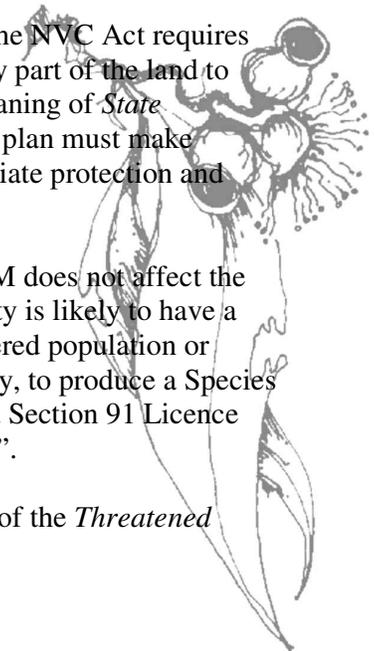
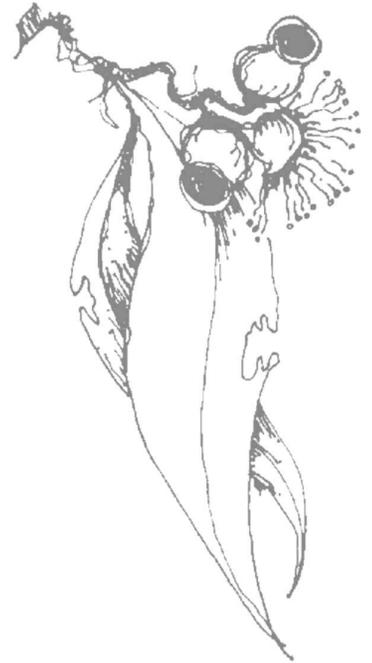
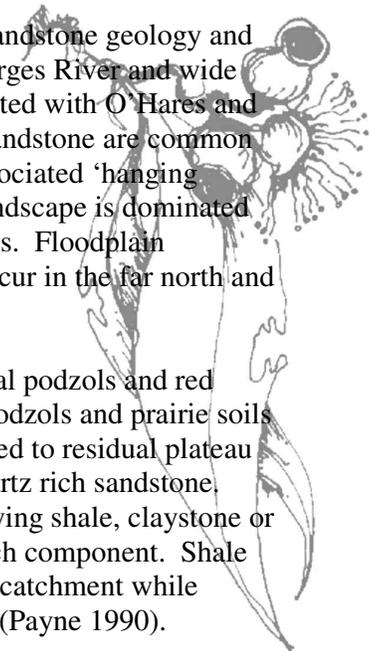


FIGURE 1 GOES HERE



The east and south of the study area is characterised by Hawkesbury Sandstone geology and geomorphology with steep, near vertical cliffed benches along the Georges River and wide stepped platforms exposing prominent interbedded shale layers associated with O'Hares and Pheasants Creeks. On the plateau tops transitional beds of shale and sandstone are common and are exposed in some areas to produce an impervious layer with associated 'hanging swamps'. In the western and northern sections of the study area the landscape is dominated by gentle undulating rises associated with Wianamatta Shale formations. Floodplain landscapes, including the southern section of the Cumberland Plain, occur in the far north and west of the study area.

Soil types within the study area range from yellow earths, sandy skeletal podzols and red podzols associated with plateau formations to brown, red and yellow podzols and prairie soils on the Wianamatta Shales. The yellow earth soils are generally confined to residual plateau tops where the underlying strata is composed of a lightly cemented quartz rich sandstone. The podzols have a clay subsoil as a result of weathering of the underlying shale, claystone or siltstone with the red podzols developing from material with an iron rich component. Shale outcropping and wide benching is predominant in the Pheasants Creek catchment while sandstone outcropping is predominant in the Georges River catchment (Payne 1990).



Climatic Conditions

The climate of the Campbelltown LGA can be described as temperate with warm to hot summers (maximum temperatures in excess of 30 degrees) and cool to mild winters. The area experiences wettest periods in the months of January-February and June with annual rainfall generally in the range of 700 to 900 mm.

2.2 Biotic Environment

Vegetation Communities

Land Units in the western and north western parts of the LGA include scattered trees and remnant stands of formerly widespread and diverse eucalypt forest and woodland communities. In the southeast the vegetation is predominantly woodland with Blue Stringybark *Eucalyptus agglomerata* and Red Bloodwood *Corymbia gummifera* as the dominant canopy species. Grey Gum *E. punctata* becomes dominant where interbedded lenses occur but is replaced as the dominant canopy species by Blackbutt *E. pilularis* where sandstone outcrops. To the south the vegetation changes to one dominated by Hard-leaved Scribbly Gum *E. sclerophylla*, Red Bloodwood and Blue Stringybark (Payne 1990).

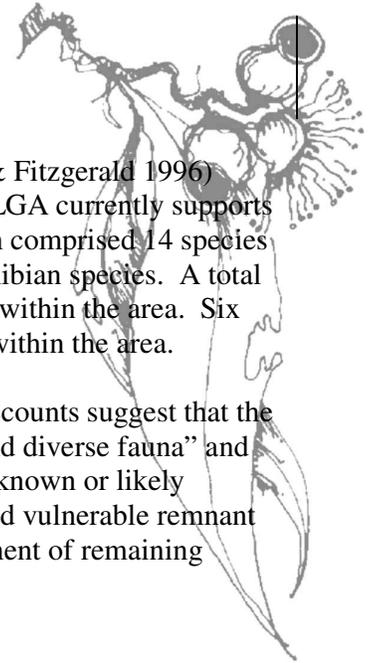
Elsewhere, woodlands with Blackbutt and Smooth-barked Apple *Angophora costata* as the dominant canopy species. Please Rephrase Narrow-leaved Apple *Angophora bakeri* occurs as a dominant lower stratum tree on some easterly aspects. Other land units support wet heathlands under a woodland canopy of Sydney Peppermint *Eucalyptus piperita*, Smooth-barked Apple and Red Bloodwood, interspersed with pockets of the Whip-stick Mallee Ash *E. multicaulis*.

Fauna Communities

See notes on hard copy

The Wedderburn Fauna Planning Study (Phillips, Callaghan, Parnaby & Fitzgerald 1996) established that the Wedderburn Plateau portion of the Campbelltown LGA currently supports a diversity of fauna species including 47 native mammal species, which comprised 14 species of Microchiropteran bats; 186 species of birds; and 71 reptile and amphibian species. A total of 22 threatened species are either known or considered likely to occur within the area. Six mammal species are considered likely to have already become extinct within the area.

The Wedderburn Fauna Planning Study (1996) stated that “historical accounts suggest that the Wedderburn Plateau and adjacent areas once supported a highly rich and diverse fauna” and that “although the area retains a reasonably diverse fauna, many of the known or likely remaining species are by all accounts reduced to very small, discrete and vulnerable remnant populations which will depend upon considered and effective management of remaining habitat for their continued survival.”



3. METHODOLOGY

The methodology and results that follow in relation to the Vegetation Mapping and Field Survey components of the CKPoM are also presented in the Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1998). The field survey methodology and results are presented in detail within a paper (Phillips & Callaghan 2000) published in *Wildlife Research*. The full paper is included in the field survey results section of this Resource Document. See hard copy notes

3.1 Community-based Koala Survey

3.1.1 Introduction

The Campbelltown Community-based Koala Survey was modeled on that undertaken in conjunction with preparation of the Draft Port Stephens Koala Management Plan (1994). The layout for reporting the results of the community survey is based on that included within the Draft Port Stephens Koala Management Plan (1994) and the subsequent approved and adopted Port Stephens Council CKPoM (2001).

The survey sought to obtain both contemporary and historical records of community Koala sightings for the Campbelltown LGA within the living memory of residents. A Community-based Koala Survey is required by SEPP 44 as an essential component in the preparation of a Comprehensive LGA-wide Koala Plan of Management. The survey also sought to gauge community attitudes to a range of potential management options for the conservation of the local Koala population.

3.1.2 Methods

It was considered economically unfeasible for Campbelltown City Council to distribute a return postage-paid survey to each of the approximately 41,705 households within the LGA. An alternative was proposed for the postal survey to be forwarded to all

households bordering identified Koala habitat and other remnant vegetation as well as to known long term residents, while making the survey readily available to the broader community outside the targeted areas.

The community-based Koala Survey was undertaken in accordance with the following strategy, with prior written approval from the NSW National Parks and Wildlife Service and the Department of Urban Affairs and Planning.

Survey Strategy

1. Direct distribution of a return postage paid survey to each household within those suburbs adjacent to Koala habitat identified by the draft Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1996).
2. Surveys were also directly distributed to households bordering significant remnant vegetation and major watercourses as well as to long-term residents on rural properties outside of the above mentioned areas.
3. Copies of the survey were made available at the Campbelltown City Council Chambers for residents outside the direct distribution areas.
4. A media program was run in conjunction with the distribution of the survey in order to advertise the availability of additional survey forms at Council chambers and to encourage residents to respond to the survey.
5. Additional information was collected from sources including the Campbelltown and Airs Historical Society, archival information within Campbelltown City Council Library, UWSM Library and Mitchell Library in Sydney, as well as through personal interviews with long term residents.

A copy of the Community-based Koala Survey is included at Appendix 1. The survey was distributed in April 1997 to approximately 13,000 households. See notes

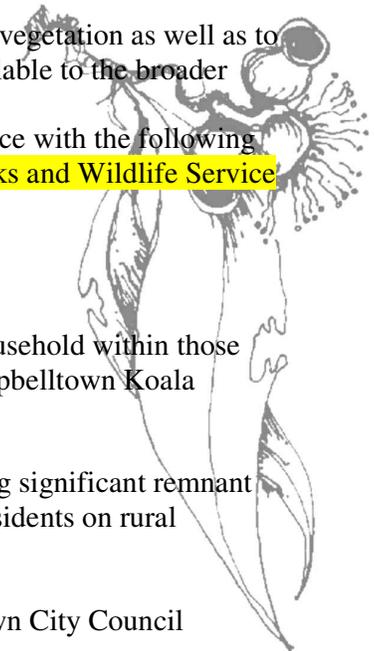
Information on a number of other species was also sought from the survey including Brush-tailed Phascogale, Flying Fox, Emu, Platypus, Tiger Cat, Wombat, Greater Glider and Brush-tailed Rock Wallaby. Records were also sought for Dogs, Foxes and Cats. It was hoped that the request for information on additional species would encourage a response from people who had not seen Koalas in the Campbelltown area.

The information from the written part of returned surveys was recorded as coded data within an Access database, while records of Koalas and other fauna were digitised directly into a Genamap-based GIS. An individual tag was assigned to each record denoting specific information linked to the relevant survey form.

3.2 Historical Ecology

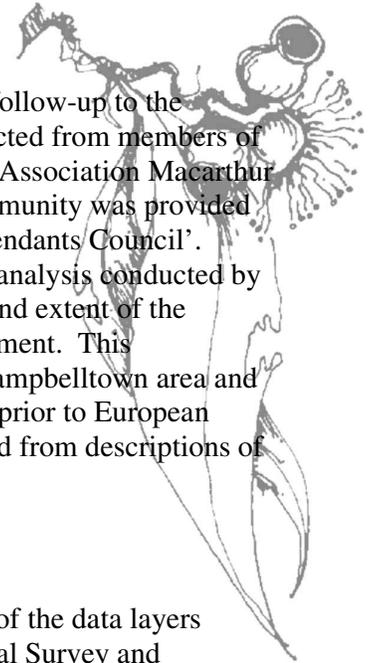
Research for the Historical Ecology section of the CKPoM incorporated a review of historical literature and interviews with local residents, members of the local historical society and ecological groups.

The review of historical literature included newspaper articles (both local and state-wide),



publications, reports and a range of historical records and documents.

Interviews were undertaken with a number of long-term residents as a follow-up to the community-based Koala survey. Anecdotal information was also collected from members of the Campbelltown and Airds Historical Society and the National Parks Association Macarthur Branch (NPA). Information specifically relating to the Aboriginal community was provided by Mr. Gavin Andrews (Gorronge) of the 'D'harawal Traditional Descendants Council'. Descriptions given by early explorers and settlers along with historical analysis conducted by present day Botanists and historians provided information on the type and extent of the vegetation of Campbelltown and its surrounds prior to European settlement. This information was used to delineate settlement patterns throughout the Campbelltown area and to estimate the rate of vegetation clearing. The extent of Koala habitat prior to European settlement and the impact of settlement on Koala habitat was interpreted from descriptions of historical vegetation clearing.



3.3 Vegetation Mapping

Accurate vegetation mapping was considered to be the most important of the data layers required for Koala habitat identification. Mr Robert Payne of Ecological Survey and Management was subsequently engaged to prepare a vegetation map for the entire LGA. Interpretation of 1:16000 (1992) stereo aerial photograph coverage was undertaken to delineate structural classes. Boundaries were marked on the aerial photographs with the aid of a stereoscope and transferred onto 1:25000 topographic map sheets for fieldwork to identify, map and describe the vegetation communities.

The vegetation was described structurally according to the classification of Specht (1981) and floristically based on the style and classifications of Keith (1994) and the floristic standard of the National Herbarium of New South Wales. At a number of locations within each of the identified vegetation communities, 20m square quadrat based descriptions were compiled and then combined to produce overall vegetation community descriptions. The most commonly occurring plant species were noted within each quadrat. At the end of the investigation all commonly occurring plant species recorded within each structural type were combined to provide an overall description of each association. Where necessary, plant specimens were collected and matched against voucher specimens held at the National Herbarium of NSW.

3.4 Field Survey (Koala Habitat Atlas)

Habitat utilisation and tree species preferences of Koalas in the study area were assessed using a plot based survey methodology developed by the Australian Koala Foundation for the purposes of the Koala Habitat Atlas Project. The survey methodology involves random stratified plot site selection, in conjunction with targeted surveys to sample the range of edaphic and floristic variables to the fullest extent possible and to ensure that statistically useful data sets are compiled for each tree species. The methodology is detailed in the Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1998) and in Phillips and Callaghan (2000).

4.0 RESULTS

4.1 Community-based Koala Survey

A total of 584 people responded to the community-based survey (4.5%). This compares poorly to a response rate of 18% to the 1992 Port Stephens Community-based Koala Survey. Of the Campbelltown survey respondents, 94 (16.1%) mapped one or more Koala sightings within the LGA. Most respondents (88.7%) indicated that they did not know if the number of Koalas had changed over the time that they had lived in their suburb.

Only two respondents reported having seen a sick Koala in their suburb. Twenty-seven respondents reported having seen a dead Koala within the LGA. Dead Koalas were most commonly reported from the roads (21/27 or 77.8%), others as a result of dog attacks (2/27 or 7.4%), with the remainder reported either dead in bushland or not specified.

The greatest perceived threats to the Koalas in the Campbelltown LGA were identified as land clearing (85.6%), housing development (84.8%), roving dogs (79.3%), bushfires (73.5%) and roads (72.1%). A total of 205 (35.1%) of the respondents suggested other serious threats to the long-term survival of Koalas including shooting, pollution, feral animals and humans. Of these, 144 respondents (24.7%) indicated that they considered the proposed Holsworthy Airport to pose a serious additional threat.

Responses to the question of which actions would be supported to help conserve Koalas in Campbelltown LGA were as follows: tree planting programs (94%); planning provisions (91.4%); restrictions on dogs (90.6%); Environmental Protection Zones (89.2%); traffic restrictions (81.8%); employ an environmental officer (73.6%). The least positive response was received in support of using public money to buy land for Koala reserves (65.1%). A total of 12.8% of respondents made other suggestions of ways to help conserve Koalas including not proceeding with the proposed Holsworthy Airport, undertaking education programs, culling feral animals, including road signs in Koala habitat, and reduced rates for land where people enter into voluntary Conservation Agreements.

The Community-based Koala Survey (1997) produced a total of 924 fauna records, 172 of which related to Koalas. The records illustrated a broad representation of observations from across the Campbelltown LGA (see Figure 2). All fauna records obtained from the community-based Koala survey have been provided to the **NSW National Parks and Wildlife Service** for installation onto the 'Atlas of NSW Wildlife' database. All survey forms will be made available to the UWSM for inclusion in their Koala database.

The Koala records from the community-based survey were combined with existing Koala records obtained from the UWSM (63 records, most of which formed part of Steven Ward's PhD thesis; UWSM), **NSW National Parks and Wildlife Service** 'Atlas of NSW Wildlife' (2 records), Holsworthy Army Base (5 records), National Parks Association (55 records) and Australian Koala Foundation (2 records) for the purposes of this chapter and for further analyses in conjunction with the Koala Habitat Atlas (see Figure 3). The outcomes of these analyses are discussed further in relation to preparation of the Koala Habitat Planning Map (see Chapter 5).

Aside from information obtained from the historical literature, only four pre-1980 Koala records were obtained for the Campbelltown LGA, the earliest being for 1967; record

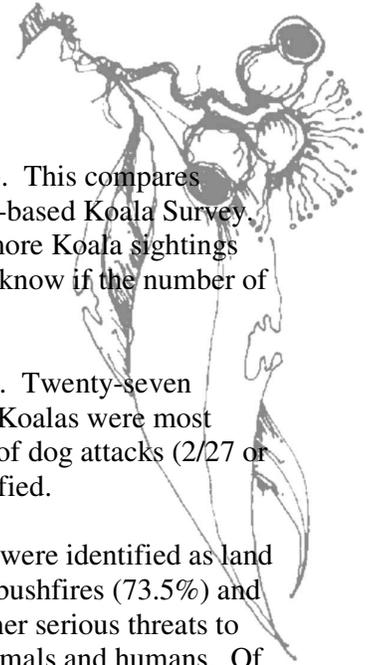


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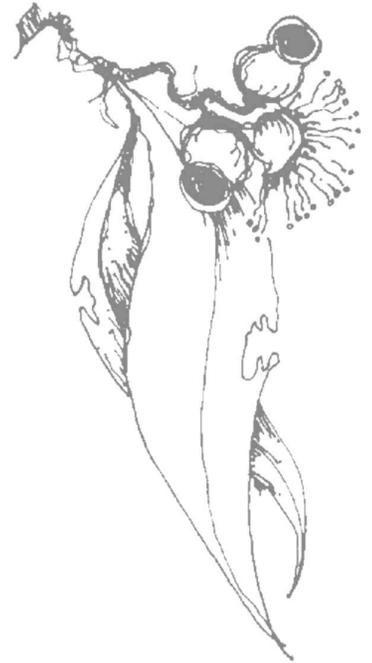
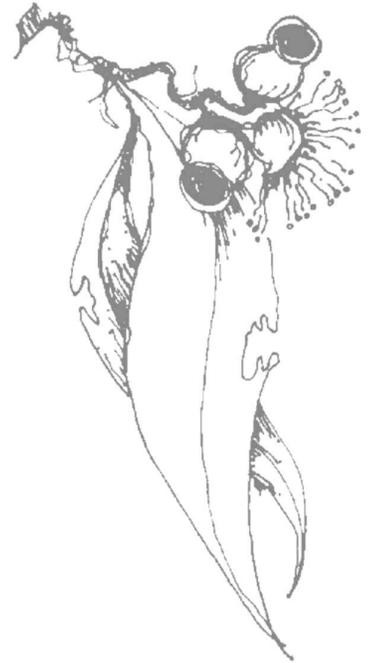


FIGURE 3 GOES HERE



supplied by the UWSM (see Figure 4). A further eleven records were obtained for the period between 1980 and 1989 (see Figure 5). The remaining 287 Koala records were either for 1990 to mid-1997 or were undated (see Figure 6).

Records for the targeted fauna species other than Koalas included Brush-tailed Phascogale (8 reported sightings), Flying Fox (55 reported sightings), Emu (6 reported sightings), Platypus (9 reported sightings), Tiger Cat (3 reported sightings), Wombat (33 reported sightings), Greater Glider (7 reported sightings), Brush-tailed Rock Wallaby (56 reported sightings), Dog (109 reported sightings), Fox (157 reported sightings) and Cat (119 reported sightings).

An additional 159 records that involved other fauna species were also collected by the survey.

A total of sixteen records of breeding female Koalas were obtained from the community survey as illustrated in Figure 7 (three additional records of breeding females were reported in the community survey but not mapped by the respondents). The greatest density of breeding female records occurred in the Kentlyn area.

The total mapped Koala records from the community-based survey indicates a number of distinct clusters notably focused on the Kentlyn, Minto Heights and the O'Hares Creek area adjacent to the Wedderburn Plateau (see Figure 3).

The substantial number of fauna records that resulted from the Community-based Koala Survey (1997) suggests a significant level of interest in the wildlife of the Campbelltown area on the part of the members of the local community that responded to the survey.

The opinions demonstrated by the majority of community survey respondents with respect to perceived threats to Koalas and endorsement of potential measures to conserve the local Koala population suggests there is likely to be significant community support for the Campbelltown CKPoM.

The principal results for the written component of the community survey are summarised below in Tables 1-10.

TABULATIONS OF RESPONSES TO WRITTEN COMPONENTS OF CAMPBELLTOWN SURVEY (1997)

1. How often do you see Koalas in your suburb?

Frequency	Number	Percentage %
Monthly	0	0
Quarterly	1	0.171
Yearly	2	0.342
Occasionally	29	4.966
Once only	34	5.822
Never	518	88.699
TOTAL	584	100

FIGURE 4 GOES HERE

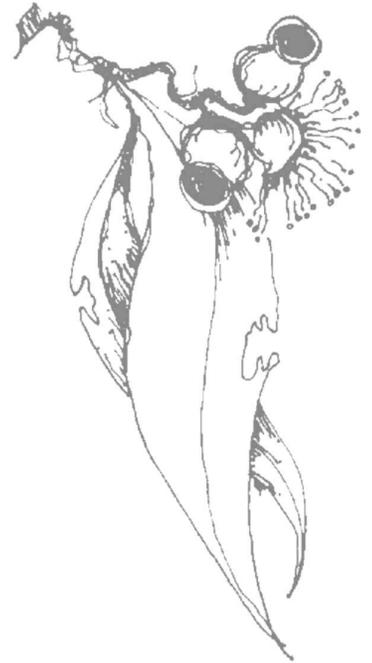


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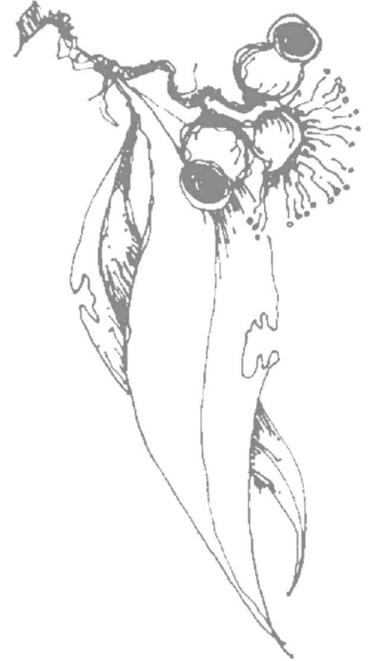


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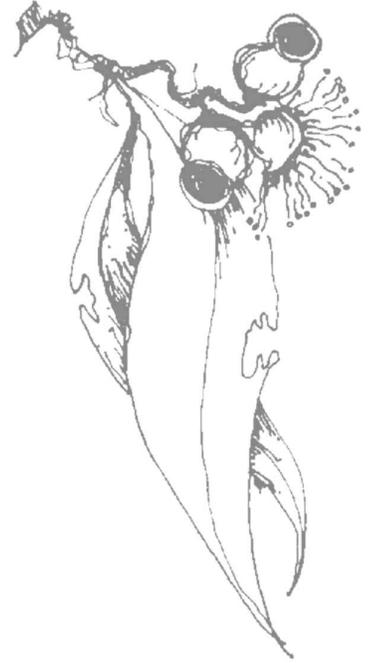
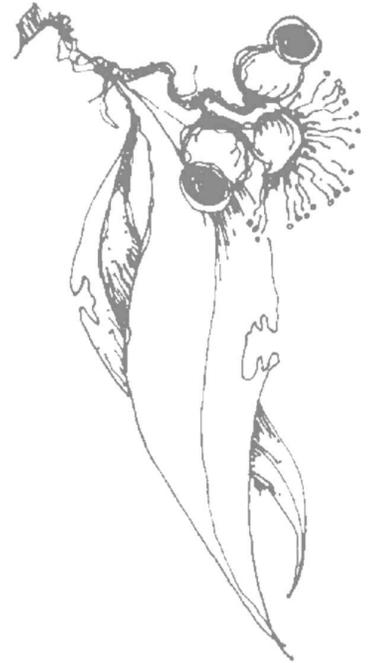
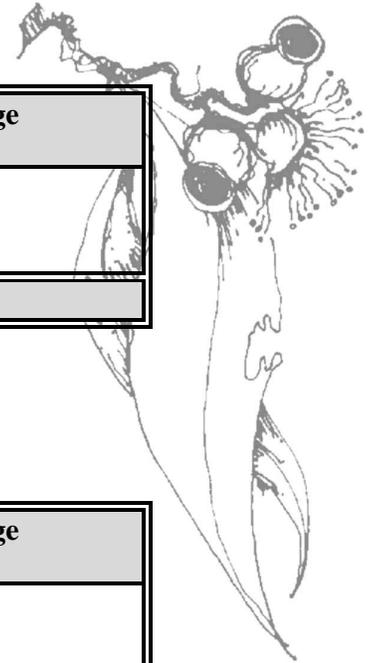


FIGURE 7 GOES HERE



2. "Have you seen Koalas in another suburb?"

Response	Number	Percentage %
YES	59	10.103
NO	518	88.699
No Response	7	1.199
TOTAL	584	100



3. "In your opinion, over the time you have lived in your suburb has the number of Koalas:"

Instance	Number	Percentage %
Increased	11	1.884
Stayed the same	20	3.425
Decreased	16	2.740
Don't know	518	88.699
No Response	19	3.253
TOTAL	584	100

4. "If you have noticed a change, in what year did this begin?"

Period	Number	Percentage %
Pre 1970	0	0
1970 - 1979	1	9.091
1980 - 1984	2	18.182
1985 - 1989	1	9.091
1990 - 1994	3	27.273
1995-1997	4	36.364
TOTAL	11	100

5. "Have you seen any sick Koalas in your local area?"

Response	Number	Percentage %
YES	2	0.342
NO	582	99.658
TOTAL	584	100

6. "Have you seen Koalas with young in your local area?"

Response	Number	Percentage %
YES	15	2.568
NO	569	97.432
TOTAL	584	100

7. "Have you even seen any dead Koalas in the Shire?"

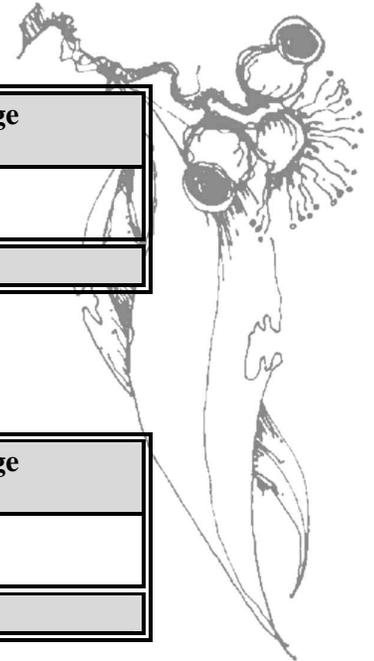
Response	Number	Percentage %
YES	27	4.623
NO	557	95.377
TOTAL	584	100

7a. "If yes, was the Koala dead on a road?"

Response	Number	Percentage %
YES	21	77.777
NO	6	22.222
TOTAL	27	100

7b. "If yes, but not on road please give details?"

Response	Number	Percentage %
Dog Attack	2	33.333
In Bushland	2	33.333
No Response	2	33.333
TOTAL	6	100



8. "In your opinion, are any of the following serious threats to the long-term survival of Koalas in Campbelltown LGA?"

Action	YES		NO	
	Number	%	Number	%
Roads	421	72.089	163	27.911
Housing Development	495	84.760	89	15.240
Roving Dogs	463	79.281	121	20.719
Land Clearing	500	85.616	84	14.384
Bushfires	429	73.459	155	26.541
<i>Other</i>	205			

9. "Conserving Koalas in Campbelltown LGA might involve some restrictions or other costs. Would you support any of the following to help conserve Koalas in Campbelltown LGA?"

Action	YES		NO	
	Number	%	Number	%
Traffic Restrictions	478	81.849	106	18.151
Restrictions on Dogs	529	90.582	55	9.412
Planning Provisions	534	91.414	50	8.562
Tree-planting Programs	549	94.010	35	5.993
Employ Environmental Officer	430	73.630	154	26.370
Environmental Protection Zones	521	89.212	63	10.788
Use public money to buy land	380	65.068	204	34.932
<i>Other suggestions</i>	75			

10. "How many years have you lived in the LGA?"

Frequency	Number	Percentage %
Less than 5 years	99	16.952
6-10 years	138	23.630
11-20 years	165	28.253
20-30 years	116	19.863
more than 30 years	41	7.021
no response	25	4.281
TOTAL	584	100

4.2 Historical Ecology

4.2.1 Introduction

Amongst the first European arrivals to the Campbelltown area prior to European settlement were six cattle that escaped from Sydney Cove settlement in May 1788 (CCC 1971; Liston 1988). The descendants of these cattle were reported by Aborigines in 1795 to be grazing near the now familiar Nepean River, which led to this area being referred to as the ‘Cowpastures’.

Rural settlement began soon after 1798 when explorers Flinders and Bass surveyed the Georges River area. Farming was restricted in the early days of settlement until 1809 when official authority was given to create farms in the district (CCC 1971). The town of Campbelltown was formally established by Macquarie in 1820 and until the mid-1820’s it was the southern limit of European settlement in Australia (Liston 1988).

4.2.2 The Original Vegetation of Campbelltown LGA

The original vegetation of the Campbelltown area reportedly varied from grasslands to open woodlands and forests depending upon soil nutrient levels, terrain, micro-climate and parent material (CCC 1994).

To the east of Campbelltown lies rugged Hawkesbury Sandstone country, to the north and west, rolling hills with woodlands of Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), and Narrow-leaved Ironbark (*Eucalyptus crebra*) on the clay soils of the Wianamatta Shale (Benson & Howell 1990).

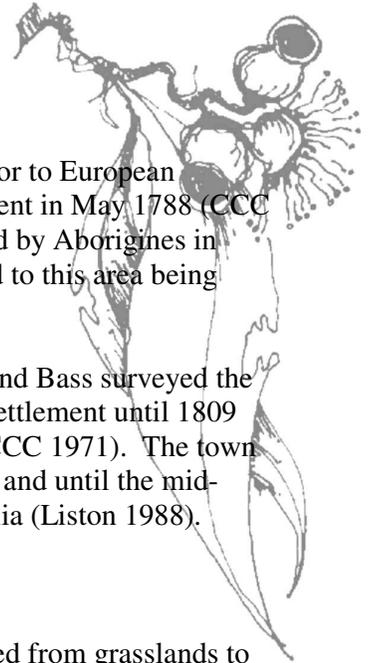
Observations from the 1820’s of the area surrounding Campbelltown indicated variations in the vegetation from the coast to the inland region. Within the Cumberland region the land adjacent to the coast has been described as follows:

“light, barren and sandy covered by stunted bushes. Inland there is a poorer clay soil covered with evergreen forest timber with a tall understorey” (Benson & Howell 1994).

Further inland *“commences a fine timbered country, perfectly clear of brush, through which you might...drive a gig in all directions without impediment in the shape of rocks, scrubs or close forest”* (Benson & Howell 1990).

Another description of the Campbelltown area by George Caley in 1803 referred to the “Cowpastures” as:

“...Exclusive of the very fine pasturage, the soil appears equally well calculated for tillage as are the banks of the Hawkesbury, and these plains are watered by chains of small ponds...There are several kinds of grass, the principle of which is wild oat, which grows in great luxuriance, and in fields that are several acres in extent. Kangaroos, Emus, and Wild Ducks, are in great abundance, and in all respects, these extensive plains surpass any conception that can be possibly formed upon report.”



“This forest is formed of an immense number of exceeding high hills, the ranges running in different directions;...Little of it can be converted to arable purposes by the hills being so high and steep, and upon the highest parts the cattle constantly travel and in these parts they seem to delight” (Currey 1966).

There is some dispute as to which area Caley was actually referring to, some believe he may have travelled south of Campbelltown, believing this area to be the Cowpastures. In the 1820's James Atkinson travelled throughout the Campbelltown area and its surrounds commenting as follows:

“In the country of Cumberland, one immense tract of forest land extends, with little interruption, from below Windsor on the Hawkesbury, to Appin, a distance of 50 miles (80 kms); large portions of this are cleared and under cultivation, and of the remainder that is still in a state of nature, a great part is capable of much improvement. The whole of this tract, and indeed all the forest in this country, is thick forest land, covered with very heavy timber, chiefly iron and stringy bark, box, blue and other gums, and mahogany” (Benson & Howell 1990).

A young woman passing through Campbelltown from Sydney to Goulburn in 1853, described the area to her mother in a letter:

“... we travelled as far as Campbelltown that evening, thirty two miles from Sydney, We saw nothing all the way but short brush wood; the monotony of the scene occasionally enlivened by a few tents and bush fires... It is nothing but one immense forest from Campbelltown to Goulburn, a distance something above one hundred miles. Every ten minutes you are almost overturned by the wheels coming in contact with great stumps of trees nearly half a yard high” (Mary-Ann, Nov 1853).

Spotted gum (*Corymbia maculata*) also occurred naturally in Appin. Its timber was used by early settlers for paving streets, making wheels for carts and buggies, barrel-making and general building purposes (Benson & Howell 1994). In 1803, Caley suggested that the area (presumably the south-east corner of Campbelltown LGA) should be declared a royal forest (Currey 1966). Since that time the area has been extensively developed for both residential and agricultural purposes.

4.2.3 The Aboriginal Community

Source: D'harawal Traditional Descendents Council (Sweet Water People).

The D'harawal peoples were basically divided into two separate groups – the Sweet (or Fresh) Water peoples and the Salt Water Peoples. The Salt Water D'harawals occupied the lands from the Kurnell Peninsula and Botany Bay, south to the Shoalhaven, and from the coast to the Illawarra escarpment. The Sweet Water D'harawals occupied those lands where the “rivers run the wrong way” and include the Nepean, Wollondilly, Georges, Cataract, and Nattai catchments. In 1798 a convict named Wilson reported seeing “a hundred thousand blacks on the Cowpastures”, whereas in the early 1800's, Barallier reported seeing 10,000 in the same area.

Where they were available, rock overhangs provided shelter, however, where these were not

available, bark shelters were erected, sometimes lined with grasses or other plant materials to make them waterproof or cooler, or warmer, dependent on the weather.

It was the Sweet Water D'harawals who occupied the Campbelltown or Cowpastures area, and consisted of some forty or fifty clans, each numbering in the vicinity of thirty to sixty individuals. The name given by the Sweet Water D'harawals to the Cowpastures area was "Yandel'ora Yugl" which means Land of Peace Between Peoples, because every generation all the nations from as far north as Maroochydore, to as far south as Melbourne met to determine laws, settle disputes and arrange marriages.

About every four years smaller meetings were held to settle disputes between D'harawals and their immediate neighbours, arrange marriages, and exchange children. During times of drought, the Gundangurra, with permission, were allowed to come down from the mountains and stay on the Yandel'ora until the rains came again. It was during such times that the conflict arose between the whites (who unfortunately could not distinguish between Gundangurra and D'harawal), and the Gundangurras. This led to the massacre of the D'harawals in 1816 in the Appin area and at Cataract Gorge, at a time when all the Sweet Water clans were meeting to discuss the conflict.

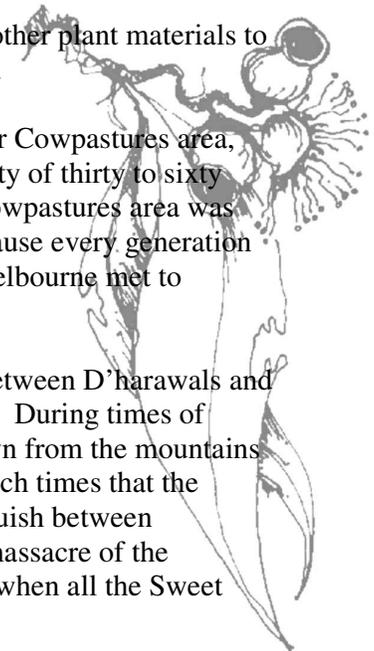
Note that the Gundangurra were the southwestern neighbours of the D'harawals, and lived in the mountains to the west of the Wollondilly River catchment and south of the Cox's River catchment.

Although the D'harawal people had a varied diet, their main food sources were plants, it is known that there were some thousands of plant species which provided food and medicine. They also ate fish, eels, and shellfish freely. Near Menangle there is archaeological evidence of large eel farms, which were tended continuously for at least 1,200 years. Meat was not a staple part of the D'harawal diet, food was far easier to gather than to hunt in forested areas.

Koalas did not form any part of the D'harawal diet because they believed that the Koalas were once a clan of the D'harawals, who, because they did not share their warm cloaks during a time of great cold, and who stole the water of the other clans, grew claws on their feet, and were banished to the tree tops as punishment. That is also why the Koalas only drink water during times of drought, and why they leave a print the same as a human thumb when they walk upon the ground.

Only five D'harawal children survived the massacres of 1816, and those children were taken to the school at Parramatta, established by Macquarie, for civilising. One child, Naala escaped after six months and returned to his home where he met up with his older brother, D'aramoi. In the 1830s Naala, with his wife and child were transported to La Perouse along with some Gundangurras who had been captured and placed in a reserve. D'aramoi, who was what could be termed a "bush black" eventually died, and was buried traditionally in 1860.

Naala's child, Ngali, returned to Yandel'ora Yugl in the late 1800's and died in the 1930's on the banks of the Nepean River, aged more than 100, and is buried at Camden.



4.2.4 European Settlement

4.2.4.1 Removal of Vegetation

In September 1809 Governor Paterson decided to encourage cultivation on the forest lands west of Sydney, following severe flooding of the Hawkesbury floodplain which destroyed crops, animals and buildings of the colony (CCC 1994). This was the catalyst to the expansion of settlement in the western region and the creation of the satellite city of Campbelltown.

Initial settlement of Campbelltown occurred on August 1st 1809 when Paterson bestowed the first six grants in the Campbelltown region (Liston 1988) and by 1811 a total of 107 Europeans had settled in the Airs district (CCC 1971). At this time the area of Airs was heavily wooded but settlers considered the soil to be “thin and poor for cultivation”, thus leading to the grazing of cattle and sheep in preference to cultivation. By 1816 most of the holdings in Airs were large (Pollon 1988).

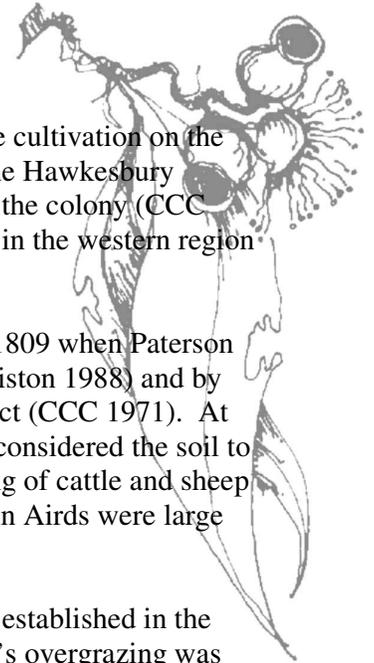
In the low-lying areas of Campbelltown, native grasses had established in the absence of cloven-hoofed livestock. However, by the 1820's overgrazing was becoming a serious problem to the north of Sydney, forcing graziers to move stock across the Blue Mountains to the western pastures (Benson & Howell 1990).

Land grants varied in size, with the larger grants given to free settlers. Smaller grants were also made to ex-convicts. The smaller land grants (30-60 acres; and 100 acres) were located primarily in the Airs and Appin districts (CCC 1994). The small holdings in the Districts surrounding Campbelltown were involved in mixed farming, growing crops and grazing cattle. The large grants engaged primarily in grazing sheep and cattle (CCC 1994).

On December 1st 1820 the boundaries of the Campbelltown township were formally marked by Governor Macquarie. During the 1820's fertile alluvial land along the eastern side of Bunbury Curren Creek was extensively cultivated (Liston 1988). By this time cereal farming had been established in the Campbelltown district, wheat was being grown near Campbelltown and remained the major cash crop for the region throughout the following forty years. Orchards and vineyards were established in the eastern districts, and clearing began on poorer soils in the mid-1800's to allow for further grazing (Benson & Howell 1990).

Farms were established around the Campbelltown area by 1822 and with intense competition for timber, many farmers posted warnings in local papers to those considering grazing cattle or felling timber on private property (Sydney Gazette, January 18th 1822).

Over the forty years following settlement native vegetation was continually cleared to be sown to wheat and other cereals. By 1839 the Campbelltown area had been extensively cleared for agriculture (Benson & Howell 1990). Cultivation of land within the area was rapid and occurred in distinct stages. In 1828, 889 ha of land were under crop in Airs and Appin, and by 1831 cultivation had been extended to 2554 ha (Liston 1988).



Settlement of the Campbelltown LGA seemed to occur in stages. Figure 8 shows the occupation that had occurred prior to 1840 in the districts of Airds and Minto which now constitute the City of Campbelltown and gives an indication of the land preferred for farming at that time.

Between 1840 and 1880 the southern districts of Campbelltown on the Bringelly Shales were established as grazing land (Terry *et. al.* 1991). During this period wheat comprised the largest productive agricultural component. The farming industry went through a boom and bust period beginning at this time with wheat never quite recovering after an outbreak of wheat stem rust fungus in the 1860's.

Wedderburn was taken up by selectors in the 1880's and 16 ha blocks were cleared of vegetation and planted with orchards (Liston 1988). During the 1890's orchards grew in popularity within the Campbelltown district as land prices in other fruit areas north and north-west of Sydney increased. The Holsworthy and Eckersley areas adjacent to the Georges River were also selected for cultivation as the slope, soil and drainage were suitable for vineyards (Liston 1988).

One tourist visiting the area in 1893 commented on the extent of cultivation within the Campbelltown area:

"...men of an industrious character brought the necessary energies to bear on the rich soil in the district (admittedly suitable for the production of grapes and most kinds of fruit), they were enabled to turn what was previously in many cases native forests into profitable, pleasing and delightful gardens..." (Sydney Mail, August 26th 1896).

By 1901 over half the area of the Campbelltown district was privately owned and fenced with 2,270 ha under cultivation (Liston 1988). Wheat and grain crops were no longer a prominent agricultural component and grapevines and other fruits covered about 28 per cent of cultivated land.

In the 1890's dairying was the major rural industry in the Campbelltown area (Liston 1988). This carried through to the 1950's but by the mid-1960's the number of Campbelltown milk-suppliers had dropped to less than 30 from 108 in 1923 (McGill 1993).

The shale country with its poorer sandstone lands along the Georges River east of Campbelltown, and the river gorge itself, was not considered suitable for cultivation by early settlers, leaving the area in a relatively natural state.

Benson & Howell (1990) stated that over the previous ten years extensive bushland areas in Campbelltown had been destroyed, they also maintained that remnant vegetation near built up areas was threatened by nutrient-enriched run off and changed fire regimes which favour the invasion of exotic weed species.

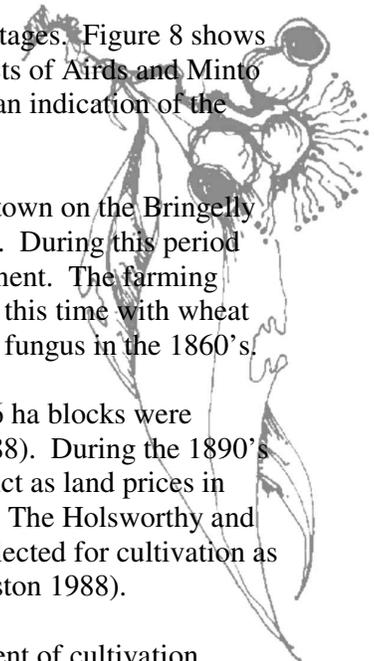
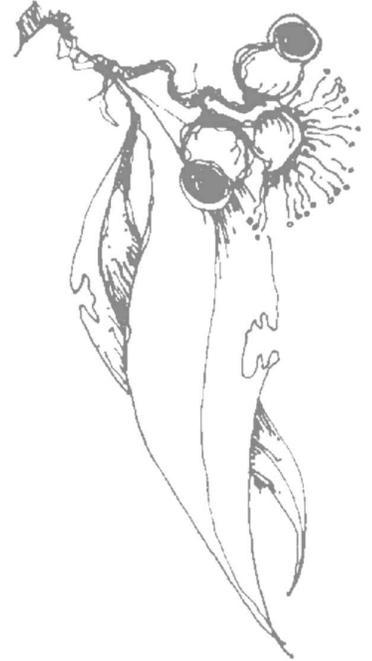


FIGURE 8 GOES HERE



4.2.4.2 Population Distribution in what is now the Campbelltown LGA

Population in what is now the Campbelltown LGA grew slowly and even fell during the early 1900's (see Table 11). The fall may have been caused by stem rust destroying wheat farms during that time (Liston 1988).

Until the 1950's the LGA was comprised of small farms around a small urban area at Campbelltown and emerging urban villages around railway platforms at Glenfield, Macquarie Fields, Ingleburn, Minto, Leumeah and Menangle Park. In the late 1950's and during the 1960's all of the villages except Menangle Park were expanding and a planned satellite city concept guided urban development which joined Leumeah to Campbelltown and developed the suburbs of Bradbury and Ruse.

In the 1970's Campbelltown became a growth corridor in the planned urban expansion of Metropolitan Sydney under the SYDNEY REGION OUTLINE PLAN 1970-2000 AD published in 1968 and the NEW CITIES OF CAMPBELLTOWN CAMDEN APPIN STRUCTURE PLAN published in 1973. Figure 9 shows the extent of land sub-division within the Campbelltown LGA as it is today (Source: Campbelltown City Council 1998).

The New Cities Structure Plan identified sensitive environmental land adjacent to the Georges River and its tributaries together with vegetated corridors joining the river and its tributaries. The identified land, which is adjacent to the Campbelltown urban area from Glenfield south to St. Helens Park, is zoned Regional Open Space. A majority of the Regional Open Space has been acquired by **PlanningNSW** and management options are currently being considered by the Department. Less sensitive plateau land from Macquarie Fields south to St. Helens Park has been zoned Scenic Protection with a 2 ha standard for subdivision and erection of houses. The current 2 ha standard is the same as that introduced when planning commenced in the early 1950's.

Wedderburn is zoned Rural with a 10 ha standard for subdivision and erection of houses. Apart from allowing the creation of some 2 ha excision lots the current 10 ha standard is also the same as that introduced when planning commenced.

The Central Hills Lands to the west of the urban area is zoned Environmental Protection with a 100 ha standard for subdivision and erection of houses, which is much stricter than the original 10 ha standard.

Gilead to the south of the urban area is zoned Rural with either a 40 ha or a 100 ha standard for subdivision and erection of houses. Apart from allowing the creation of some 2 ha excision lots both of these current standards are much stricter than the original 10 ha standard.

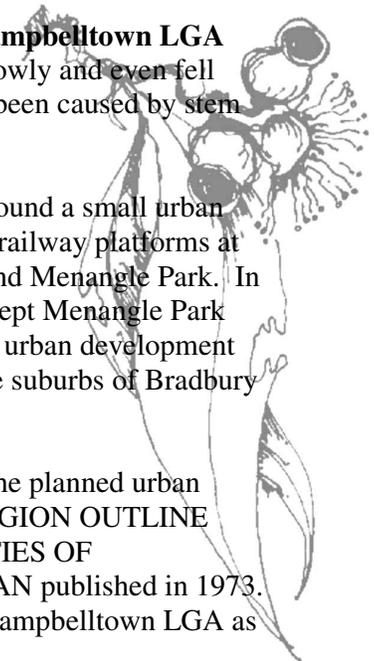


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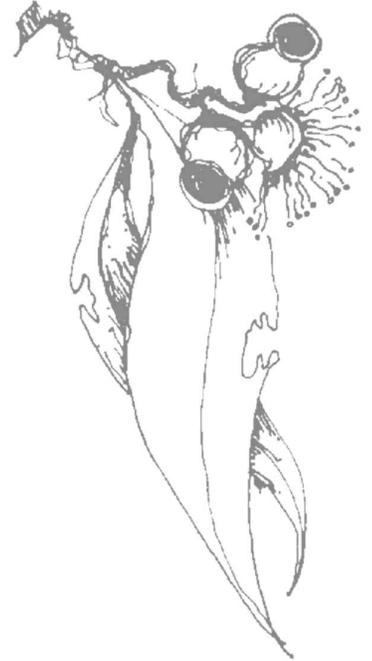
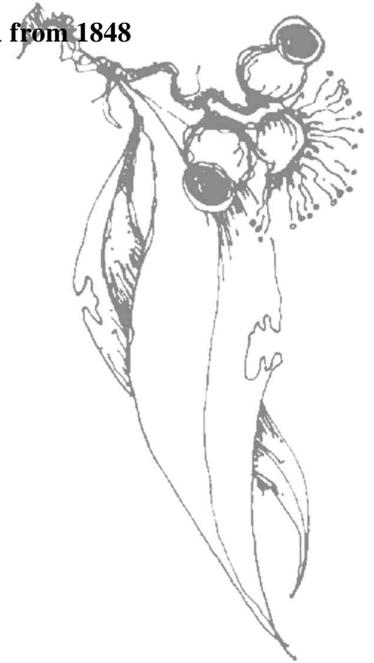


Table 11: Population Growth within the Campbelltown LGA from 1848

Year	Approx. Population
1848	541
1861	938
1881	688
1891	2,381
1901	3,000
1911	1,925
1947	6,995
1954	9,690
1961	18,701
1963	24,000
1974	43,000
1976	53,700
1981	91,125
1982	98,900
1988	127,686
1989	131,006
1991	137,898
1996	143,773



(Source: Campbelltown City Council 1997)

4.2.5 Bushfires Documented for the Campbelltown Area from 1828

Bushfires are a regular occurrence adjacent to the urban areas of Campbelltown. Due to the climate and location of the area and a high incidence of arson, the area often succumbs to serious bushfires, which burn rapidly and often over large areas of land (Longhurst 1997).

The first recorded fire in the Campbelltown area occurred in 1828 when Mr. Alexander Harris was walking from Sydney to Illawarra (thought to be along the old South Rd), reporting *bushfires blazing and trees falling with native animals fleeing from the flames* (Campbell 1996).

The Wedderburn area is highly susceptible to wildfires due to the high density of bushland and the type of vegetation present (predominantly sclerophyllous trees and shrubs). The bushland adjoining the Georges River is also a potentially high risk area because of the Military Reserve to the east. Many fires have swept in from the Military Reserve and criss-crossed the Georges River (Campbell 1996).

The major documented bushfires for the Campbelltown area occurred in 1872, 1929, 1955-1957, 1965, 1968, 1971, 1975, 1994 and 2001 (see Appendix 3). Most of these fires occurred along the Georges River.

4.2.6 Droughts in the Campbelltown Area

The first recorded drought for the Campbelltown area occurred between 1814 and 1816 (Liston 1988).

In 1902 the Campbelltown region was reportedly part of a widespread drought which affected large areas of eastern Australia between 1895 and 1903. Seriously deficient rainfall years occurred in 1906, 1907 and 1909 (Bureau of Science/Meteorology 1975).

Another drought along the eastern seaboard affected the Campbelltown district between 1944 to 1945, followed by serious droughts throughout 1965, 1968 and 1969. Strong winds and high temperatures during spring and early summer of 1965 combined with the drought conditions resulted in serious bushfires over much of the eastern half of NSW (Bureau of Science/Meteorology 1975).

4.2.7 Koala Sightings and Koala Hunting within the Campbelltown LGA

On the basis of research of available historical records and data on the Campbelltown area it appears that Koalas were either not often observed or not reported in the lives of the early settlers. Most of the historical information available on Koalas within the area is anecdotal, held by people who's families have lived in the area for generations.

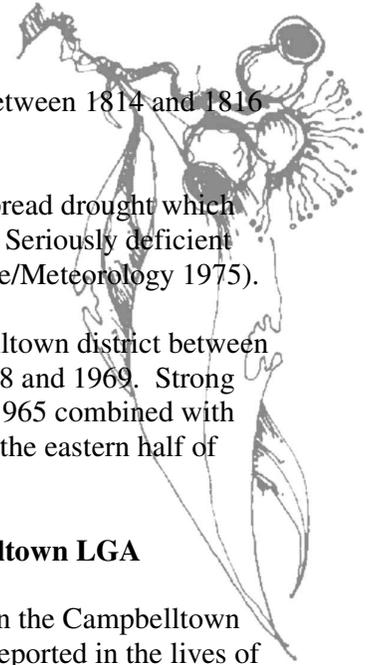
The only time Koalas appear to have been reported in the historical literature for the area prior to the 1960s was around the turn of the century when they were hunted for their skins. Aub and Mick Rixon who lived in the Georges River area in the early 1900's were obtaining one shilling per Koala pelt at the time. *With his 60 to 80 hounds, Mick would venture out to the second creek over (presumably O'Hares Ck) to hunt* (Close 1993). At the turn of the century Keith Longhurst's father also hunted Koalas in the Wedderburn area, selling pelts for one shilling each (Longhurst, March 21st 1997).

Hunting during this period coincides with an Act of Parliament passed prior to September 1903 declaring a closed season on possums, wombats and kangaroos during a certain portion of the year. Penalties for shooting out of season included arrest and a £5 fine causing an uproar from local farmers and orchardists (Campbelltown Herald, September 9th 1903). There was no mention of protection for Koalas in this article, which may have resulted in more intense hunting during this period.

Other suggestions of hunting for pelts in the Campbelltown area include advertisements for Marsupial Skins (including that of bears) by Sydney distributors in newspapers such as the Town and Country Journal (June 21st 1905) and the Sydney Gazette.

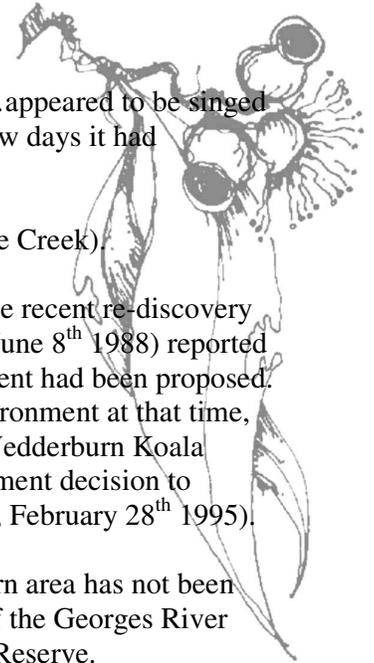
More recent sightings of Koalas in the Campbelltown LGA have been recorded by the Australian Museum, the National Parks Association, Associate Professor Robert Close and students from the University of Western Sydney Macarthur (UWSM) and from the community-based Koala survey undertaken by the Australian Koala Foundation and Campbelltown City Council.

The earliest of these more recent Koala records for the Campbelltown area was in Minto in 1967, as documented by Associate Professor Robert Close. Additional early recordings of Koalas were reported in the CKPoM community-based Koala survey,



including:

- ❖ 1976 - Thomas John Moorland (sighting - Myrtle Creek) - "...appeared to be singed making us believe it had been caught in a bushfire. After a few days it had vanished".
- ❖ 1970's - G. Wilson (sighted at Wedderburn).
- ❖ 1978 - Ian and Peggy Rodden (sighted at Ingleburn and Myrtle Creek).



The local newspapers of the Campbelltown area have followed the recent re-discovery of the Koala colony at Wedderburn. The Macarthur Advertiser (June 8th 1988) reported the presence of a Koala colony at Wedderburn where a development had been proposed. This was followed by the New South Wales Minister for the Environment at that time, Mr. Tim Moore who placed an Interim Protection Order on the Wedderburn Koala colony (Macarthur Chronicle, June 14th 1988) and a State government decision to establish a Koala sanctuary at Wedderburn (Macarthur Chronicle, February 28th 1995).

The decision to establish a Koala sanctuary within the Wedderburn area has not been formalised at the time of preparing this CKPoM. The area east of the Georges River remains under federal control as part of the Holsworthy Military Reserve.

4.2.8 Conclusions

Many variables may have contributed to the low density of the remaining Koala population in the Campbelltown Local Government Area. Benson & Howell (1990) note that the shale country, poorer sandstone lands along the Georges River east of Campbelltown and the river gorge itself were not used for agriculture. This may account for the continued presence of Koalas in the area today as it wasn't desirable agricultural land and subsequently remained largely uncleared.

Following European settlement, clearing of forests and woodlands on the most arable lands may have contributed to the contraction of the Koala population to the poorer sandstone country of the Georges River area. Prior to clearing the arable land may have provided the most preferred habitat for Koalas. Subsequently, today the Koala population appears likely to be restricted to sub-optimal habitat. The fact that much of the arable lands were cleared during the early years of settlement (1820-1840) may also explain why there were few documented early sightings of Koalas within the Campbelltown area other than around the Georges River.

The information supplied by the D'harawal Traditional Descendants Council (Sweet Water People) suggests that the D'harawal people would have had little impact on the local Koala population. Koalas did not constitute part of their diet, which predominantly included plants together with fish, eels and shellfish.

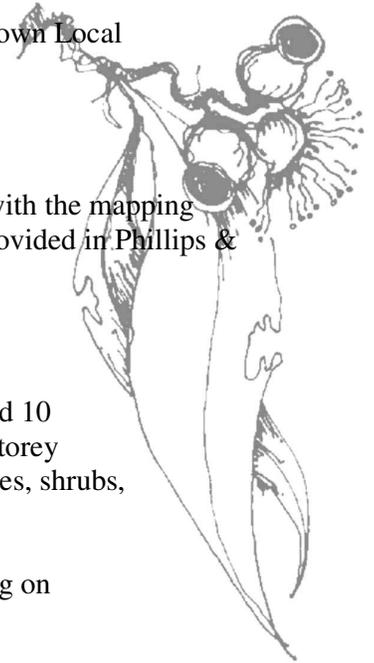
The article referring to the Act passed by the New South Wales government in 1903 to protect native wildlife such as kangaroos, wombats and possums made no mention of protection for Koalas. This may have resulted in more intensive hunting of Koalas, which remained unprotected during the closed season.

Bushfires within the Campbelltown area appear to have occurred quite regularly and at varying intensities. Intense wildfires such as those that occurred in 1929 also have

contributed to the present distribution of Koalas in the Campbelltown Local Government Area.

4.3 Vegetation Mapping

The following vegetation communities were identified in conjunction with the mapping undertaken by Mr. Robert Payne (see Figure 10). Further details are provided in Phillips & Callaghan (1998).



Woodland on Hawkesbury Sandstone

Structure: Open to very open cover of trees generally between 8 and 10 metres high but occasionally up to 15 metres high. Understorey ranges between sparse to dense with a cover of lower trees, shrubs, monocotyledons, graminoids and grasses.

There are two distinct vegetation types present depending on whether the underlying strata is sandstone or shale.

Main Trees: Sandstones

Corymbia gummifera, *Eucalyptus sclerophylla*, *E. oblonga*, *E. agglomerata* and *Angophora costata*. Sometimes *E. resinifera*, *E. consideniana*, *E. sieberi*, *E. punctata*, *E. multicaulis* and *Angophora bakeri*.

Shales

Eucalyptus punctata, *Corymbia gummifera*, *E. oblonga* and *E. sclerophylla*. Sometimes *E. racemosa*, *E. globoidea* and *Angophora bakeri*.

Ironstone Heath on Hawkesbury Sandstone

Structure: Very open cover of trees up to 10 metres high with a dense understorey of lower trees and shrubs, but a mid dense to sparse cover of monocotyledons, graminoids and grasses.

Main Trees: *Eucalyptus sclerophylla* is dominant but sometimes *Corymbia gummifera*, *E. punctata* and *E. oblonga* occur.

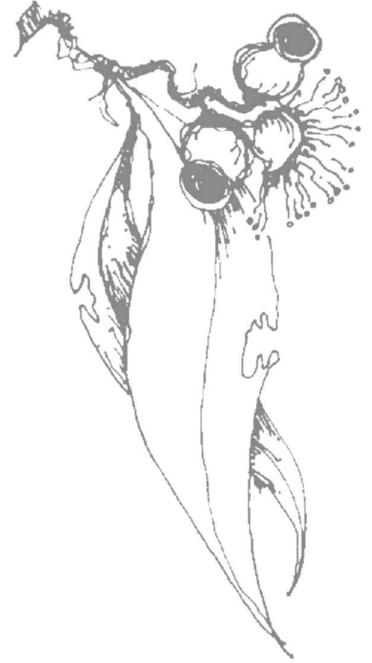
Sedgeland on Hawkesbury Sandstone

Structure: Dense cover of graminoids (sedges) and shrubs up to 0.5 metres high with occasional trees.

Main Trees: *Eucalyptus sclerophylla*.

Remarks: Very restricted in distribution within the boundaries of the City of Campbelltown and should be nominated as a conservation area to protect the receiving waters of Woronora Creek.

FIGURE 10 GOES HERE



Mallee Heath

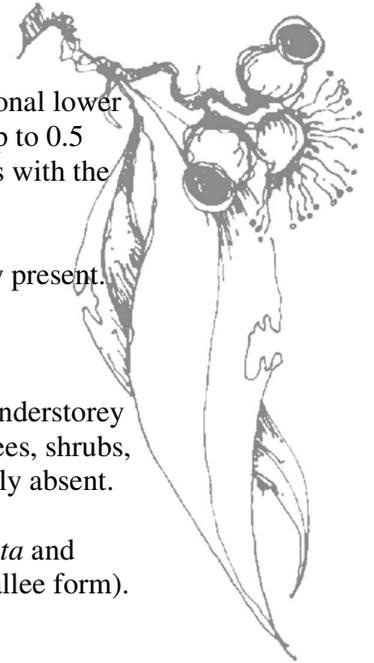
Structure: Dense stands of mallees up to 5 metres high with occasional lower trees, up to 2 metres high and a sparse cover of shrubs up to 0.5 metres high. The density of understorey cover correlates with the coverage of rocky outcrops.

Main Trees: *Eucalyptus leuhmanniana* with *E. multicaulis* commonly present.

Eastern Gully Forest on Hawkesbury Sandstone

Structure: Open to very open cover of trees 20 - 25 metres high. Understorey varies from sparse to mid dense with a cover of lower trees, shrubs, monocotyledons, graminoids and ferns. Grasses generally absent.

Main Trees: *Angophora costata*, *Corymbia gummifera*, *E. agglomerata* and *E. piperita*. Occasionally *E. punctata* and *E. sieberi* (mallee form).



Western Gully Forest on Hawkesbury Sandstone

Structure: Mid-dense to open cover of trees up to 30 metres high. Understorey generally with a mid dense cover of lower trees, but a sparse cover of shrubs, ferns, herbs, graminoids, grasses and scramblers.

Main Trees: *E. pilularis*, *E. punctata*, *Corymbia gummifera*, *E. agglomerata*. At times *E. fibrosa*, *E. crebra*, *Angophora bakeri*, *A. costata* and *Syncarpia glomulifera*.

Dry Rainforest

Structure: Trees with a closed canopy cover up to 10 metres high often with emergents up to 20 metres high. Understorey mostly absent.

Main Trees: *Syncarpia glomulifera*, *Eucalyptus punctata*, *Backhousia myrtifolia*, *Trochocarpia laurina*.

Woodland on Wianamatta Shale, Slopes and Plateau

Structure: Trees up to 20 metres high but commonly 15 metres high with an open to very open canopy cover. Understorey sparse to mid dense with a cover of shrubs up to 1.5 metres high with lower trees up to 4 metres high and a cover of herbs, graminoids and grasses up to 0.25 metres high.

Main Trees: *Eucalyptus tereticornis*, *E. moluccana*, *E. crebra*, *E. fibrosa*, *E. punctata* and *Angophora floribunda*. Occasionally *E. racemosa*, *Corymbia maculata* and *Angophora bakeri* can be locally dominant.

Open Woodland Along River Flats

Structure: Remnant riparian woodlands comprised of a very open canopy of trees up to 25 metres high. Understorey generally disturbed but comprises a lower tree, shrubs, herb, graminoid and fern layer.

Main Trees: *Eucalyptus saligna* x *E. botryooides*, *E. elata*, *E. viminalis*, *Angophora subvelutina* and *A. floribunda*.

Woodland Along Smaller Creeks

Structure: Remnant riparian woodland with open cover of trees up to 10 metres high and a dense understorey of herbs, graminoids and herbs.

Main Trees: *Casuarina glauca*.

4.4 Field Survey (Koala Habitat Atlas)

A total of 2,499 trees comprised of 1,159 eucalypts and 1,340 non-eucalypts from 45 plot sites were assessed during the field survey component (see Figure 11). A detailed presentation and discussion of the survey results has been provided in the Campbelltown Koala Habitat Atlas report (Phillips & Callaghan 1998) and in Phillips & Callaghan 2000.

The field survey results support a model of Koala habitat utilisation in the Campbelltown LGA that is primarily based upon two preferred species of eucalypt: Grey Gum *Eucalyptus punctata* and Blue-leaved Stringybark *Eucalyptus agglomerata*. Both of these eucalypt species were shown to be the subject of significant levels of utilisation by Koalas in the study area, particularly where they occur on substrates derived from shales including bench formations and outcropping deposits on the plateau tops. The preferential use of *E. punctata* and *E. agglomerata* on substrates derived from shales, in comparison to that recorded for these species on sandstones, suggested that utilisation by Koalas was influenced by differences in nutrient status between the substrates (Phillips & Callaghan 2000).

Koalas are also known to utilise a number of other Eucalyptus and non-eucalyptus tree species within the Campbelltown LGA including Turpentine *Syncarpia glomulifera*.

The Phillips & Callaghan (2000) paper has been inserted in the following section with the permission of the CSIRO, publishers of the *Wildlife Research* journal.

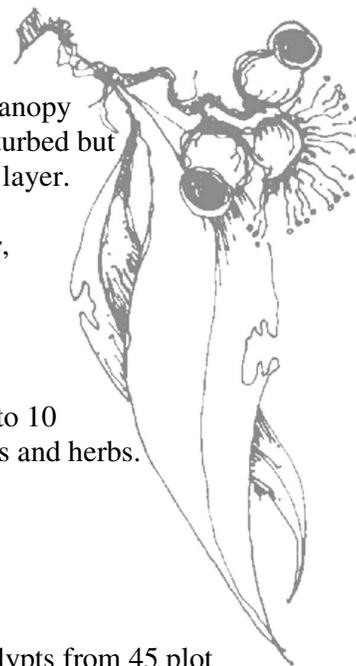
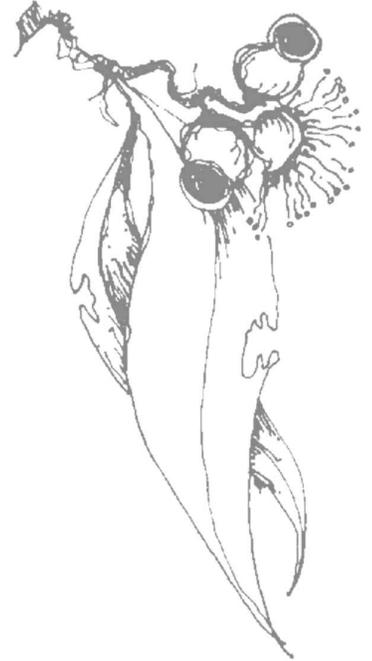
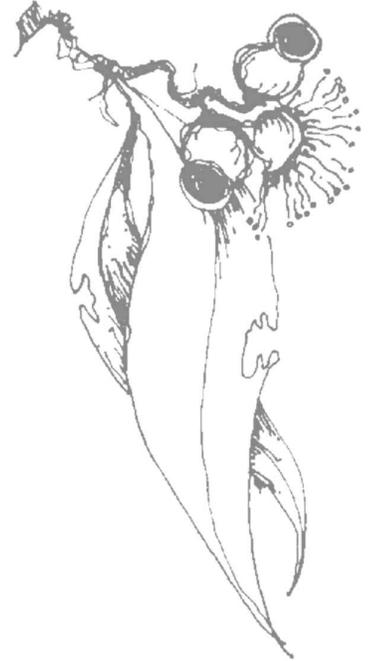


FIGURE 11 GOES HERE



PHILLIPS & CALLAGHAN 2000 (PAPER) GOES HERE



5. KOALA HABITAT IDENTIFICATION AND MAPPING

5.1 Preparation of the Koala Habitat Atlas

The Campbelltown Koala Habitat Atlas (Phillips & Callaghan 1998) identified the extent and distribution of Koala habitat in the LGA based on a categorisation of the forest and woodland communities in terms of the relative abundance of the two preferred tree species in conjunction with the soil types.

5.1.1 Standard Koala Habitat Categories

For the purposes of the Koala Habitat Atlas, the Australian Koala Foundation recognises the following standard categories of Koala habitat:

Primary Habitat

Areas of forest or woodland where primary koala food tree species comprise at least 50% of the overstorey trees.

Secondary Habitat (Class A)

Areas of forest or woodland where primary koala food tree species comprise less than 50% but at least 30% of the overstorey trees; or

Areas of forest or woodland where primary koala food tree species comprise less than 30% of the overstorey trees, but together with secondary food tree species comprise at least 50% of the overstorey trees; or

Areas of forest or woodland where secondary food tree species alone comprise at least 50% of the overstorey trees (primary koala food tree species absent).

Secondary Habitat (Class B)

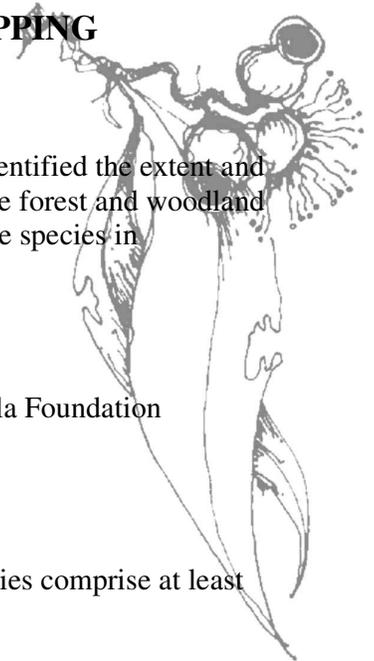
Areas of forest or woodland where primary koala food tree species comprise less than 30% of the overstorey trees; or

Areas of forest or woodland where primary koala food tree species together with secondary food tree species comprise at least 30% (but less than 50%) of the overstorey trees; or

Areas of forest or woodland where secondary food tree species alone comprise at least 30% (but less than 50%) of the overstorey trees (primary koala food tree species absent).

Secondary Habitat (Class C)

Areas of forest or woodland where koala habitat is comprised of secondary and supplementary food tree species (primary koala food tree species absent except for possible scattered individual trees), where secondary food tree species comprise less than 30% of the overstorey trees.



Marginal Habitat

Areas of forest or woodland where koala habitat is comprised of secondary and/or supplementary food tree species, where secondary food tree species comprise less than 10% of the overstorey trees.

Unknown Habitat Value

Areas of forest or woodland containing tree species considered likely to be the subject of significant levels of utilisation by Koalas, but whose value cannot be quantified due to an absence of Koala faecal pellet evidence.

5.1.2 Campbelltown Koala Habitat Atlas

The field surveys and analysis together with the subsequent scientific paper (Phillips & Callaghan 2000) confirmed the following Eucalyptus species as being preferentially utilised by Koalas in the Campbelltown LGA: Grey Gum *Eucalyptus punctata* and Blue-leaved Stringybark *E. agglomerata*, particularly when occurring in association with either shale benching or outcropping shale deposits including those on the plateau tops. Phillips and Callaghan (2000) proposed that these two tree species could best be described as ‘secondary’, rather than ‘primary’, Koala food tree species. Nonetheless according to Phillips and Callaghan (2000), **Grey Gum *E. punctata* and Blue-leaved Stringybark *E. agglomerata* constitute the preferred Koala food trees for the Campbelltown LGA.** Consequently, these species provide the basis for the Koala habitat model and associated mapping.

Koalas are also known to utilise a number of other Eucalyptus and non-eucalyptus tree species within the Campbelltown LGA including Turpentine *Syncarpia glomulifera*, which was identified by Phillips and Callaghan (2000) as receiving the most significant use by Koalas amongst the non-eucalyptus tree species.

The criteria used to categorise and model Koala habitat for the Campbelltown Koala Habitat Atlas (see Figure 12) are outlined in Section 5.1.3.

Densities for Grey Gum *E. punctata* and Blue-leaved Stringybark *E. agglomerata* were determined on the basis of data from field based Atlas plot assessments together with descriptions for each of the identified floristic associations provided in the vegetation mapping report.

5.1.3 Campbelltown Koala Habitat Descriptions

Primary Koala Habitat

No ‘primary’ Koala food tree species were identified by Phillips and Callaghan (2000) for the Campbelltown LGA. Grey Gum *Eucalyptus punctata* and Blue-leaved Stringybark *E. agglomerata* were classified as ‘secondary’ Koala food tree species.

Consequently, no Primary Koala Habitat was identified for the Campbelltown LGA.

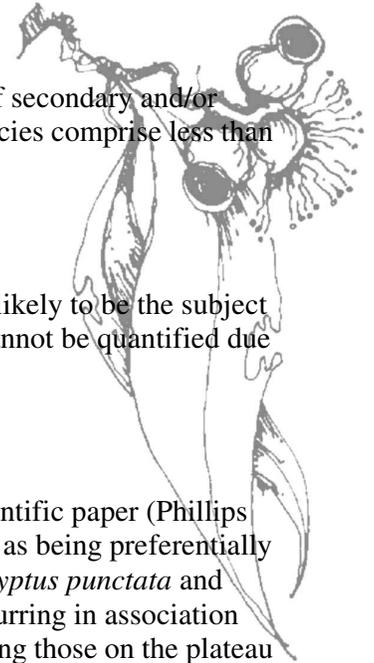
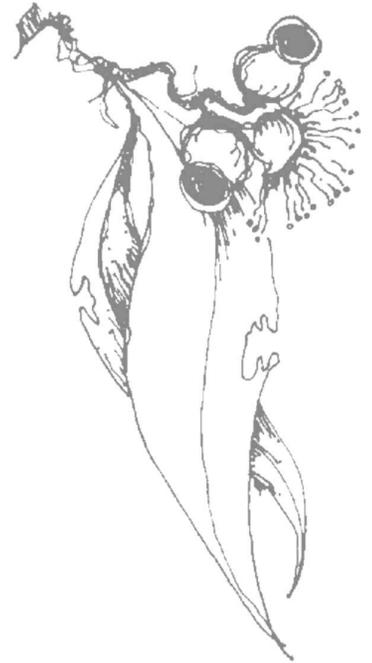


FIGURE 12 GOES HERE



Secondary (Class A) Koala Habitat

Approximately 2,423 hectares of Secondary (Class A) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities dominated or co-dominated by Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* growing on substrates *derived* from outcropping shale (both on bench formations and on plateau tops). This habitat category supports relatively high densities of either or both *E. punctata* and *E. agglomerata*; combined average density = 50 % +/- 6.6 %; n = 7 sites; range = 30-71 %.

Secondary (Class B) Koala Habitat

Approximately 2,197 hectares of Secondary (Class B) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities dominated or co-dominated by Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* growing on substrates *not derived* from shale. These substrates are derived principally from sandstone often with localised shale influence (including steep-sided gullies, gully bottoms and plateau tops). This habitat category generally contains lower densities of either or both *E. punctata* and *E. agglomerata* (relative to Secondary Class A Koala Habitat); combined average density = 20 % +/- 1.5 %; n = 8 sites; range = 13-26 %.

Secondary (Class C) Koala Habitat

Approximately 4,448 hectares of Secondary (Class C) Koala Habitat was identified and mapped in the Campbelltown LGA. This includes those vegetation communities containing Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* as scattered trees or at low density (generally less than 10%), growing on substrates *derived* from shale.

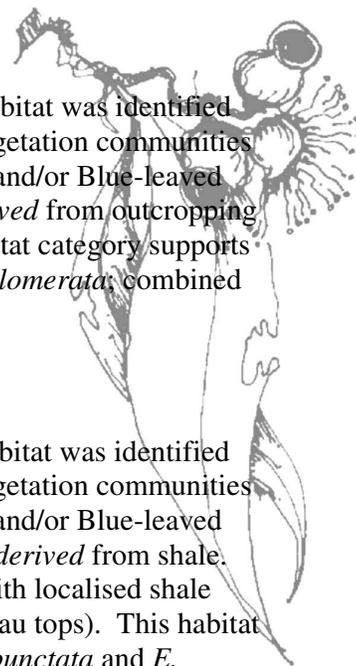
Marginal Koala Habitat

Approximately 6,814 hectares of Marginal Koala Habitat was identified and mapped in the Campbelltown LGA. This includes remaining forest or woodland communities containing eucalypt species, but with Grey Gum *Eucalyptus punctata* and/or Blue-leaved Stringybark *Eucalyptus agglomerata* often totally absent, or occurring as scattered trees or at low density (generally less than 10%), growing on substrates *not derived* from shale.

5.2 Preparation of the Koala Habitat Planning Map

5.2.1 Intersection of Koala Records with the Koala Habitat Atlas

The Koala Habitat Planning Map has been based upon the Koala Habitat Atlas, interpreted in conjunction with the distribution of Koala records (310 in total) obtained from the community-based Koala survey, the UWSM and other sources.



For the purpose of analysis, all Koala records for the Campbelltown LGA were digitally intersected with the Koala Habitat Atlas map (see Figure 13). A report was produced showing the number of Koala records within each of the Koala Habitat Atlas habitat categories (see Table 12).

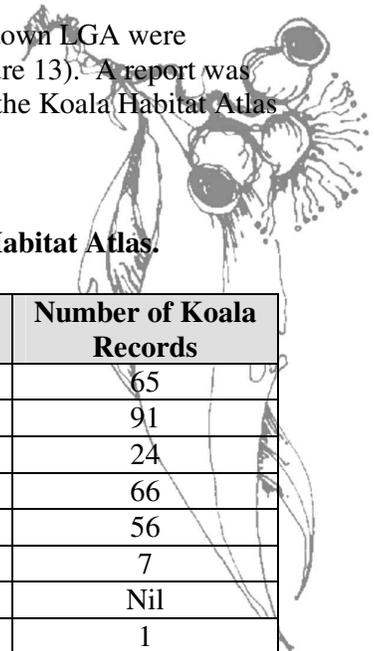


Table 12. Koala records for each category in the Koala Habitat Atlas.

Koala Habitat	Approximate Total Area (ha)	Percentage of LGA (%)	Number of Koala Records
Secondary (Class A)	2,423	7.77	65
Secondary (Class B)	2,197	7.05	91
Secondary (Class C)	4,448	14.27	24
Marginal	6,814	21.86	66
Mainly Cleared Land	14,910	47.84	56
Unknown Habitat Value	121	0.4	7
Other	16	0.05	Nil
Waterbody	238	0.76	1
TOTALS	31,167	100	310

Approximately half of the Koala records (156 out of 310) occur within the two highest-ranked Koala Habitat Atlas categories (*i.e.* Secondary Class A and Class B Koala Habitat). The occurrence of a relatively high number of Koala records within areas mapped as Marginal Koala Habitat (66 records) and Mainly Cleared Land (56 records) appears to be predominantly associated with the occurrence of nearby Secondary Class A or Class B Koala Habitat (see Table 13).

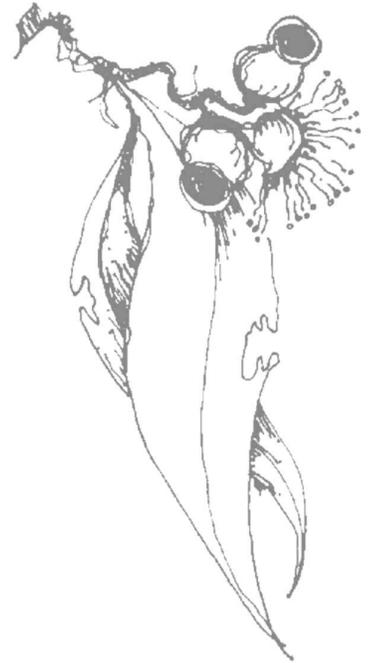
5.2.2 Comparison of Distribution of Koala Records with All Fauna Records

Assessment of the pattern of distribution for all fauna records from the Campbelltown community-based Koala survey indicates that records were distributed broadly across the LGA. However, the areas of highest overall fauna record density appear to coincide strongly with areas of highest Koala record density.

The area where the bulk of fauna records occur involves a strip that roughly follows the fringe of the Campbelltown urban area. This suggests that the relatively high density of fauna records in this area is likely to have been influenced by the concentration of people in the urban fringe. The distribution of fauna records also roughly coincides with the western extent of the relatively intact remaining forest in the LGA. The area further to the west has been predominantly cleared and/or highly fragmented for either urban or agricultural purposes.

Many Koala sightings appear to fall near to roads or other areas frequented by people in the vicinity of the urban fringe. The higher proportions of records from these areas is likely to in part reflect the higher concentration of people and possibly the greater visibility of Koalas within roadside remnants and mainly cleared areas. The scarcity of records from the more remote bushland areas should not be interpreted as an absence of Koalas.

FIGURE 13 GOES HERE



5.2.3 Campbelltown Koala Habitat Planning Map

The *Campbelltown Koala Habitat Planning Map* is depicted in Figure 14.

In preparing the Koala Habitat Planning Map it was decided that Secondary Class A and Class B Koala Habitat categories from the Koala Habitat Atlas should be combined to define *Preferred Koala Habitat*. This decision was supported by the results from the intersection of Koala records with the Koala Habitat Atlas.

Secondary Class C Koala Habitat from the Koala Habitat Atlas was renamed as *Supplementary Koala Habitat* for the Koala Habitat Planning Map.

Marginal Koala Habitat remained the same for both the Koala Habitat Atlas and the Koala Habitat Planning Map.

Habitat Buffers were added to all Preferred Koala Habitat areas, before *Habitat Linking Areas* were included to complete the Koala Habitat Planning Map.

Habitat Buffers

Habitat Buffers can contribute to the long-term survival of Preferred Koala Habitat by ensuring that incompatible *development* or *activities* do not occur on immediately adjacent lands. Habitat Buffers may afford protection to Preferred Koala Habitat by minimising the detrimental impact of “edge effects” such as nutrient impacts, wind damage and weed invasion. Habitat Buffers provide for the likely extension of significant Koala Activity beyond areas of Preferred Koala Habitat. Even Habitat Buffers that extend over Mainly Cleared Land containing only scattered trees can perform this latter function. Such areas should be considered for habitat restoration projects where appropriate. Habitat Buffers warrant protection and management through performance standards equivalent to those for Supplementary Koala Habitat.

A 100m Habitat Buffer was added to all Preferred Koala Habitat in recognition of the significance of this habitat category. The 100m Habitat Buffer captured 44 of the total of 310 Koala records for the Campbelltown LGA (see Table 13).

Habitat Linking Areas

The identification and effective management of Habitat Linking Areas is considered essential for effective conservation of Koala populations. They potentially provide opportunities for the safe movement of dispersing sub-adult Koalas between breeding populations or into areas of vacant habitat. Depending upon features such as the size and quality of the koala habitat they contain, Habitat Linking Areas may also provide opportunities for Koalas to establish home ranges either as extensions from active breeding aggregations, or as an alternative for those animals that may be unable to establish a home range within higher quality habitat. As Koalas are capable of travelling considerable distances between trees (Moon 1990; Preveit 1991), Habitat Linking Areas that overlap with Mainly Cleared Land may still perform important functions. Such areas should also be considered for habitat restoration projects where appropriate.

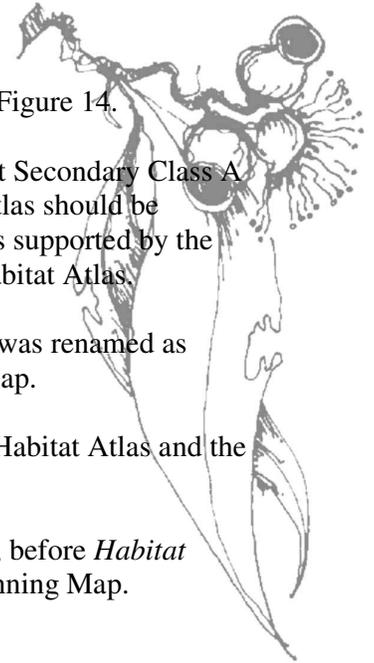
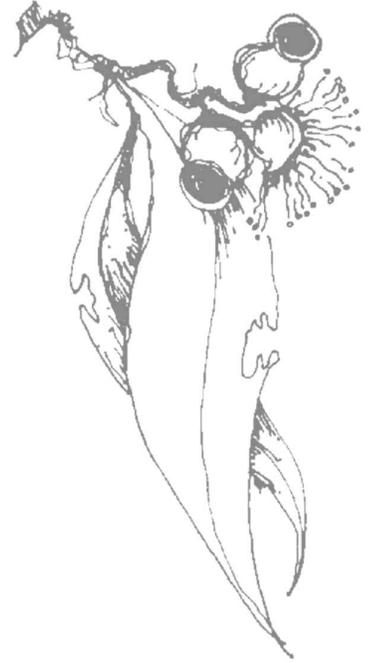


FIGURE 14 GOES HERE



Habitat Linking Areas should be subject to equivalent development standards to those applied to Supplementary Koala Habitat and Habitat Buffers.

The process for modelling the Habitat Linking Areas involved the use of Genamap-based GIS software to assign links wherever a temporary 500m buffer around Preferred and Supplementary Koala Habitat areas either joined or overlapped.

5.2.4 Intersection of Koala Records with the Koala Habitat Planning Map

The *Preferred Koala Habitat* together with the *Habitat Buffers* accounted for 200 (or 64.5%) of the total of 310 Koala records. The computer-modelled *Habitat Linking Areas* accounted for a further 91 (29.4%) of the 310 Koala records (see Table 13).

Table 13. Koala records for each category in the Koala Habitat Planning Map.

Koala Habitat	Approximate Total Area (ha)	Percentage of LGA (%)	Number of Koala Records
Preferred Koala Habitat	4,613	14.8	156
<i>Preferred Habitat Buffer</i>	2,212	7.09	44
Supplementary Koala Habitat	3,362	10.8	10
<i>Habitat Linking Areas</i>	3,984	12.79	91
Marginal Koala Habitat	3,818	12.25	2
Mainly Cleared Land	12,827	41.16	6
Unknown Habitat Value	91	0.29	Nil
Other	17	0.05	Nil
Waterbody	238	0.77	1
TOTALS	31,162	100	310

Of the remaining 19 Koala records, 10 occur in *Supplementary Koala Habitat* and 2 occur in *Marginal Koala Habitat*.

Only six of the 310 Koala records remain in the Mainly Cleared Land category once the Habitat Buffers and Habitat Linking Areas were added, supporting the notion that these records seem to be largely associated with proximity to Koala habitat areas.

The Koala Habitat Planning Map emphasises the importance of the Preferred and Supplementary Koala Habitat, which collectively comprise only 25.6% of the LGA and approximately 49.8% of the remaining forested area. The Koala Habitat Planning Map provides a sound basis for directing planning and management measures to those areas of most importance for the long-term conservation of the local Koala population.

5.3 Conservation Status of the Campbelltown Koala Population

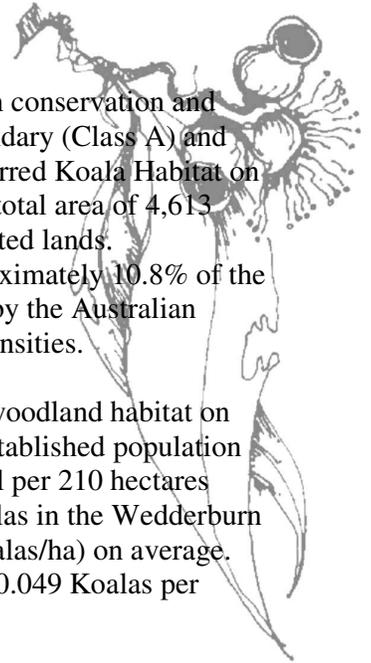
The habitat categories with the greatest potential for effective long-term conservation and management of the Campbelltown Koala population includes the Secondary (Class A) and Secondary (Class B) Koala Habitat, collectively designated as the Preferred Koala Habitat on the Koala Habitat Planning Map. Preferred Koala Habitat comprises a total area of 4,613 hectares, approximately 14.8% of the LGA and 37% of remaining forested lands. Supplementary Koala Habitat comprises a further 4,448 hectares, approximately 10.8% of the LGA and 28% of remaining forested lands. Field research undertaken by the Australian Koala Foundation indicated that these habitats contain Koalas at low densities.

Research conducted on two low-density Koala populations occupying woodland habitat on low fertility soils in Central Queensland by Melzer and Lamb (1994) established population densities of one animal per 67 hectares (0.01 Koalas/ha) and one animal per 210 hectares respectively. Close (1993) proposed that the population density of Koalas in the Wedderburn area was likely to be in the order of one animal per 10 hectares (0.1 Koalas/ha) on average. Ward (2002) estimated a density within the Southern Sydney region of 0.049 Koalas per hectare, excluding dependent young.

Phillips and Callaghan (2000) acknowledged that the extent to which the low Koala population density has been influenced by historical land use practices or other threatening processes such as fire and predation could not be confirmed. However, they suggested that the small size of the remaining Koala population is a likely reflection of habitat quality and associated carrying capacity, particularly given the presence of the local population in the area since the turn of the century (Close 1993). Phillips and Callaghan (2000) proposed that the low Koala activity levels recorded during the Australian Koala Foundation field research might be expected given the low nutrient environments.

If it was assumed the majority of the local Koala population is primarily sustained by the available Preferred Koala Habitat, then application of population density estimates of 0.01, 0.049 and 0.1 Koalas per hectare would result in upper estimates for the number of Koalas in the main population of 46, 226 and 461 respectively. Such estimates would not take into account the presence of Koalas within other categories of Koala habitat. However, nor would it account for a proportion of the Preferred Koala Habitat that would be unoccupied by Koalas at any given time. The substantial range in these values reflects the difficulties in deriving population estimates using broad extrapolation techniques. A range of methods may be necessary to obtain adequate data for meaningful estimation of population size. Using a combination of home range analysis, volunteer search records and estimation of the extent of areas used by breeding animals, Ward (2002) proposed a Koala population size for the Southern Sydney region of between 90 and 200 individuals.

Whilst a degree of uncertainty remains in regards to the actual size of the local Koala population, there seems no doubt that the population is low density and quite small. Given the small population size, the degree of geographic isolation from other known Koala populations and the subsequent low probability of adequate levels of recruitment from outside the study area, as well as significant threats from bushfire, further habitat loss or disturbance and predation by domestic and/or feral animals, the remaining Koala population in the Campbelltown LGA is clearly very vulnerable and in need of decisive management.



6. HABITAT CONSERVATION

6.1 Introduction

An effective strategy to conserve Koala habitat is considered essential for the long-term survivorship of Koalas in the Campbelltown LGA. Consistent with the principles of biodiversity conservation, the conservation of Koala habitat will also benefit other local species of native fauna.

6.2 Objectives

The objectives of this chapter are to:

- i) Identify options for conserving Koala habitat; and
- ii) Provide an effective strategy to conserve Koala habitat and provide for the long-term survival of Koalas in the Campbelltown LGA.

6.3 Conservation Options

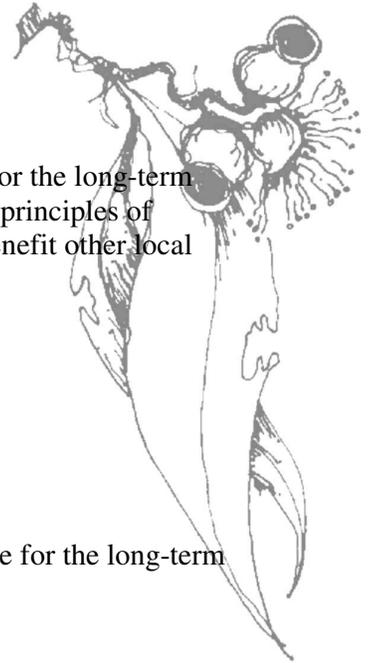
A number of options are available to conserve Koala habitat through existing legislation, government agencies, and planning instruments. The appropriate option for conserving a particular area of Koala habitat will depend upon a number of factors including the nature of the habitat, its conservation significance, and the land tenure.

6.3.1 Threatened Species Legislation

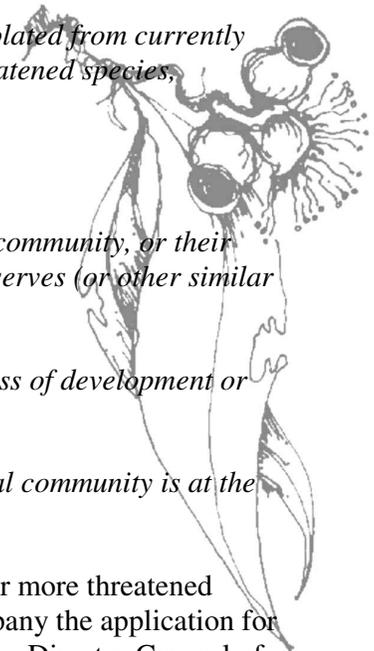
In New South Wales, the Koala is listed as 'Vulnerable' in Schedule 2 of the *Threatened Species Conservation Act 1995*.

The *Threatened Species Conservation Act 1995* amended the *Environmental Planning and Assessment Act 1979* requiring that consent authorities consider whether a proposed development is likely to have a significant effect on the environment of a threatened species (including the Koala), population or ecological community. For this purpose, Section 5A of the *Environmental Planning and Assessment Act 1979* contains a test of significance, which the consent authority must take into account. This test of significance includes the following eight parts:

- (a) *in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction,*
- (b) *in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,*
- (c) *in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed,*



- (d) *whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community,*
- (e) *whether critical habitat will be effected,*
- (f) *whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,*
- (g) *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,*
- (h) *whether any threatened species, population or ecological community is at the limit of its known distribution.*



Where a proposal is likely to have a significant impact on one or more threatened species, a Species Impact Statement (SIS) is required to accompany the application for the development or activity. In such cases the concurrence of the Director General of National Parks and Wildlife is required before any consent can be issued.

Division 2 (11) of the *Threatened Species Conservation Act 1995* establishes eligibility criteria for listing a population as an ‘endangered population.’

The preparation and adoption of a CKPoM does not eliminate the requirement to take the eight part test into account in determining whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats, in accordance with the *Threatened Species Conservation Act 1995*, and to prepare Species Impact Statements where necessary.

6.3.2 Land Use Planning

The *Environmental Planning and Assessment Act 1979* (Part 3) provides for the preparation of State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs) and Local Environmental Plans (LEPs).

i) State Environmental Planning Policies (SEPPs)

State Environmental Planning Policy No. 44 - Koala Habitat Protection

SEPP 44 aims to: “encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free living populations over the present range and to reverse the current trend of population decline.”

SEPP 44 applies to land greater than 1ha in LGAs that are listed in Schedule 1 of the SEPP. These LGAs represent the known geographic range of the koala in NSW. SEPP 44 requires that a council, prior to granting consent to a development application, must consider the likely impact of the development on koala habitat. This is achieved by following the procedure outlined in SEPP 44,

which includes the need for investigations first for potential koala habitat and then core koala habitat and, if the latter is identified, the preparation of a Individual Koala Plan of Management (KPoM).

Councils are encouraged by SEPP 44 to prepare comprehensive LGA-wide Koala Plans of Management to facilitate processing of Development Applications and to satisfy the aims of the policy. The preparation and approval of a comprehensive LGA-wide Koala Plan of Management (CKPoM) eliminates both the need for individual assessments of potential and core Koala habitat and the preparation of individual Koala Plans of Management.

ii) Regional Environmental Plans (REPs)

Regional Environmental Plans need to be further examined for their potential to contribute to the protection of Koala habitat. CKPoMs should contribute significantly to the preparation and updating of REPs and to other regional conservation planning initiatives.

iii) Local Environmental Plans (LEPs)

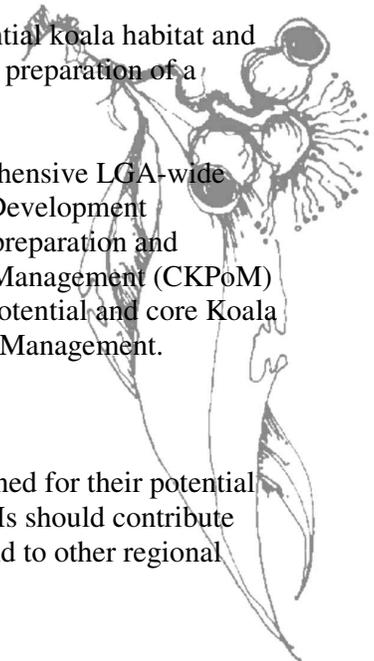
Local Environmental Plans provide a statutory zoning framework for Local Government Areas. Local Environmental Plan zonings can be applied to areas of high conservation value such as areas of significant Koala habitat in order to provide an appropriate level of protection. Environmental Protection Zones usually restrict permissible activities and land use within that zone to those that are considered compatible with the conservation values and the specified objectives of the zone.

6.3.3 Development Assessment

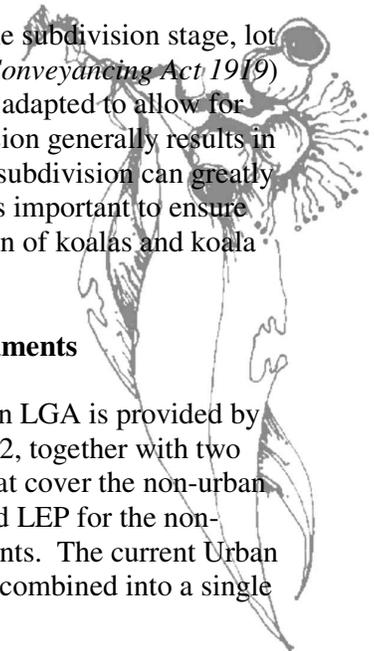
The development assessment process refers to the procedure by which development and land use is assessed and regulated. In New South Wales, the *Environmental Planning and Assessment Act 1979* (EP&A Act), and subsequent amendments, provides the primary legislative framework for the development assessment process.

Part 4 of the EP&A Act provides the legislative framework for the assessment of development applications. In assessing an application to develop land, a consent authority has to refer to a variety of sources, many of which stem from the provisions of the EP&A Act (Binning *et al.* 1999). These include: State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs), Local Environmental Plans (LEPs), Development Control Plans (DCPs), deemed environmental planning instruments, council codes and policies, directions under section 79C of the EP&A Act, and **Department of Urban Affairs and Planning** circulars (Farrier 1993).

There is less flexibility when considering proposals under Part 4 of the EP&A Act compared with that under Part 3, because, in the case of the former, the legislative framework regarding the range of permissible uses is largely established. There is, however, a need to recognise an important type of development that is assessed under Part 4 of the EP&A Act, which by its nature provides for a degree of flexibility in addressing koala habitat issues: the subdivision of land. Subdivision of land is the



division of land into two or more parts (s.4B EP&A Act). At the subdivision stage, lot sizes and lot layouts are determined and covenants (under the *Conveyancing Act 1919*) can be established, which provides scope for the proposal to be adapted to allow for the protection of koalas and their habitat. However, as subdivision generally results in a decrease in lot sizes and hence an intensification of land use, subdivision can greatly reduce the potential for koala habitat to be protected. Thus, it is important to ensure that subdivisions are compatible with the long-term conservation of koalas and koala habitat.



6.3.4 Campbelltown Local Environmental Planning Instruments

The statutory planning and zoning framework for Campbelltown LGA is provided by the Campbelltown (Urban Area) Local Environmental Plan 2002, together with two separate LEPs and five deemed planning instruments (IDOs) that cover the non-urban areas of the LGA. Council is planning to prepare a consolidated LEP for the non-urban areas to replace the existing individual planning instruments. The current Urban Area LEP 2002 and the proposed Non-urban Area LEP may be combined into a single LGA-wide LEP.

i) Environmental Protection Zones

Four separate Environmental Protection Zones are included within the Campbelltown (Urban Area) Local Environmental Plan 2002 that could potentially be applied to Koala habitat areas.

These Environmental Protection Zones include 7 (d1) Environmental Protection 100 hectare Minimum Zone; 7 (d4) Environmental Protection 2 hectare Minimum Zone; 7 (d5) Environmental Protection 1 hectare Minimum Zone; and 7 (d6) Environmental Protection 0.4 hectare Minimum Zone. The protection of Koala habitat would be consistent with the specific objectives of both the 7 (d4) and 7 (d5) zones.

The objectives of the 7(d4) Environmental Protection 2 hectare Minimum Zone are:

- a) to identify and protect land and watercourses forming part of the Georges River catchment area, and
- b) to conserve the rural character of the area by maintaining a minimum area of 2 hectares for lots used for rural living, and
- c) to protect environmentally important land and watercourses possessing scenic, aesthetic, ecological or conservation value, and
- d) to allow some diversity of development but only where it is unlikely to have a detrimental effect on the quality and character of the locality or the amenity of any existing or proposed development in the locality.

The objectives of the 7 (d5) Environmental Protection 1 hectare Minimum Zone are:

- a) to conserve the rural-residential character of the land by maintaining a minimum area of 1 hectare for lots used for rural-residential living, and
- b) to protect environmentally important land and watercourses possessing scenic, aesthetic, ecological or conservation value, and
- c) to allow some diversity of development, but only where it is unlikely to

have a detrimental effect on the quality and character of the locality or the amenity of any existing or proposed development in the locality.

ii) Other Zones

Other zones included within the Campbelltown (Urban Area) Local Environment Plan 2002 could potentially provide some degree of protection for Koala habitat in accordance with their objectives and restrictions on development.

These other zones include:

- ❖ 5 (a) Special Uses A Zone;
- ❖ 6 (a) Local Open Space Zone;
- ❖ 6 (b) Regional Open Space Zone; and
- ❖ 6 (c) Private Open Space Zone.

iii) Constraint Clause

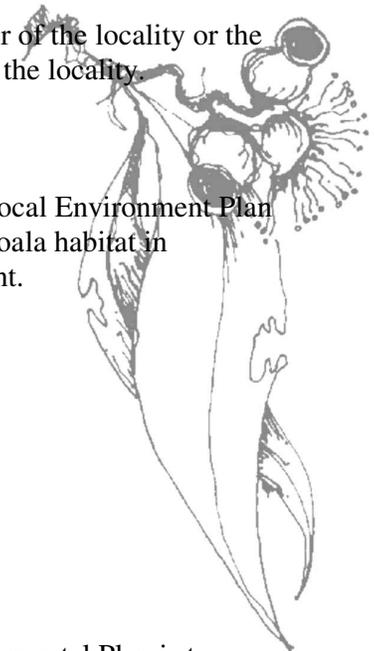
Another option to protect Koala habitat through a Local Environmental Plan is to include a Habitat Constraint Clause. Such a clause would require Council consent for any activity within Koala habitat areas identified on maps accompanying the Local Environmental Plan. The clause would include a number of objectives against which to assess each application. For the purposes of the CKPoM, such objectives should include the following:

- ❖ To ensure that the Koala population of Campbelltown LGA is sustained over the long term;
- ❖ To protect Koala Habitat areas from any development which would compromise habitat quality or integrity;
- ❖ To ensure that any development within Koala habitat occurs in an environmentally sensitive manner;
- ❖ To ensure that acceptable levels of investigation are undertaken and considered prior to any development in Koala habitat areas; and
- ❖ To ensure that development does not further fragment Koala habitat areas.

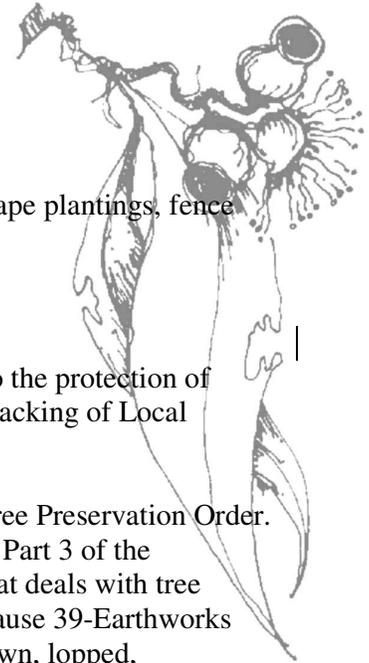
iv) Development Control Plans

Campbelltown City Council currently has a number of Development Control Plans and Policies. Development Control Plans (DCPs) are not statutory planning instruments and as such are more flexible than Local Environment Plans or deemed planning instruments. DCPs generally aim to guide development to reflect community expectations and environmental sensitivities. DCPs can take any one of a number of forms, from providing performance-based standards for developments such as dual occupancies, to providing a structure for the subdivision of land.

A DCP could also provide guidelines and development standards for developments that occur in Koala habitat areas. There is no current Koala-specific DCP for the Campbelltown LGA to address habitat protection and management issues. Matters to be addressed in any Koala-specific DCP should include the following:



- ❖ Information to be submitted with development applications;
- ❖ When a Species Impact Statement is likely to be required;
- ❖ Controls on any proposed tree clearing;
- ❖ Requirements for habitat restoration works;
- ❖ Traffic management; and
- ❖ Guidelines for the positioning of building envelopes, landscape plantings, fence construction, and domestic pet ownership.



v) **Tree Preservation Order**

See notes

A Tree Preservation Order (TPO) could potentially contribute to the protection of Koala habitat by regulating habitat clearing, with the statutory backing of Local Environmental Plans.

Campbelltown City Council does not currently have a formal Tree Preservation Order. However, a Special Provisions Clause has been included within Part 3 of the Campbelltown (Urban Area) Local Environmental Plan 2002 that deals with tree preservation issues. Subclause (3) of this Special Provision (Clause 39-Earthworks and preservation of trees), states that “A tree must not be cut down, lopped, ringbarked, injured or destroyed without development consent.” Subclause (3) does not apply to tree pruning for its regeneration or ornamental shaping; or where the pruning or removal of any tree is in accordance with an approval granted by Council.

A Tree Preservation Order could include the protection of Koala habitat as a specific objective and could refer to the CKPoM and/or to a Development Control Plan for guidance when assessing applications for tree removal or lopping.

6.3.5 National Parks and Wildlife Service

The National Parks and Wildlife Service (NPWS) has statutory responsibilities for the conservation, protection and management of the State's natural and cultural heritage. The NPWS is not only responsible for the management of National Parks, Nature Reserves, Aboriginal and Historic Sites and relics, but also for the protection of the State's flora and fauna species, ecological research, preparation of Recovery Plans under the *Threatened Species Conservation Act 1995*, the conservation of threatened species and the maintenance of biodiversity.

The National Parks and Wildlife Service is currently considering a proposal to establish a Koala Reserve to the east of the Wedderburn plateau. See notes

Voluntary Conservation Agreements

A Voluntary Conservation Agreement (VCA) is a contractual agreement negotiated between the Minister administering the *National Parks and Wildlife Act 1974* and a land-holder, with the aim to conserve areas of specific value for the conservation of natural or cultural heritage in New South Wales.

Lands containing viable habitats of threatened species, significant ecosystems or habitat remnants, or cultural sites may be considered suitable by the National Parks and Wildlife Service for VCAs. These agreements are voluntary on the part of the

land holder, although once entered into they are legally enforceable and run with the title of the land. Conservation Agreements are registered with the Registrar-General and remain in place until such time as terminated by mutual agreement between both the Minister and the property owner.

The terms of a Voluntary Conservation Agreement may include restrictions on the use of the specified area and the Minister may be authorised under the terms of the agreement to provide technical land management and conservation advice and financial assistance.

Wildlife Refuges

A Wildlife Refuge can be declared over a property, by joint agreement between the property owner and the National Parks and Wildlife Service, where the property has substantial areas of natural habitat and where the owner is prepared to make a positive contribution to wildlife conservation. A Wildlife Refuge status over a property does not affect the title of the land or the owner's rights.

6.3.6 Department of Defence

Approximately 20,000 hectares within the Campbelltown LGA is managed for military use by the Department of Defence at the Holsworthy Army Base. This land is zoned as 5(a) Special Uses A Zone.

6.3.7 Sydney Water

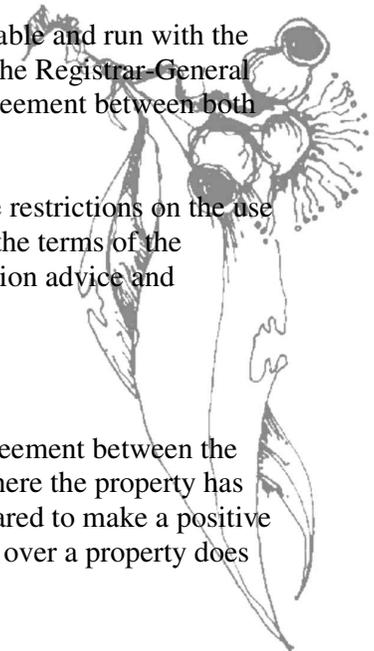
Approximately 1,300 hectares within the Campbelltown LGA is managed by Sydney Water for catchment protection. This land is zoned as 5(a) Special Uses A Zone.

6.3.8 Private Land Holders

A substantial amount of the identified Koala habitat within the Campbelltown LGA is in private ownership. Consequently, private landholders will have a significant role in providing for the long-term conservation of Koalas and Koala habitat in the LGA. Irresponsible land management on private lands could contribute to the further loss of Koalas and Koala habitat.

The CKPoM urges private land holders to consult with Council and/or the National Parks and Wildlife Service wherever a proposed development or activity on their lands is likely to affect Koala habitat, whether requiring consent or otherwise. These authorities can then provide advice on appropriate procedures in accordance with the relevant legislation and planning instruments and recommend measures to reduce and/or ameliorate likely effects on the habitat of Koalas.

Campbelltown City Council can also provide advice to private landholders on appropriate measures to improve Koala habitat values for degraded areas of former habitat (see the Habitat Restoration Chapter).



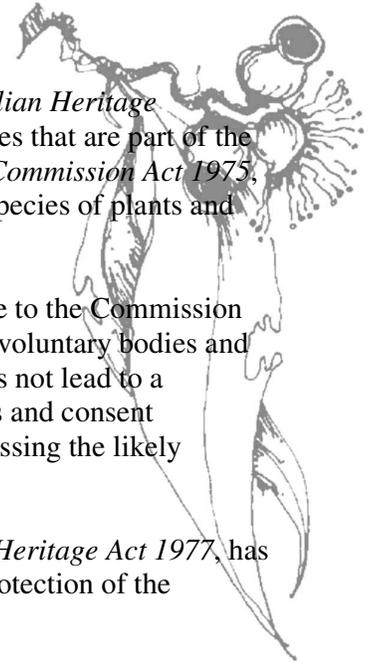
6.3.9 Register of the National Estate

The Australian Heritage Commission operates under the *Australian Heritage Commission Act 1975* to identify and maintain a register of places that are part of the 'National Estate'. In accordance with the *Australian Heritage Commission Act 1975*, potential national estate places include habitats of endangered species of plants and animals (Bates 1992).

Nominations for the Register of the National Estate can be made to the Commission by State governments and their departments, local government, voluntary bodies and individuals. Under Commonwealth legislation the Register does not lead to a preservation order, but rather, directs the attention of developers and consent authorities to the need to address heritage considerations in assessing the likely impacts of developments or activities (Bates 1992).

The Heritage Council, established under the New South Wales *Heritage Act 1977*, has specific responsibilities for the registration, conservation and protection of the environmental heritage of New South Wales (Bates 1992).

Significant Koala habitat areas in the Campbelltown LGA should be considered for potential nomination for inclusion on the Register of the National Estate.



7. HABITAT RESTORATION

7.1 Introduction

In the absence of careful management, the remaining Koala habitat areas have the potential to become further degraded and fragmented to the detriment of Koalas and other native species. Existing land management strategies and practices rarely relate specifically to the restoration of Koala habitat. Consequently, a management strategy is considered necessary to identify principal impacts associated with land degradation and to outline opportunities to optimise Koala habitat quality within the Campbelltown LGA. Furthermore, as the resources for restoration works are finite, it is essential that areas be prioritised to ensure the maximum possible benefit of habitat restoration efforts to Koala conservation.

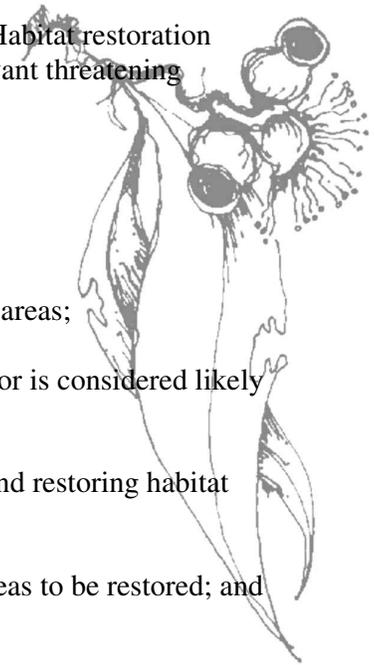
Koala habitat restoration projects in the Campbelltown LGA will need to involve a range of activities including revegetation (plantings), assisted regeneration (*e.g.* control of weeds; fencing to exclude livestock) and reconstruction. Selection of the most suitable approach for different sites will depend upon the specific requirements to achieve recovery of the vegetation communities. Assisted regeneration techniques are most appropriate where natural recovery potential is high, whilst more intensive revegetation and reconstruction activities may be necessary in more heavily cleared and disturbed areas where the potential for natural recovery is low (Greening Australia 1999). Habitat reconstruction as defined by Saunders and Hobbs (1995) involves recreating the ecological requirements of the target species. For Koalas this will include revegetation with suitable trees for food, shelter and social interaction. However, Saunders and Hobbs (1995) maintain that habitat reconstruction means more than simply replanting vegetation. It also involves facilitating the restoration of other ecosystem components and processes that are vital to ecosystem function (see the Habitat Restoration Chapter in the CKPoM [See notes](#)). Thus, the restoration of Koala habitat should

ideally involve more than simply replanting suitable species of trees. Habitat restoration projects should also involve measures to ameliorate impacts from relevant threatening processes.

7.2 Objectives

The objectives of this chapter are to:

- i) Identify principal impacts of land degradation on Koala habitat areas;
- ii) Identify areas where degradation to Koala habitat has occurred or is considered likely to occur;
- iii) Identify and discuss appropriate means of addressing impacts and restoring habitat values;
- iv) Detail criteria to be used to derive a prioritised list of habitat areas to be restored; and
- v) Identify means of implementing Koala habitat restoration.



7.3 Impacts on Koala Habitat Areas

7.3.1 Koala Habitat Destruction, Degradation and Fragmentation

Clearing of Native Vegetation was listed in September 2001 as a 'Key Threatening Process' in NSW under the *Threatened Species Conservation Act 1995*.

Habitat destruction and degradation have devastating effects on populations of Koalas and other fauna. As well as potential death or injury to Koalas during habitat clearing, habitat destruction and degradation is likely to increase pressure on adjacent habitat as remaining animals are confined to smaller areas, with individuals forced to live under sub-optimal conditions. The long term effects on Koala populations may include increased incidence of disease and mortality, and in severe cases, potential localised extinctions.

Habitat fragmentation can have significant implications for Koalas and other fauna populations due to deleterious effects of inbreeding and increased threats from domestic and feral dogs, foxes, motor vehicles and bushfires. Hume (1990) contends that habitat fragmentation is the primary threat to Koalas. In addition to the aforementioned deleterious effects, Koalas occupying fragmented habitat may also suffer nutritional stress, rendering them more susceptible to disease (Hume 1990).

7.3.2 Feral Animals

Feral animals including dogs, foxes, cats, goats and others are known to inhabit the Campbelltown LGA. Feral animals, particularly feral dogs and foxes and to a lesser extent feral cats, are considered a threat to Koalas and are addressed in the Feral Animal Management Chapter.

The impact of feral animals such as dogs and foxes on Koalas is exacerbated when

habitat is fragmented, as Koalas are forced to spend more time on the ground moving between trees, thus making them more vulnerable to predation (Hume 1990). Hence, restoration of fragmented habitat, in conjunction with measures aimed at controlling feral animals, should help to reduce the impact of feral animals on Koalas.

7.3.3 Weed Infestation

Weeds could potentially impact on Koala habitat by inhibiting natural germination and regrowth of native plant species including Koala food trees and by affecting soil nutrient availability. The colonization of Koala habitat by infestations of weeds, particularly ground cover weeds can inhibit the germination and growth of native plant seedlings. Exotic grasses often replace native shrubs in areas where fires are frequent and tend to exclude the regeneration of native species. The impact of restricting future generations of Koala food trees from colonizing a site involves the habitat being dominated by senescing trees with limited or no replacement Koala food trees. The implementation of a weed control program to restore degraded Koala habitat will assist in providing an essential food source for Koalas in the long term.

Campbelltown City Council is currently in the process of implementing a Weed Management Strategy for the LGA.

7.3.4 Bushfires

Severe bushfires have the potential to significantly affect Koala habitat and Koala populations. Changed fire regimes can have a detrimental effect on Koala habitat. Regular wildfire or hazard reduction burning can reduce or eliminate the growth of seedling Koala food trees therefore leaving areas with only mature eucalypts remaining and no replacement trees (as per weeds). Fire tolerant species could eventually dominate and lead to changes in the plant community.

Habitat fragmentation can exacerbate the harmful effects of bushfires, with recolonisation of severely burnt habitat by Koalas made difficult, or in some cases impossible, where these areas are isolated from unburnt habitat supporting breeding aggregations of Koalas.

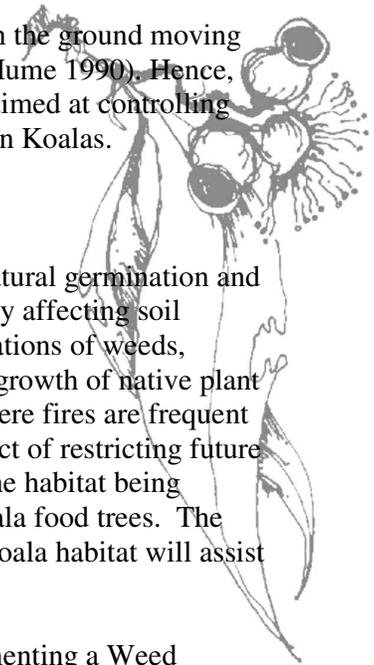
7.4 Areas of Habitat Degradation

The most obvious degradation of Koala habitat within the Campbelltown LGA has resulted from agricultural and urban development and the provision of services such as roads, water, sewage and electricity.

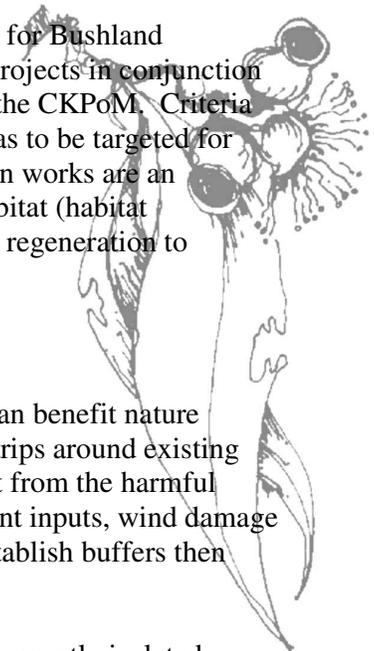
While the long-term survival of Koalas within urban environments is questionable, Koalas do currently exist in and/or adjacent to the Wedderburn, Kentlyn and Minto Heights urban areas.

7.5 Criteria for Identification and Prioritisation of Areas for Restoration

Priority must be given to those restoration projects that are likely to maximise the benefit to Koala conservation in the Campbelltown area. The development of a prioritized list of habitat areas to be restored will be a time consuming task, due to the many different criteria which need to be considered, and the level of detail which should be included. It is proposed that the



Campbelltown City Council Interdepartmental Committee, responsible for Bushland Regeneration and Restoration, develop a prioritised list of restoration projects in conjunction with the UWSM and the Australian Koala Foundation for inclusion in the CKPoM. Criteria which would need to be considered to develop a detailed list of the areas to be targeted for habitat restoration are outlined below. As noted previously revegetation works are an essential tool for linking fragmented habitat and expanding existing habitat (habitat restoration). Restoration by way of weed control to provide for natural regeneration to replace mature eucalypts in existing habitat is also essential.



7.5.1 Intended Aims of Revegetation Works

Hobbs (1993) identifies four ways in which revegetation works can benefit nature conservation. Firstly, revegetation can be used to create buffer strips around existing remnants of native vegetation. This serves to protect the remnant from the harmful effect of external factors (known as ‘edge effects’) such as nutrient inputs, wind damage and weed invasion. Additionally, if native species are used to establish buffers then they can also provide extra habitat.

Secondly, revegetation can aim to re-establish linkages between currently isolated habitat patches. Linking patches of habitat has the potential to ameliorate some of the detrimental effects of habitat fragmentation, for example by facilitating the exchange of genetic material between sub-populations and thus reducing the chance of inbreeding, by allowing fauna access to additional resources, or by facilitating the dispersal of sub-adult Koalas and recolonisation of unoccupied habitat. High priority will be given to projects aimed at restoration of areas identified as linking habitat in the Koala Habitat Planning Map (see Figure 15).

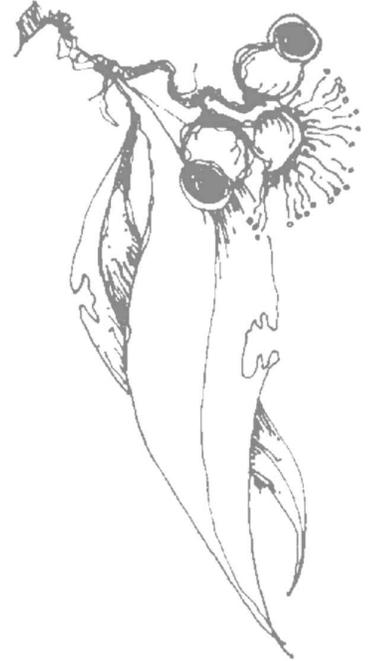
These areas are likely to play a significant role in the long-term conservation of Koala populations within the LGA, including those that occupy otherwise fragmented habitat.

Thirdly, revegetation can be used to extend existing habitat. This is done to a degree by establishing buffers and links but could for example also increase the number of trees available for use by Koalas for food and/or shelter.

Finally, revegetation can be aimed at enhancing the quality of existing habitat, both to increase its worth as habitat and to stop the encroachment of land degradation such as dieback, soil salinisation, and soil erosion, thus helping prevent any further decline in habitat quality.

The habitat restoration program established by the CKPoM will include revegetation works that attempt to address each of these four aims. Each of these aims, if achieved, has the potential to contribute to the conservation of the Campbelltown Koala population. Revegetation works could address an individual aim, or may address several aims concurrently. There may be circumstances where preference needs to be given to one aim over another; for instance it may be desirable to use resources to enhance the quality of existing habitat ahead of restoring links between habitat areas. Priority should be given to those works that have greatest potential long-term benefit to the Campbelltown Koala population. A list of suitable species for planting, based upon native species present in nearby Koala habitat, should be prepared for each site where revegetation (plantings) will be a necessary component of the restoration activities.

FIGURE 15 GOES HERE



7.5.2 Size of Habitat Patches

Notwithstanding the influence of preferred browse species, it makes intuitive sense that for patches of similar habitat, larger patches will have the potential to support greater numbers of Koalas than smaller patches. Given this, revegetation aimed at enhancing, buffering, adding to or linking larger remnants will generally be given priority over smaller remnants. However, there may be instances when several small habitat patches collectively have the same potential to support Koalas as a single large patch of similar size. Under such circumstances priority would be assigned using other criteria, for example the effort required for restoration (see section 7.5.7)

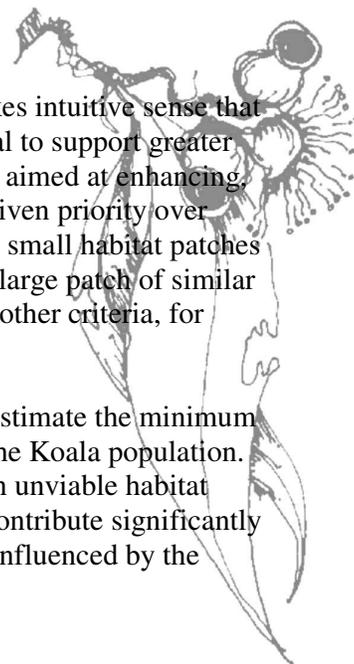
In assessing the significance of patch size it will be important to estimate the minimum viable patch size with the potential to be utilised by members of the Koala population. This would contribute to ensuring that resources are not wasted on unviable habitat areas. Data on home range sizes collected by the UWSM could contribute significantly to this process. Determination of a minimum viable area will be influenced by the nature and quality of the habitat in the first instance.

7.5.3 Shape of Habitat Patches

The shape of habitat patches is important as it determines the perimeter to area ratio, which in turn usually influences the impact of edge effects. Patches with a high perimeter to area ratio, for example long and narrow patches, are usually subject to greater edge effects than those with lower ratios. Patches that are more susceptible to edge effects will generally require more active management and in extreme cases will not be viable over the long term.

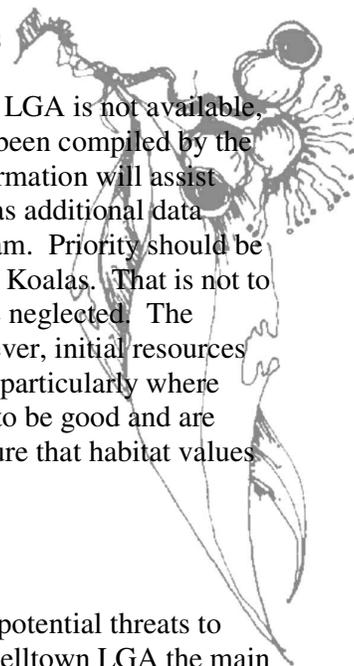
7.5.4 Type of Koala Habitat

The types of Koala habitat that comprise a remnant need to be considered when assigning priority to restoration works, as different habitat types will vary in their value to the long-term conservation and management of Koalas. Koala habitat categories identified for the Campbelltown LGA in order of decreasing importance to Koalas include: Secondary Habitat (Class A), Secondary Habitat (Class B), Secondary Habitat (Class C) and Marginal Habitat. Priority for restoration works should be given where this involves remnants containing Secondary Habitat (Class A) and Secondary Habitat (Class B), collectively referred to as Preferred Koala Habitat, over those containing Secondary Habitat (Class C), which in turn should be given priority over remnants containing Marginal Habitat. Where two remnants both contain a particular type of habitat, especially Secondary Habitat (Class A) and/or Secondary Habitat (Class B), priority should be assigned on the basis of the extent and shape of the respective habitat types; *e.g.* restoration works involving a remnant with a larger area of Secondary Habitat (Class A) would be ranked higher than that involving a remnant with a smaller area of Secondary Habitat (Class A). Again, exceptions to this rule may occur for example where several small patches of Secondary Habitat have the potential to be effectively linked through restoration.



7.5.5 Size of Koala Population/Presence of Extant Populations

Whilst a precise Koala population estimate for the Campbelltown LGA is not available, substantial data concerning the distribution of the population has been compiled by the UWSM, the Australian Koala Foundation and Council. This information will assist with initial priority setting for restoration works and refinements as additional data becomes available via UWSM and the CKPoM monitoring program. Priority should be given to works that would be likely to benefit a greater number of Koalas. That is not to say that habitat that does not support extant populations should be neglected. The existence of vacant habitat may prove crucial in the future. However, initial resources should be directed to those patches that currently support Koalas, particularly where prospects for long term survival of the population are considered to be good and are likely to be significantly enhanced by restoration activities to ensure that habitat values are maintained.



7.5.6 Presence of Threats to Koalas

When planning revegetation works it is necessary to consider the potential threats to Koalas when they use replanted areas in the future. In the Campbelltown LGA the main threats to be considered in this regard are habitat destruction which involves the removal of key food resources, continuing urban and/or semi-rural encroachment into or adjacent to significant areas of Koala habitat, bushfire, motor vehicles, and roaming domestic/feral dogs. Revegetation works may in fact be detrimental to Koalas if they increase the risks associated with such threats. For instance, revegetation works that involve the planting of trees in the vicinity of a major road could result in more Koalas being hit by motor vehicles. Similarly, plantings that attract Koalas to urban areas may result in a greater number of dog attacks on Koalas. The latter problem should be addressed by programs aimed at minimising threats to Koalas associated with domestic dogs. The former problem is probably best managed by avoiding revegetation works in the immediate vicinity of major roads.

7.5.7 Effort Required for Restoration

In deciding how best to allocate resources to restoration works consideration needs to be given to the effort that will be required to achieve the goals of each project. The effort required will depend on the goals that are set (see section 7.5.10 for further discussion on goals), and will also be a function of the degree of modification that has occurred to the area in question (Hobbs and Hopkins 1990). Areas in which ecosystems have been highly modified will require greater effort for restoration than those that have been modified to a lesser degree (*e.g.* by partial clearing, or lesser still, by changed fire or grazing regimes; Hobbs and Hopkins 1990). Thus, a decision has to be made on whether resources are used to redress less substantial modifications at a number of locations, or to address instances where the degree of modification has been high in fewer locations, or a combination of the two.

7.5.8 Current Land Tenure and Land Use Zoning

Current land tenure is an important factor to consider as this will ultimately determine whether planned restoration works can be carried out. Decisions on which works should be given priority should be made on the basis of other criteria, but recourse

should be made to the land tenure to establish whether permission for works can be obtained, whether the land owner or land management agency can assist with the works, and importantly who will be responsible for the ongoing maintenance of any plantings or weed control. Long-term security of restored areas will also be a critical issue. In some cases, private landowners may be prepared to establish either a Voluntary Conservation Agreement under the *National Parks and Wildlife Act 1974* or a Property Management Agreement under the *Native Vegetation Act 1997*.

Land use zonings also need to be considered. The benefit of restoration works could be compromised, or rendered totally ineffective, if for instance, future development occurs in those areas. Thus, priority should be given to areas where the land use zoning is unlikely to result in future development and consequent degradation of restored habitat.

7.5.9 Pre-European Vegetation of the Area

Historical studies that give insight into the distribution of plant communities prior to European settlement need to be considered for at least two reasons. Firstly, they provide guidance on where certain species should be planted, which is needed if revegetation is aimed to restore the mosaic of plant communities that existed before European settlement. Secondly, these studies can be used to estimate the extent to which habitat areas were connected in the past. This has important long term implications when considering the reestablishment of links between habitat areas, due to potential detrimental effects on population genetics when two previously isolated populations of a species are connected (Soule and Gilpin 1991).

7.5.10 Other Considerations

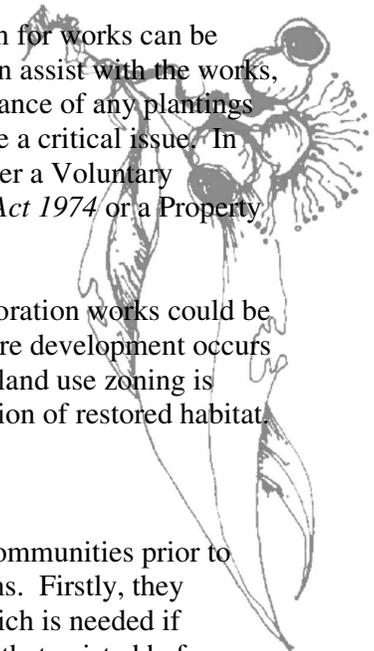
There is a need to define the goals of each restoration project (Hobbs and Hopkins 1990). In particular, a decision needs to be made on whether the goal is to restore the ecosystem to what it was prior to modification, which would perhaps be of greater benefit to other species and in addressing land degradation generally. Alternatively, the goal may be species-specific, *i.e.* to restore Koala habitat. Consideration also needs to be given to what goals are achievable (Hobbs and Hopkins 1990).

Monitoring should be undertaken wherever possible to evaluate the success and cost effectiveness of restoration projects.

7.6 Co-ordination of Habitat Restoration

Effective habitat restoration is generally very labour intensive, requiring a substantial number of dedicated people. People who may be able to assist with habitat restoration programs include community and school groups, landcare groups such as Friends of Smith's Creek, people directed to carry out community service, ecotourism groups, and employment programs such as the Federal Government's Green Corps and Work for the Dole programs.

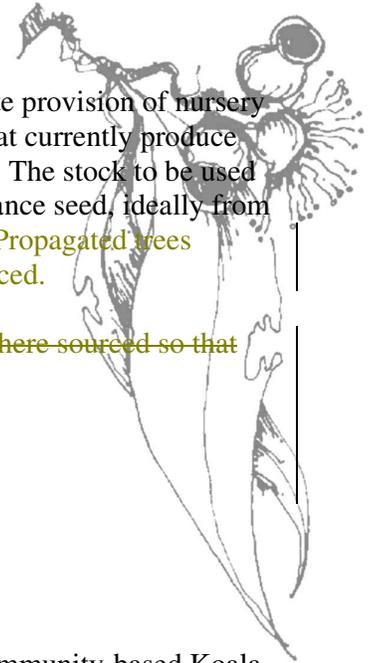
At present Campbelltown City Council employs one part-time Bushland Regenerator.



7.7 Provision of Nursery Stock

In order to undertake the necessary habitat restoration work, an adequate provision of nursery stock will be required. Existing nurseries and/ or community groups that currently produce tubestock could be approached to provide suitable species for planting. The stock to be used for restoration projects should ideally be propagated from local provenance seed, ideally from trees that are known to be favoured by Koalas in the local population. **Propagated trees should be planted in the same locality in which the seed stock was sourced.**

~~Propagated trees should be labeled with identification of the location where sourced so that they can be matched with restoration projects in the same locality.~~



8. TRAFFIC MANAGEMENT

8.1. Introduction

A total of 478 of the 584 respondents (81.8%) to the Campbelltown Community-based Koala Survey (1997) indicated that they would support 'Traffic Restrictions' to help conserve Koalas in the Campbelltown LGA.

The management strategies addressed in this chapter aim to reduce the risks of Koalas being struck and killed or injured on roads within the LGA.

8.2. Objectives

The objectives of this chapter are to:

- i) Identify roads and/or sections of roads within the Campbelltown LGA where Koalas are known to cross and/or be hit by traffic; and
- ii) Detail relevant management strategies and recommendations to reduce the risk of Koala road fatalities and increase community awareness.

8.3 Information on Koala Road Mortality

Twenty-one of the 584 people (3.6%) who responded to the Campbelltown Community-based Koala Survey (1997) reported having seen a Koala dead on a road within the Campbelltown LGA. A total of 16 records of Koalas killed by cars were marked on a map covering the Campbelltown LGA, along with 2 records of Koalas spotted on roads (these records include those supplied by the UWSM). The mapped records of Koalas killed on roads included one in 1989, one in 1994, one in 1995, four in 1996, three in 1997 and one in 1998. The remaining four records were undated (see Figure 16).

The Campbelltown community-based Koala survey produced nine reports of Koala road fatalities for the LGA that were additional to those previously recorded by SMWS and the UWSM.

All records of traffic collisions with Koalas within Campbelltown LGA that have been compiled for the CKPoM have resulted in the death of the Koala involved.

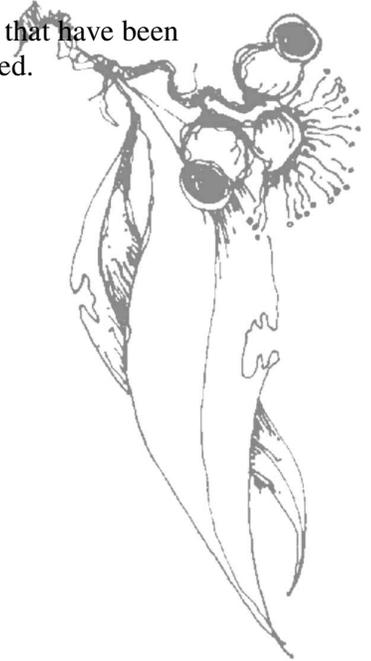
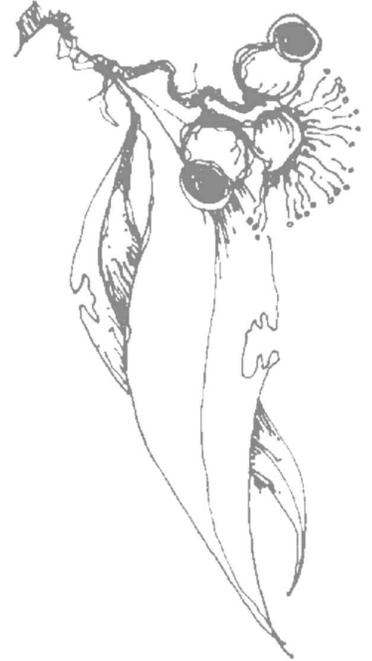


FIGURE 16 GOES HERE



The significance of the impact of road fatalities is likely to be greater than might otherwise be suggested by the data, due to the low density and estimated small size of the remaining local Koala population.

8.3.1 Peak Collision Period

Koalas are likely to be most active in terms of movements within their home range during the breeding season from approximately August to February. During this period the number of Koalas hit by cars tends to increase, as was demonstrated with respect to the Port Stephens Koala population in the *Draft Koala Management Plan* (1994).

8.4 Relationship between Koala Fatalities and Traffic Speed

The available data set for the Campbelltown LGA is too small to permit any conclusions with respect to Koala fatalities and traffic speed. However, data analyses undertaken in conjunction with the Port Stephens CKPoM suggested that the greater the speed of the vehicle, the less the likelihood of a Koala surviving a collision. Evidence from Port Stephens and Campbelltown suggest that the majority of collisions will result in death of the Koala, despite the designated traffic speed.

Other factors are considered likely to influence the chance of Koalas being hit while attempting to cross a road. These factors include features of the roadside environment such as the width of the cleared zone between the road edge and adjacent trees, the width of gravel shoulders, the presence of roadside drains, the height of roadside vegetation, the degree of habitat disturbance in adjacent areas, and the nature of any roadside lighting. These factors may affect driver ability to see a Koala before it attempts to cross onto the roadway.

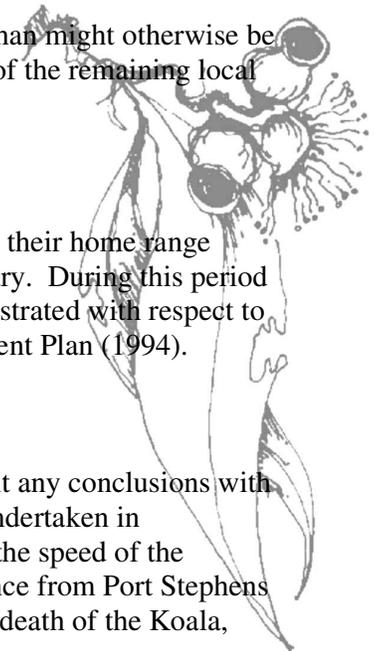
8.5 Disturbance to Habitat

Habitat disturbance may result in Koala movements beyond that associated with normal home ranging behaviour. This might include efforts to re-establish contact with other members of the local population or to satisfy nutritional requirements. Such forced movement may involve road crossings and subsequent conflict with vehicles.

8.6 Identification of Collision Areas

Concentrations of two or more Koala road fatalities were recorded on Wedderburn Road, Georges River Road between Old Kent Road and Peter Meadows Road, on Peter Meadows Road approaching the intersection with Junction Road, on Hansens Road and on Appin Road. In addition, one Koala road kill was recorded on Aberfoyle Road, and one on the road between Old Kent Road and Hamilton Road (see Figure 16). Each of the aforementioned sections of roadway either pass through Preferred Koala Habitat or occur within identified Habitat Linking Areas.

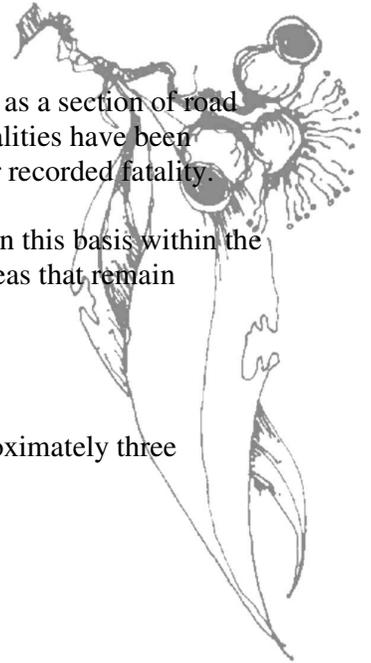
Interpretation of the above information in conjunction with the Koala Habitat Planning Map has allowed a number of apparent black spots, conflict areas and potential problem areas to be identified.



8.6.1 Koala Black Spots

Although difficult to quantify, a Koala Black Spot is defined here as a section of road that carries a relatively high traffic volume, where Koala road fatalities have been recorded within approximately one kilometre or less from another recorded fatality.

The following four Koala Black Spot areas have been identified on this basis within the Campbelltown LGA (see Figure 17). There may be other such areas that remain undetected due to an absence of records.



1. Wedderburn Road

Five Koalas were reported killed on Wedderburn Road over approximately three kilometres south from the Georges River.

This section of road is characterised by:

- i) Preferred Koala Habitat in the vicinity.
- ii) Identified Habitat Linking Area.
- iii) Both 60 km/h and 70 km/h Speed Zones.
- iv) Poor roadside clear zones in a number of areas.

2. Georges River Road

Two Koalas were reported killed on Georges River Road over approximately one kilometre between Old Kent Road and Peter Meadows Road.

This section of road is characterised by:

- i) Adjoining Preferred Koala Habitat as well as linking habitat in the north.
- ii) A Speed Zone of 60 km/h.
- iii) Poor roadside clear zones in places.

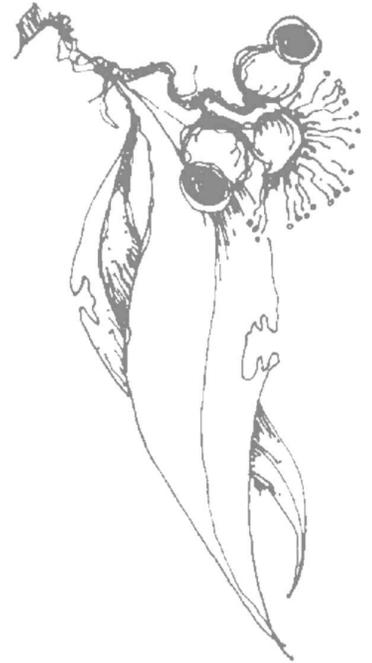
3. Peter Meadows Road

Two Koalas were reported killed on Peter Meadows Road over approximately one kilometre approaching the intersection with Junction Road and Hansens Road.

This section of road is characterised by:

- i) Adjoining Preferred Koala Habitat as well as linking habitat in the north.
- ii) A Speed Zone of 80 km/h.
- iii) Poor roadside clear zones in places.

FIGURE 17 GOES HERE

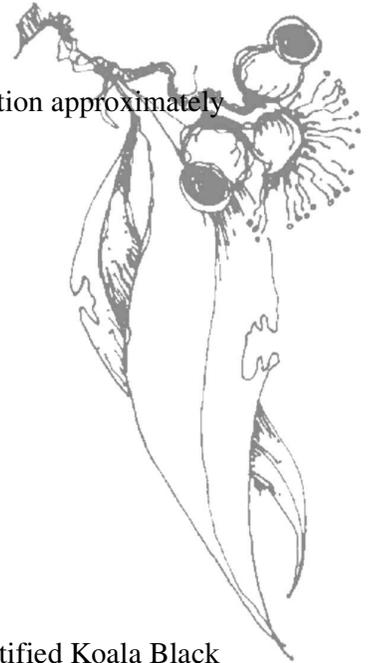


4. Appin Road

Two Koalas were reported killed on Appin Road in the same location approximately one kilometre to the north of the LGA boundary.

This section of road is characterised by:

- i) Preferred Koala Habitat in the vicinity.
- ii) Identified Habitat Linking Area.
- iii) A Speed Zone of 90 km/h.
- iv) Poor roadside clear zones in a number of areas.



8.6.2 Conflict Areas

A Conflict Area is defined as a section of road, other than an identified Koala Black Spot, not less than 500m either side of a recorded Koala road fatality. The following two Koala Conflict areas have been identified on this basis within Campbelltown LGA (see Figure 17).

- ❖ Aberfoyle Road (near the Wedderburn Road intersection).
- ❖ See notes

8.6.3 Potential Problem Areas

A Potential Problem Area is defined as a section of road that carries a relatively high traffic volume where no Koala road fatalities have been recorded, but which passes through or adjacent to Preferred Koala Habitat or Habitat Linking Areas (see Figure 17).

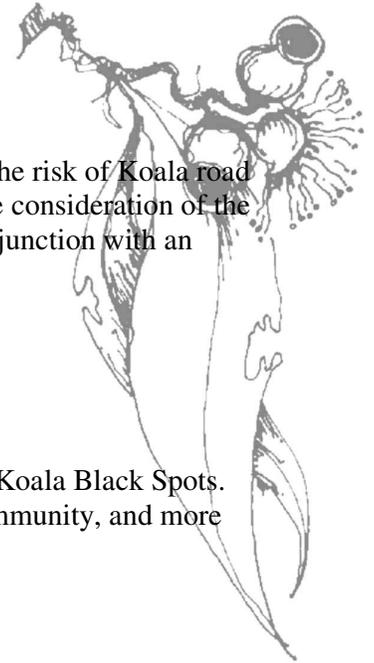
These include the following:

- ❖ Hansens Road north from the intersection with Peter Meadows Road.
- ❖ The area of Georges River Road not mentioned above.
- ❖ Wedderburn Road north from the Georges River onto Greengate Road and the eastern section of Riverside Drive.
- ❖ The area of Aberfoyle Road not mentioned above.
- ❖ Minerva Road north from around 1km north of Victoria Road.
- ❖ Blackburn Road.
- ❖ Lysaghts Road south from Blackburn Road.
- ❖ Appin Road from approximately 1km north of the LGA boundary for a distance of

around 4km.

8.7 Management Strategies

A number of potential management strategies could be used to reduce the risk of Koala road fatality or injury. Determination of the appropriate strategy will require consideration of the characteristics of adjacent habitat and the roadside environment, in conjunction with an assessment of the management options.



8.7.1 Management Options

i) Fatality Signs

Signs may be used to highlight Koala road fatalities in identified Koala Black Spots. Fatality signs should be updated annually in order to keep the community, and more specifically drivers, informed of the known impact.

ii) Wildlife Reflectors

The authors consider it unlikely that wildlife reflectors would provide an effective means of reducing Koala road mortality. These reflectors, which are fixed to guide posts, were originally developed in Europe where deer present a major traffic management problem. The most suitable height to position reflectors for Koalas has not been determined.

iii) Koala Warning Signs

In urban areas of Port Macquarie the Koala warning sign design illustrates a Koala sitting in a tree. More recent designs, such as those used in Coffs Harbour and Port Stephens, illustrate a Koala walking along the ground. The impact of Koala warning signs might be enhanced by painted sections across the roadway to designate the start and end of identified high Koala risk areas.

iv) Exclusion Fencing

A number of designs have been developed for Koala exclusion fences. One design consists of a flat metal surface facing away from the road, with fence support structures on the side closest to the road.

A design trialled in Southeast Queensland involved cyclone mesh fencing supported firmly at the base and left floppy at the top. In parts of Northern NSW cyclone mesh fencing has been used with a metal strip attached near the base.

Potential problems associated with exclusion fencing include the following:

- ❖ Exclusion fences contribute to habitat fragmentation which may lead to reductions in genetic diversity, increased vulnerability to disease and bushfires, and reduced long-term viability of Koala populations;

- ❖ Exclusion fences would act as a barrier to other species of native fauna;
- ❖ Exclusion fences could prevent other fauna from escaping bushfire;
- ❖ Exclusion fences would be impractical where there are a number of property accesses as the design requires a continuous fence-line; and
- ❖ Exclusion fences could inhibit access to adjacent bushland for fire fighting.

v) **Road Crossings**

Road crossing strategies attempt to direct or regulate Koala crossings of roads. Four potential methods are available:

- ❖ Koala underpasses;
- ❖ Koala crossings; and
- ❖ Koala overpasses and road bridges that span habitat.

Koala Underpasses

Current fauna underpass designs often consist of 1.5m to 2m diameter pipes. Larger box-style culverts of up to around 3m by 3m have been installed on sections of road in several areas of NSW. Koala-proof fencing is generally used in an attempt to direct Koalas to underpasses for road crossing.

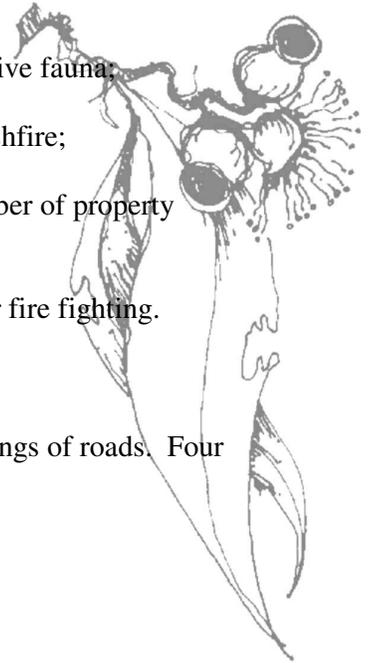
The long-term effectiveness of underpasses has yet to be determined. As arboreal mammals, Koalas are considered unlikely to enter a narrow pipe under a road. Prevett (1991) argues that Koalas are highly dependent upon smell and may be deterred if other animals such as foxes or dogs, or a dominant male Koala use the underpass.

Koala Crossings

Koala crossings are also largely untried. Like underpasses and bridges, they may necessitate the use of exclusion fencing to direct Koalas to a control point on the road for crossing. This method would reduce the length of road that could be crossed, and could be coupled with appropriate signs, slow speed zones and road markings at Koala crossings. This could potentially result in a reduction in collisions with Koalas. In some cases it may be possible to identify road sections where Koalas are most likely to cross due to the location of adjoining habitat. It may be feasible to install slow speed zones or other measures at these locations.

Koala Overpasses and Road Bridges

Koala overpasses and bridges used to span habitat are also considered worth trialling. These methods would involve greater expense in comparison to other methods and are therefore unlikely to be feasible for existing roads. However, these options should be considered when new roads are planned for areas where there is no practicable



alternative to crossing significant Koala Habitat areas. The Road Bridge option may be cost effective if considered in conjunction with drainage requirements.

vi) Speed Reduction

As indicated earlier, the proportion of Koala fatalities from vehicle collisions appears to decrease with reductions in the speed zone.

Speed reductions would need to incorporate the following:

- ❖ Agreement/consent from the Roads and Traffic Authority;
- ❖ Endorsement from the Police Department who would be responsible for enforcing reduced speed limits;
- ❖ Extensive public consultation and media coverage to ensure community awareness and support; and
- ❖ Appropriate sign posting.

A successful media campaign and public exhibition would be critical to inform drivers and to promote community acceptance of speed reduction. A less preferred option in this regard would be to use speed advisory signs similar to those used for road bends, crests and curves. In some instances speed reductions could be facilitated with the introduction of appropriate vehicle calming devices such as speed humps or chicanes.

vii) Roadside Clearance

The amount and height of vegetation on the side of roads is likely to have an effect on Koala collisions. A cleared roadside verge may allow Koalas to be seen by drivers at an earlier stage, thus increasing the likelihood of avoiding a collision.

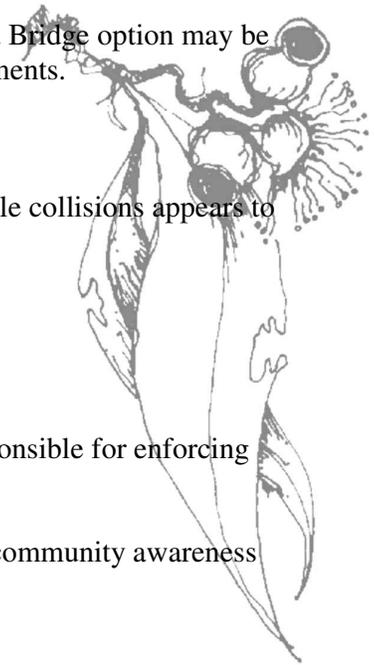
This strategy could be implemented by regular slashing of roadside areas.

viii) Injured Wildlife Information Signs

When a Koala or any native animal is hit by a vehicle and survives, it is important that the animal receives quick and appropriate attention. One method of informing people of appropriate action and contacts when they encounter injured fauna is to provide roadside information signs.

ix) Street Lighting

Improving driver visibility is a further means of minimising Koala road fatalities in known risk areas. The installation of suitable lighting to illuminate the roadway would aim to increase driver response time in the event of an animal venturing onto the road.



9. DOG MANAGEMENT

9.1 Introduction

As of April 1st 2001 there were approximately 18,000 registered dogs in the Campbelltown LGA, although the actual number of domestic dogs within the area is likely to be considerably greater. Irresponsible dog ownership potentially results in substantial numbers of uncontrolled, roaming domestic dogs. These roaming dogs, particularly large dogs and dog packs, pose a significant threat to Koalas that occupy habitat within and adjacent to urbanised areas.

9.2 Objectives

The objectives of this chapter are to:

- i) Minimise the risk of dog attacks on Koalas;
- ii) Increase public awareness of the problem of dog attacks on native fauna; and
- iii) Promote responsible dog ownership.

9.3 Reports of Dog Attacks on Koalas

The Campbelltown community-based Koala survey (plus UWSM records) produced 4 reports of dog attacks on Koalas in the LGA, which included a mother and joey. All four of these Koalas reportedly died as a result of the attacks (see Figure 18).

Campbelltown City Council and the local Wildlife Information and Rescue Service (WIRES) or Sydney Metropolitan Wildlife Service ?? have also advised of several instances where dogs were reportedly harassing Koalas within urban areas of the Campbelltown LGA.

9.4 Management Strategies

It would be unrealistic to contend that dog attacks on Koalas could be totally eradicated. The most effective method of minimising dog attacks is considered to be through the promotion of *responsible dog ownership*. A strategy to promote responsible dog ownership should involve the following:

- i) Community education regarding the importance of responsible dog ownership;
- ii) Establishment of a set of community standards to define and help to promote and regulate responsible dog ownership; and
- iii) Establishment of a penalty system to reflect community attitudes to irresponsible dog ownership.

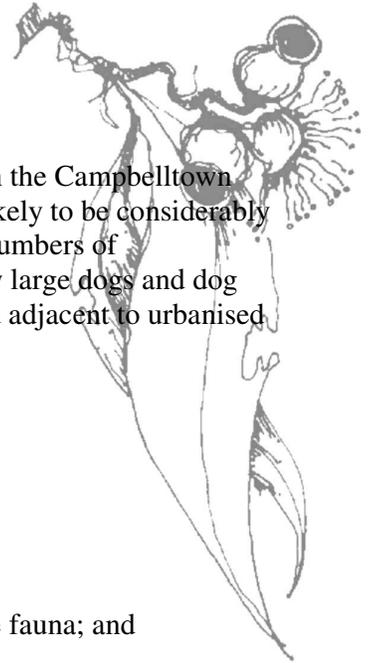
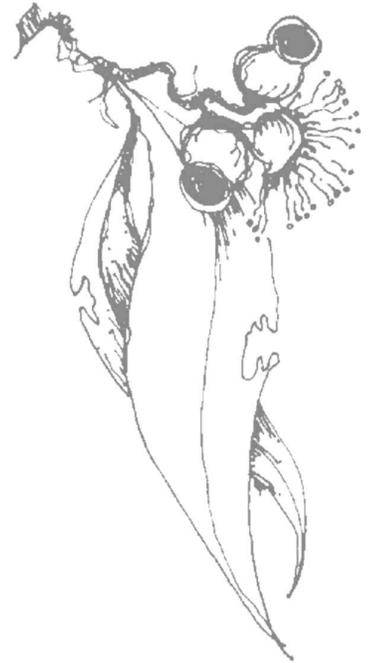


FIGURE 18 GOES HERE



The following management strategies are available to Council:

- ❖ Dog Control through enforcement of the *Companion Animals Act 1998*;
- ❖ Preparation of a Local Companion Animal Management Plan;
- ❖ Provision of dog exercise areas; and
- ❖ Establishment of a targeted education program.

9.4.1 *Companion Animals Act 1998*

This *Companion Animals Act 1998* repealed both the *Dog Act 1966* and the *Dog Regulation 1997*. Most of the provisions of the *Dog Act 1996* were transferred, with some being updated and amended.

Council is responsible for the administration and execution of the *Companion Animals Act 1998*, which includes the carrying out of patrols, impounding strays, seizing animals where an offence has occurred and undertaking to sell or destroy dogs not claimed.

It is clearly legislated that dogs should be either contained within the boundaries of the owner's property or be under effective control by means of a chain, cord or leash when in a public place. Despite this legislation and continual press reports outlining the problems, some owners still allow their dogs to roam free. The irresponsible actions of these owners can result in problems such as dogs defecating on other people's property, attacking and injuring people or animals (including native fauna), causing a traffic hazard or causing a general nuisance.

The economic and environmental costs associated with irresponsible dog ownership are incurred by Council and the community.

With respect to Koalas and other native or introduced animals, the following sections of the *Companion Animals Act 1998* are particularly relevant:

- ❖ The owner of a dog is guilty of an offence under Part 3, Division 1, Section 16 of the *Companion Animals Act 1998* if the dog rushes at, attacks, bites, harasses or chases any person or animal (other than vermin), other than on the property on which the dog was being kept.
- ❖ If a dog attacks or bites any person or animal (other than vermin) other than under circumstances referred to in Section 16 (2), an authorised officer may, at any time within 4 hours afterwards, secure or seize the dog in accordance with Section 18. Any other person may seize the dog if it is on the property owned or occupied by the person.
- ❖ Under Part 3, Division 1, Section 13 of the *Companion Animals Act 1998* it is an offence for a dog to be in a public place (other than a designated off-leash area), unless under the effective control of a competent person by means of an adequate chain, cord or leash.



- ❖ A dog found in a public place, in contravention of Part 3, Division 1, Section 13 may be seized by any person. If the owner of the dog is present, the dog can only be seized by an authorised officer and only then if the contravention continues after the owner has been told of the contravention.
- ❖ A dog that has, without provocation, attacked or killed, or repeatedly threatened to attack or chase a person or an animal (other than vermin), can be declared dangerous by a council or a local court under Part 5, Division 1, Section 34 or under Part 5, Division 2, Section 44 of the *Companion Animals Act 1998*. The owner of a dog that is declared dangerous has greater responsibility to ensure that it is contained so as not to pose a threat to people and animals. If the owner breaches the conditions, Council can approach the Court to fine the owner, and/or destroy the dog and prohibit the owner from owning another dog.
- ❖ Under Part 3, Division 1, Section 23 of the *Companion Animals Act 1998* a Court that convicts a person of an offence under a number of provisions of the Act can order that the person is disqualified from owning a dog for a specified period.

It is considered important for the general public to be aware of these provisions so that the impact of domestic dogs on Koalas and other animals can be minimised.

In accordance with the *Companion Animals Act 1998* Council may elect to prepare a Local Companion Animal Management Plan to identify areas containing habitat of species, such as Koalas, that are vulnerable to predation by dogs (or cats). In such areas, special conditions can be developed to protect native species. These conditions could include for example the requirement that owners keep their dogs on their own properties at all times. Section 14 (1) (h) of the *Companion Animals Act 1998* provides for the designation of specific public places as “Wildlife Protection Areas”, where dogs could be prohibited.

Chapter 5 of the CKPoM Resource Document identifies and categorises Koala habitat throughout the Campbelltown LGA. This provides the means to identify areas where special conditions could be imposed with respect to dog ownership in order to protect Koalas. Preferred and Supplementary Koala Habitat are considered the most important categories of habitat for the long-term survival of the Campbelltown Koala population. The following special conditions should therefore be considered with respect to Preferred and Supplementary Koala Habitat:

- ❖ Prohibition of dogs in public places containing Preferred Koala Habitat (as provided under s.14 (1) (h) of the *Companion Animals Act 1998*); and
- ❖ Enforcement of the following additional restriction on current dog owners: that an owner of a dog, upon becoming aware of the presence of a Koala on the owner’s property, restrain or confine the dog to protect the Koala until it has left the premises.

Legal Action

In order for legal action to be taken against the owner of a dog which rushes at, attacks, bites, harasses or chases a Koala (without provocation and outside of the property on which the dog was being kept), evidence has to be presented to the Court which proves beyond reasonable doubt that the incident occurred, and that the accused is the owner of the dog in question. This may involve the any one or more of the following:

- ❖ A witness to the attack who is prepared to give evidence in Court;
- ❖ The witness has to be able to recognise the dog;
- ❖ Although not essential, presentation of a Veterinarian's report confirming that the Koala was attacked by a dog; and
- ❖ Photographic evidence of the attack.

Dog Problem Areas

Dog problem areas have been identified from the recorded locations of dog attacks on Koalas within the Campbelltown LGA, and on the basis of advice from Campbelltown City Council regarding areas where dogs are known to roam uncontrolled.

These dog problem areas include the Scenic Protection areas of Kentlyn, Minto Heights, Long Point and the Rural and Scenic Protection areas of Wedderburn.

A particular problem involves the tendency of some dog owners to release their dogs at night to roam, which is difficult to police.

Impounding Officer

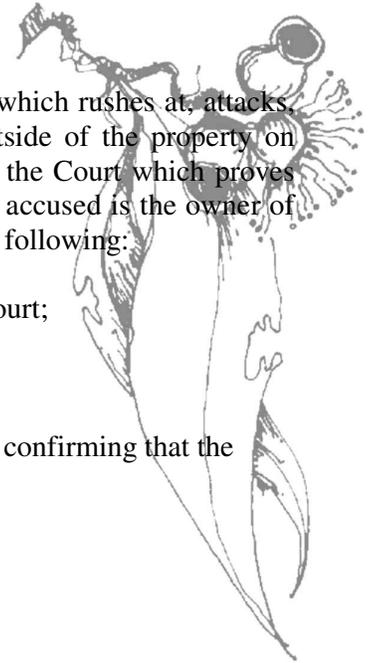
Campbelltown City Council Dog Control Officers are responsible for dog enforcement within the LGA. These officers are aware of a number of dog problem areas. The duties of the Dog Control Officers principally involve impounding stray or roaming dogs. Council Environmental Protection Officers also undertake public awareness campaigns within the LGA advocating dog desexing and responsible ownership of dogs.

People should be aware that they may take photographs or video recordings of a straying dog in a public place so that the owner can be located and appropriate action taken.

9.4.2 Dog Exercise Areas

Council has responsibility for the provision of public areas for dog owners to exercise their animals. However, it is important for these areas do not to conflict with Preferred or Supplementary Koala Habitat.

Dog attacks on Koalas usually result in serious injury and often death. It is important for Koala/dog conflict to be minimised in public reserves where Koala habitat exists.



There is currently one designated Dog Exercise Area in the Campbelltown LGA. This area is located on Eagleview Road at Ingleburn. Council is also considering the possibility of designating two further areas; one in Raby and one in the southern suburbs of Campbelltown.

Signposting at public reserves is an important means of advising people whether dogs are allowed and if so under what restrictions. It is considered important for signs at each reserve where dogs are prohibited, to advise of the nearest reserve where dogs are allowed.

9.4.3 Education

The role of education in promoting responsible dog ownership cannot be overestimated. The *Companion Animals Act 1998* requires all councils to establish an Animal Management Committee and to prepare Local Companion Animal Management Plans. The *Companion Animals Act 1998* makes provision for Councils to raise revenue to successfully implement their local plans. Such revenue may potentially enable the employment of additional staff and the development of improved education programs.

Press releases should be issued prior to the Koala breeding season. Publicity should also be sought when a series of dog attacks occurs and when an owner has been successfully convicted as result of a dog attack on a Koala.

10. FERAL ANIMAL MANAGEMENT

10.1 Introduction

The Campbelltown LGA is known to contain a range of feral animal populations including wild dogs, foxes, cats, rabbits and goats. It is likely that feral animals currently affect land administered by each of the principal land management agencies and organisations, as well as private lands within the Campbelltown LGA.

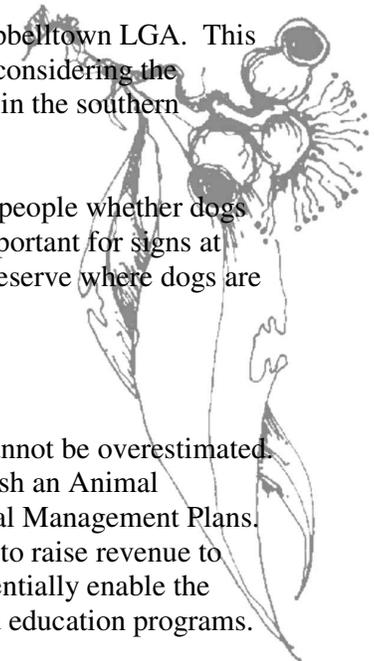
The principal land management agencies in the Campbelltown LGA include Campbelltown City Council, Sydney Water, the **Department of Land and Water Conservation**, and the Australian Army.

Several feral animal species known to occur in the Campbelltown LGA are considered to have the potential to impact upon Koalas.

10.2 Objectives

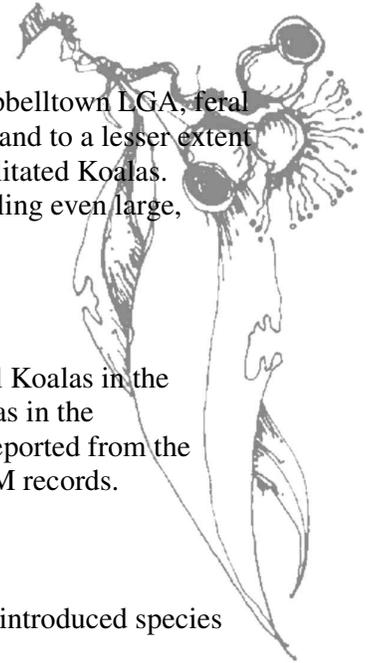
The objectives of this chapter are to:

- i) Outline the potential impacts of feral animals on Koalas;
- ii) Identify the issues to be addressed by feral animal management; and
- iii) Develop a suitable strategy to reduce the impact of feral animals on Koalas.



10.3 Likely Impacts of Feral Animals on Koalas

From the range of feral animal species known to occur within the Campbelltown LGA, feral dogs have the greatest potential to impact directly upon Koalas. Foxes and to a lesser extent feral cats are also considered to have the potential to take small or debilitated Koalas. However, like domestic dogs, feral dogs are known to be capable of killing even large, healthy adult Koalas.



10.3.1 Wild or Roaming Domestic Dogs

The potential for wild or roaming domestic dogs to attack and kill Koalas in the Campbelltown LGA was evidenced by the predation of two Koalas in the Kentlyn/Minto Heights area and one in the Wedderburn area as reported from the Campbelltown community-based Koala survey (1997) and UWSM records.

10.3.2 Foxes

Foxes are known to prey upon native fauna as well as upon other introduced species such as rabbits.

The capacity of foxes to take Koalas was confirmed by Dr. Andrew Krockenberger during the course of his Ph.D. research, which focussed on a Koala population near Nowendoc in north-eastern NSW. As reported in the July 1992 Australian Koala Foundation Newsletter, Krockenberger confirmed that at least six Koalas had been scavenged after death by foxes in his study area over a twelve-month period. He was confident that three of these six Koalas were actually killed by foxes.

10.3.3 Feral Cats

Feral Cats are known to occur in most habitats across Australia including many offshore islands. The diet of feral cats in Australia is known to be highly varied, and to include a range of small to medium-sized mammals (Newsome 1991).

Feral cats are likely to present only a minor threat to Koalas, although they may have the potential to take young Koalas.

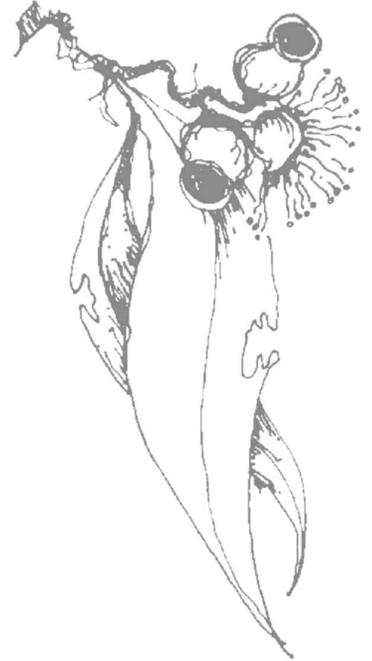
10.4 Management Issues

The following issues should be addressed to facilitate the development of an effective Feral Animal Management Strategy:

10.4.1 The Extent of the Problem

Feral dogs, foxes and cats appear to be widespread within the Campbelltown LGA. The Campbelltown community-based Koala survey (1997) provided a total of 385 recorded sightings of wild or roaming dogs (109), foxes (157) and cats (119), see Figure 19. All of these records have been digitised and will be installed on Campbelltown City Council's GIS. These records provide a basis for monitoring the distribution of feral animals in the LGA using future reported sightings.

FIGURE 19 GOES HERE



10.4.2 Priority Feral Animal Management Areas

Priority areas should be identified for feral animal management programs. Identification of priority areas should be carried out with reference to the Koala Habitat Planning Map. For example, areas of Preferred Koala Habitat where feral dogs or roaming domestic dogs are known to occur should be identified as priority areas for wild dog management.

10.4.3 Management Options

Appropriate options for feral animal management should be identified and evaluated on the basis of relevant legislation, research findings, previous experience, target and non-target species, animal ethics and environmental suitability.

10.4.4 Funding Options

A number of potential funding sources may be available to implement a Feral Animal Management Plan for the Campbelltown LGA including the Commonwealth Government 'Feral Pests Program' administered by Environment Australia. All potential funding sources should be thoroughly investigated.

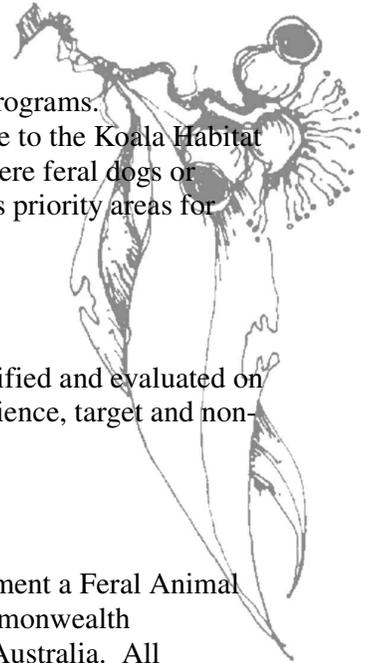
10.5 Feral Animal Management Plan

A co-ordinated approach to feral animal management should be adopted by all relevant land management agencies in the Campbelltown LGA. This would maximise the efficiency of management practices and minimise the likelihood of rapid recolonisation by feral animals of a particular management area following treatment.

The formation of a Feral Animal Management Committee for the Campbelltown LGA would facilitate the development of a co-ordinated and effective feral animal management strategy.

While the Feral Animal Management Committee should consider all feral animal issues within the Campbelltown LGA, those associated with impacts on native fauna including Koalas should be conferred a high priority.

The Feral Animal Management Committee should also seek to develop an effective community awareness program concerning feral animal management, as well as developing and promoting a suitable forum to receive ongoing feral animal reports and to monitor the effectiveness of management practices.



11. BUSHFIRES *See Notes*

11.1 Introduction

Fire represents a significant threat to wildlife. Bushfire management features prominently in the policies and practices of land management agencies within the Campbelltown LGA. This is particularly the case with respect to the NSW Rural Fire Service, which has considerable fire fighting resources including a number of local Volunteer Bushfire Brigades that operate under the co-ordination of the Campbelltown Bush Fire Management Committee. Other agencies that have responsibility for fire fighting resources in the Campbelltown LGA include: the Australian Army base at Holsworthy and the National Parks and Wildlife Service.

Bushfires within the Campbelltown area are considered to have the potential to significantly impact upon Koala habitat and the local Koala population.

11.2 Objectives

The objectives of this chapter are to:

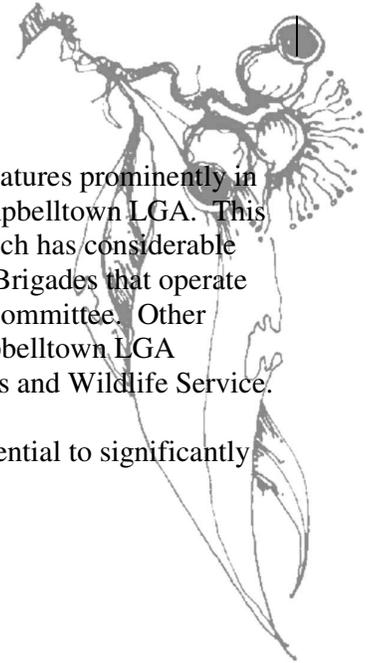
- i) Identify and monitor the impacts of bushfires on Koalas and Koala habitat in the Campbelltown LGA;
- ii) Identify relevant ecological issues that should be addressed through bushfire management programs; and
- iii) Recommend appropriate measures to minimise potential adverse effects of bushfires on Koalas and Koala habitat in the Campbelltown LGA.

11.3 Koalas and Bushfire

Under most circumstances, low intensity bushfires or prescribed (hazard reduction) burns are not considered likely to significantly affect Koalas. In contrast, high intensity bushfires are known to kill many animals including Koalas. While high intensity bushfires are likely to dramatically reduce fauna populations over the short-term, studies of some species and their habitat following bushfire suggest that their long-term survival may not be threatened by high intensity bushfire (Catling, 1991).

However, the ability of fauna species to recolonise a specific area of habitat following a high intensity bushfire is likely to be affected by a number of factors including:

- ❖ The extent and intensity of the bushfire;
- ❖ The rate and nature of habitat regeneration;
- ❖ The capacity of adjacent fauna populations to provide adequate levels of recruitment to recolonise burnt areas; and
- ❖ The impact of threats posed by factors such as feral and native predators, and traffic which could affect the potential for recolonisation from adjacent unburnt habitat, as well as potentially affecting survivorship of any fauna occupying regenerating habitat.



When intense bushfires affect extensive areas of significant habitat for species such as Koalas, the impact at the population level could be dramatic over both the short and long-term. This is particularly likely where habitat has already been highly fragmented, often as a result of development activity, and where the young in the population have been predominantly eliminated.

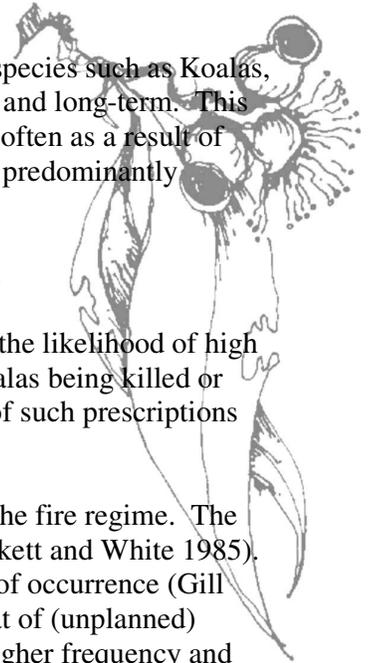
11.4 Koala Habitat and Associated Plant and Animal Communities

While it is important to prescribe hazard reduction burns that minimise the likelihood of high intensity fires occurring in Koala habitat and thus reduce the risk of Koalas being killed or injured, it is also important to consider the possible long-term impacts of such prescriptions on plant and animal communities.

Examination of the long-term impacts of fire requires consideration of the fire regime. The fire regime is the pattern of fire over time and across the landscape (Pickett and White 1985). Components of the fire regime include intensity, frequency and season of occurrence (Gill 1975). The fire regime of hazard reduction burning may differ from that of (unplanned) wildfires; typically, hazard reduction burns are of lower intensity and higher frequency and occur during different seasons, generally spring or autumn, rather than summer, which is typical in the case of wildfires (Williams and Gill 1995).

Recurrent hazard reduction burns could cause changes to Koala habitat by reducing the survival of juvenile trees and potentially causing the decline of populations of species utilised by Koalas. The majority of *Eucalyptus* species are generally capable of surviving a fire: they can grow new shoots from epicormic buds protected from the fire by bark or in underground lignotubers (Williams and Gill 1995). However, this ability to survive a fire is dependent on the presence of a number of features (*e.g.* fire resistant bark, stores of buds and energy (starch) reserves), which may not develop in juvenile plants for several years (Keith 1996). In the interim such plants are likely to be killed by fire, and if a series of fires occurs with such frequency that intervals between successive fires are less than that required to develop the aforementioned features, then all such juveniles may be lost, senescent adults will not be replaced, and the population will decline (Keith 1996). Even those plants that have developed energy reserves and a store of buds can be killed by frequent fires; if the interval between fires is insufficient to allow for their replenishment (Keith 1996). Both adult and juvenile eucalypts could be killed in this way. However, hazard reduction burns are more likely to affect juvenile eucalypts, as it would be expected that the crown of adult eucalypts would remain largely intact. The season of burning can also be important; energy reserves may be low after periods of rapid plant growth, thus making plants more vulnerable to fires that occur soon after such growth periods (Cremer 1973). Research that addresses these issues as they relate to tree species that are significantly utilised by Koalas and other native fauna in the Campbelltown LGA should be given high priority.

It is widely acknowledged that hazard reduction burns can cause changes to the composition of plant communities, and to the understorey in particular (see review by Williams and Gill 1995). Understorey species that survive a fire and resprout from protected buds may be affected in a similar manner to that outlined above. Species that are usually killed by fire and rely on regeneration from seed to perpetuate their populations could also be lost under a regime of high fire frequencies if plants are killed before they set seed or if stores of seed (*e.g.* in the soil) are depleted before they can be replenished (Benson 1985; Keith 1996).



Furthermore, the low intensities of hazard reduction burns may prevent the germination of seeds of species where high temperatures act as germination cues (Auld and O'Connell 1991). Changes to the plant species composition of the understorey are also likely to impact on fauna; Catling (1991) noted that hazard reduction burns could result in a simplification of the structure of forests by reducing shrub cover, which in turn may lead to long-term reductions in the abundance and diversity of fauna species.

The above discussion has focused on some of the potential consequences of low intensity, high frequency hazard reduction burns. While it is important to manage fuel loads in Koala habitat to minimise the risk of Koalas being injured or killed, the potential impact of high frequency hazard reduction fires on Koala habitat and other plant and animal communities needs to be recognised and where possible avoided. It is recommended that priority be given to research to determine fire management strategies that best meet the objectives of: protecting people and property; reducing the risk of injury or death to Koalas; and long-term conservation of Koala habitat and associated plant and animal communities within the Campbelltown LGA.

11.5 Fire Management Planning

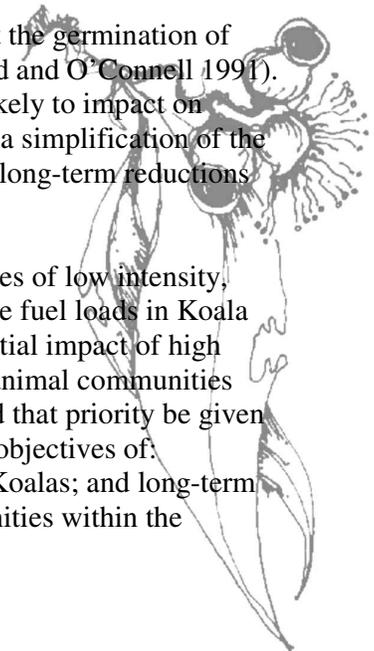
A co-ordinated approach to fire planning and management within Fire Districts and Local Government Areas is facilitated through the *Rural Fires Act 1997* which repealed the *Bush Fires (Amendment) Act 1994* and infers responsibilities on Campbelltown City Council as a local authority.

In addition, Land Management Agencies such as the **NSW National Parks and Wildlife Service** operate as public fire authorities in accordance with the *Rural Fires Act 1997* and are required to prepare Bush Fire Risk Management Plans for areas under their control.

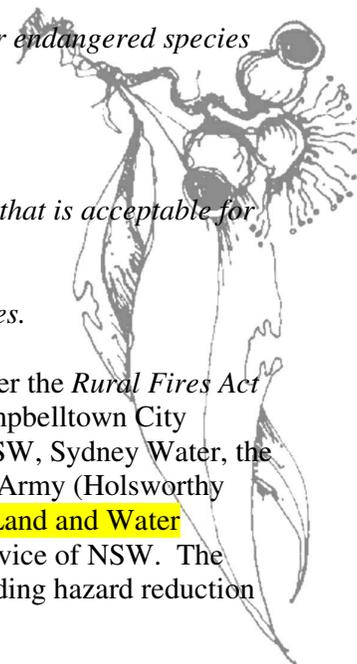
The 'Campbelltown Bush Fire Management Committee' formally operates in accordance with a Fuel Management Plan under Section 41AB(4) of the *Bush Fires Act 1949 (as amended)* which identified schemes for the reduction of fire hazards in the Campbelltown LGA.

The Fuel Management Objectives identified by the Campbelltown Bush Fire Management Committee include:

- ❖ *To minimise the risk of bush fire damage to life, property and environment;*
- ❖ *To minimise the risk to safety of all personnel and the public by reducing the potential for severe bush fires;*
- ❖ *To effectively manage bush fires for the protection and conservation of the natural, cultural, scenic and recreational features of the area;*
- ❖ *To promote effective and efficient utilisation of local fire fighting resources through cooperative planning arrangements;*
- ❖ *To minimise the probability of wildfire escape into surrounding lands;*
- ❖ *To protect the life and property in adjoining lands;*



- ❖ To ensure where practicable the conservation of rare, threatened or endangered species and communities of flora and fauna;
- ❖ To minimise soil erosion and sedimentation within a catchment;
- ❖ To achieve a long term spectrum of fire intensity and fire visitation that is acceptable for both environmental protection and commercial activities; and
- ❖ To minimise the cost of fire management and damage from bush fires.



The Campbelltown Bush Fire Management Committee established under the *Rural Fires Act 1997* consists of representatives from the NSW Rural Fire Service, Campbelltown City Council, **NSW National Parks and Wildlife Service**, State Forests of NSW, Sydney Water, the NSW Police Service, State Rail, the NSW Fire Brigade, the Australian Army (Holsworthy Range), the Nature Conservation Council of NSW, the **Department of Land and Water Conservation**, the Roads and Traffic Authority, and the Ambulance Service of NSW. The Committee meets quarterly to discuss district fire planning issues including hazard reduction burning and bushfire management.

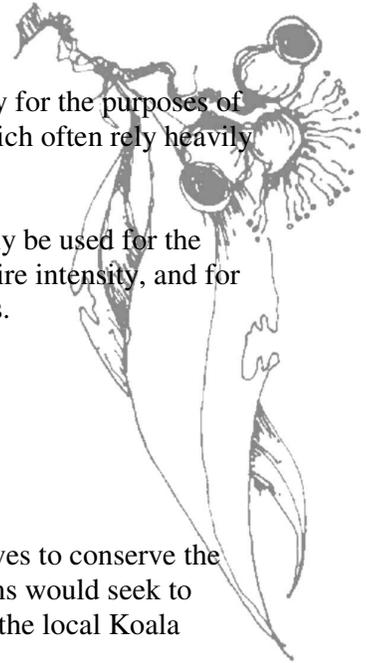
The *Rural Fires Act 1997* includes the protection of the environment as one of its objectives by requiring activities “to be carried out having regard to the principles of ecologically sustainable development described in section 6 (2) of the *Protection of the Environment Administration Act 1991*”. In accordance with the *Rural Fires Act 1997*, Bush Fire Management Committees are required to have regard to these principles in carrying out any function that affects the environment. In addition, the issue of a fire permit or a notice requiring the establishment of a fire break under the *Rural Fires Act 1997* does not affect any requirement to obtain a licence under Part 6 of the *Threatened Species Conservation Act 1995*.

The *Rural Fires Act 1997* requires each Bush Fire Management Committee to prepare both a draft plan of operations and a draft bush fire risk management plan. The *Rural Fires Act 1997* specifies that a draft bush fire risk management plan “may restrict or prohibit the use of fire or other particular fire hazard reduction activities in all or specified circumstances or places to which the plan applies.” The *Rural Fires Act 1997* indicates that “A plan might, for example, prohibit the use of fire because of its effect on fauna or flora in, or the cultural heritage of, a particular place.” Both of these draft plans are required to be prepared and submitted to the Bush Fire Co-ordinating Committee within three months after the constitution of the Bush Fire Management Committee. A draft plan of operations is required to be prepared and submitted within each successive 2-year period following the constitution of the Committee. A draft bush fire risk management plan is required to be prepared and submitted within each successive 5-year period.

11.6 Mapping Bushfires

Recent research indicates that it may be possible to use satellite imagery for the purposes of bushfire history mapping as an alternative to conventional methods, which often rely heavily upon the availability of post-fire aerial photograph coverage.

Digital and visual analysis of Landsat TM imagery data could potentially be used for the purposes of identifying burnt vegetation, mapping fire boundaries and fire intensity, and for monitoring post-fire regrowth on the basis of spectral reflectance values.



12. EDUCATION

12.1 Introduction

Public education is considered to be an important component of initiatives to conserve the Koala population in the Campbelltown LGA. Public education programs would seek to promote a sense of stewardship and increase awareness of the plight of the local Koala population. These programs may involve:

- ❖ Education within schools and community groups;
- ❖ Utilising local media to heighten awareness of issues relating to Koalas;
- ❖ Educational literature such as information brochures; and
- ❖ Information displays in buildings such as Council Chambers and libraries.

Members of the public should be informed on issues such as what action to take and who to contact if they encounter an injured or distressed Koala; habitat requirements for Koalas; the importance of responsible dog ownership; and the need to drive with caution in signed Koala road risk areas. Education objectives need to focus on informing people about the importance of retaining, managing and restoring Koala habitat in the area, which is essential to the ongoing survival of the Campbelltown Koala population.

12.2 Objectives

The objectives of this chapter are to:

- i) Heighten public awareness regarding the presence of Koalas in the Campbelltown area;
- ii) Ensure information on issues relating to Koalas is made readily available;
- iii) Inform the local community on ways they can contribute to the conservation of the Campbelltown Koala population; and
- iv) Inform the local community on appropriate action in cases where sick, injured, distressed or dead Koalas are encountered.

12.3 Educational Strategies

12.3.1 Information Brochures

It is recommended that initial resources should focus on providing an information brochure to outline Koala conservation issues addressed in this CKPoM and inform people on ways they can contribute to Koala conservation in the Campbelltown LGA.

12.3.2 Sign Posting

The following roads within Campbelltown LGA currently have Koala Warning Signs: Wedderburn Road, Georges River Road, Peter Meadows Road, Hansens Road and Old Kent Road. Specific recommendations regarding road signage have been addressed in the Traffic Management Chapter of this CKPoM.

12.3.3 Environmental Education

Campbelltown City Council currently provides environmental education programs on bushfires, weeds, animal control, recycling and waste management.

Involvement of Campbelltown City Council with school environmental groups and community groups could be beneficial to Koala conservation. It would be advantageous for Campbelltown City Council to liaise with schools that adjoin areas containing Koala habitat. This could provide opportunities for school participation with implementation and ongoing maintenance of local Koala habitat restoration programs.

The UWSM has prepared a video for schools on how to protect Koalas and has also provided a Koala reference collection for the Campbelltown City Library.

12.3.4 Telephone Hold Recordings

Information could be relayed to the public through the existing telephone hold systems at Campbelltown City Council concerning Koalas and their conservation requirements.

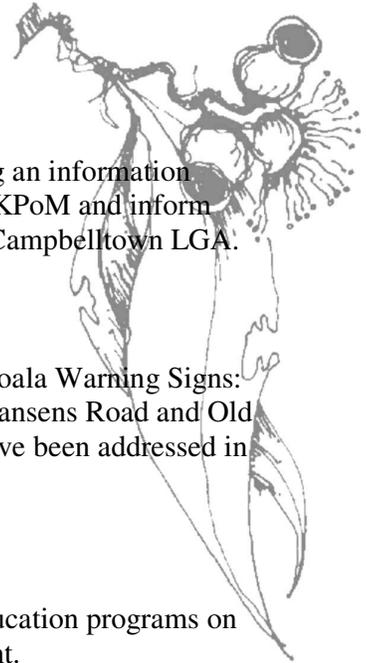
12.3.5 Media

Press Releases

Press releases provide an opportunity to communicate to a wide range of people through print and/or radio. Press Releases could target specific issues such as the importance of responsible dog ownership and the potential impacts on Koalas from roaming domestic dogs/wild dogs. Press releases should also be issued to encourage reporting of Koala sightings to the UWSM Koala Hotline.

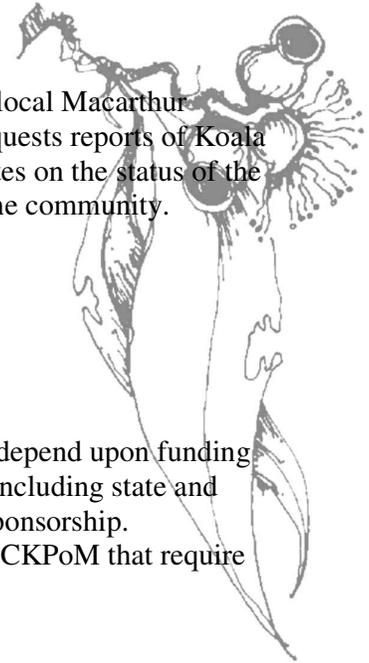
Community Service Announcements

Commercial television and radio stations provide 30 seconds of free air for public awareness campaigns. Community Service Announcements could be used in conjunction with Press Releases to target specific Koala conservation issues within the Campbelltown LGA.



Weekly Columns

The UWSM produces a weekly Koala conservation article in the local Macarthur Advertiser. The article notifies the public of Koala issues and requests reports of Koala sightings within the LGA. The articles also provide regular updates on the status of the local Koala population and foster a sense of stewardship within the community.



13. FUNDING

13.1 Introduction

The ability of this CKPoM to meet the identified objectives will partly depend upon funding for implementation. Funding can be sought from a number of sources including state and federal government grants, Council revenue, and private or corporate sponsorship. Appropriate funding sources need to be identified for the actions in the CKPoM that require financial input.

13.2 Objectives

The objectives of this chapter are to:

- i) Identify potential sources of funding for implementation of the CKPoM; and
- ii) Provide a strategy to ensure the necessary levels of funding are achieved.

13.3 Funding Sources

13.3.1 Government Grants

A number of state and federal government departments operate environmental funding programs. Some of the more relevant programs include the following:

a) **Environmental Trust Grants (NSW Environment Protection Authority)**

The Environmental Trust Grants scheme operates three separate trusts:

- ❖ Environmental Education Grants;
- ❖ Environmental Research Grants; and
- ❖ Environmental Restoration and Rehabilitation Grants.

Applications for these grants are usually sought through the media at the beginning of each year and grantees are notified of results during July.

The recommendations within the Education Chapter concerning the establishment of an environmental education program, targeting school environment groups and the general community, may satisfy the criteria for the Environmental Education Grants program. Similarly, recommendations detailed in the Research,

Monitoring and Habitat Restoration Chapters may be able to attract funding under Environmental Research Grants and Environmental Restoration and Rehabilitation Grants.

b) Natural Heritage Trust (Environment Australia)

The National Landcare Program aims to provide community groups with funding to undertake management and conservation projects. Bushland restoration and management projects that eventuate from the Habitat Restoration Chapter may be able to attract funding from this program. Port Stephens Council was successful in securing a National Heritage Trust Grant for Koala habitat restoration in conjunction with the Port Stephens Council CKPoM.

c) Save the Bush Program (Environment Australia)

The 'Save the Bush Program' is co-ordinated by Environment Australia with the principal objective of promoting the maintenance of biological diversity by encouraging the investigation, protection and appropriate management of remnant native vegetation located outside national parks and other reserves. The program encourages the co-operative participation of the community as well as local, state and federal governments.

d) Endangered Species Program (Environment Australia)

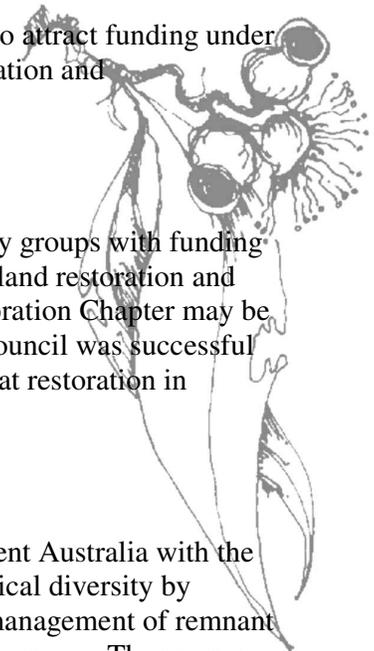
The Endangered Species Program generally provides funding for the preparation and implementation of Species Recovery Plans for nationally recognised threatened species on the ANZECC lists. Whilst scheduled as 'Vulnerable' under the *Threatened Species Conservation Act 1995* in NSW, the Koala is not currently listed as a nationally threatened species.

e) National Feral Animal Control Program (Natural Heritage Trust)

The National Feral Animal Program aims to identify improved pest management strategies through the adoption of 'best' practice feral animal management and the production of 'Threat Abatement Plans' for nationally listed threatened species.

The Program is available to government and non-government agencies and community groups for projects that target both agricultural and natural lands, particularly where there is a strong educational focus. However, it appears unlikely that funding would be available through this program at present for Koala-based projects given that the species is not currently listed as nationally threatened and that dogs are excluded from the list of targeted feral animals.

Environmental funding programs are also introduced as a result of government policies (periodically through relevant government departments). These programs need to be identified and investigated by the CKPoM Steering Committee at an early stage in the implementation process.



13.3.2 Campbelltown City Council

Recent legislative changes have resulted in increased environmental responsibilities under the Local Government Act. Consequently, Councils with fragile environmental systems are now required to focus attention towards appropriate environmental management. This has placed increased pressures on the resources of Councils.

One avenue that could be pursued to overcome the funding problem is for Council to seek to impose an Environmental Levy on ratepayers. This levy would be used to raise additional revenue to fund environmental programs throughout the Campbelltown LGA, potentially including implementation of the CKPoM. This would require approval from the Department of Local Government for Council to implement a special variation to the general rate.

13.3.3 Roads and Traffic Authority

The Roads and Traffic Authority could be approached to contribute funds toward relevant projects detailed in the Traffic Management Chapter of the CKPoM.

13.3.4 Conservation Groups

A number of conservation groups are actively involved with Koala issues in the Campbelltown LGA including Sydney Metropolitan Wildlife Services Inc. (SMWS), the National Parks Association (NPA) and the Australian Koala Foundation (AKF).

SMWS care for sick, injured or orphaned native wildlife including Koalas under licence from the [NSW National Parks and Wildlife Service](#).

13.3.5 Private Funding Sources

Private organisations are sometimes willing to assist with Koala conservation efforts and may be prepared to contribute funds toward implementation of the CKPoM, particularly for projects likely to gain positive media coverage.

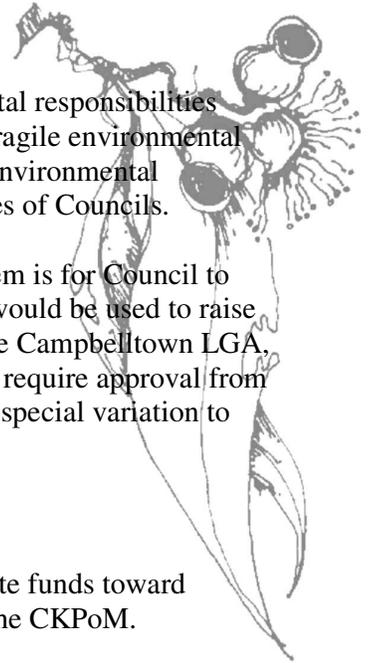
14. RESEARCH

14.1 Introduction

Koala Management planning and decision making should be guided wherever possible by the outcomes of rigorous scientific research. Research can also contribute to the monitoring and evaluation of the effectiveness of management programs.

A number of Koala research projects have already been undertaken in the Campbelltown LGA to investigate matters such as tree species preferences, habitat utilisation and home-ranging behaviour. Much of this work has been undertaken by researchers from the UWSM and the Australian Koala Foundation.

Limitations on both financial and staff resources, as well as increasing threats to Koalas, accentuates the importance of directing research into areas where information is lacking and

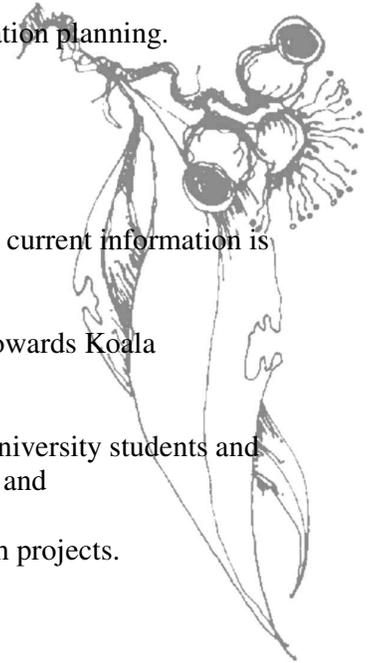


where results are most likely to contribute to improving Koala conservation planning.

14.2 Objectives

The objectives of this chapter are to:

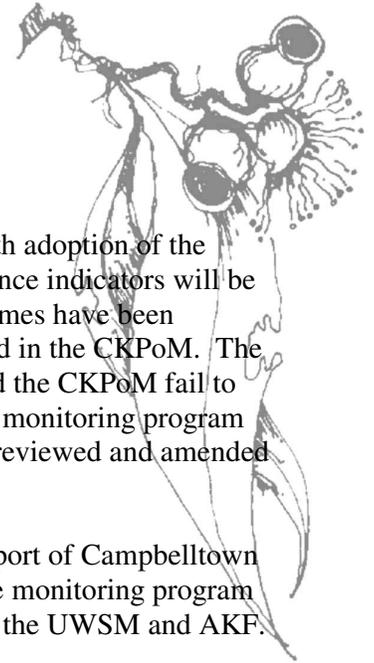
- i) Encourage and facilitate Koala research focusing on topics where current information is inadequate or incomplete;
- ii) Ensure effective utilisation and application of research findings towards Koala management practice and decision making;
- iii) Encourage ongoing involvement of final year and postgraduate University students and University staff in Koala research within the Campbelltown area; and
- iv) Facilitate the involvement of volunteers in suitable Koala research projects.



14.3 Potential Future Koala Research Projects

The following list identifies a number of research topics which could potentially enhance Koala management planning and practice within the Campbelltown LGA. The list is intended as a preliminary guide only:

- ❖ Investigation of mapped Koala Habitat Linking Areas in the Campbelltown LGA to assist in developing a prioritised list of potential habitat restoration projects, in accordance with the Habitat Restoration Chapter.
- ❖ Evaluation of potential methods for reducing Koala road mortality including the use of underpasses or overpasses, slow-speed zones, warning signs and driver education.
- ❖ Identification of potential release sites for hand-reared or rehabilitated Koalas, where it is determined to be inappropriate to release at the encounter site.
- ❖ Ongoing research into the success of Koala rehabilitation and release programs.
- ❖ Research into recolonisation of habitat following severe bushfire.
- ❖ Ongoing research concerning the effects of predation by roaming domestic dogs, wild dogs and foxes on Koalas in the Campbelltown LGA, in conjunction with the proposed Campbelltown Feral Animal Management Committee (see Chapter 10).
- ❖ Identification of lands within the Campbelltown LGA where 'Conservation Agreements' could benefit Koala habitat conservation and management.
- ❖ Follow-up postal survey each five years to assist with assessment of the ongoing conservation status of Koalas, and public attitudes and perceptions towards Koala management in the Campbelltown LGA.
- ❖ Evaluation of the effectiveness of the Campbelltown Koala Plan of Management, in conjunction with the monitoring program (see Chapter 15).



15. MONITORING PROGRAM

15.1 Introduction

An ongoing monitoring program will be commenced in conjunction with adoption of the Campbelltown CKPoM. As part of this program a number of performance indicators will be identified to provide a means to determine the level to which key outcomes have been achieved and to quantify the success or failure of the measures specified in the CKPoM. The monitoring program will also include a procedure to be followed should the CKPoM fail to meet the identified performance indicators. A proposal for funding the monitoring program should also be specified. It is intended for the CKPoM to be regularly reviewed and amended if necessary to reflect the findings of the monitoring program.

The monitoring program will require the ongoing commitment and support of Campbelltown City Council. It is proposed that the responsibility for co-ordinating the monitoring program be assigned to a suitably qualified Council Officer, in conjunction with the UWSM and AKF.

15.2 Objectives

The objectives of this chapter are to:

- i) Identify suitable performance indicators upon which to gauge the success of the CKPoM over time;
- ii) Detail an appropriate ongoing monitoring program including identification of those responsible for undertaking the program;
- iii) Detail a suitable funding proposal for the monitoring program;
- iv) Specify a procedure to be followed should the CKPoM fail to meet any of the identified performance indicators;
- v) Define the procedure for bi-annual reporting on the status of Koala populations and Koala habitat within the Campbelltown LGA; and
- vi) Define an acceptable procedure for annually reviewing and potentially amending the CKPoM if necessary. This procedure will also be important for resolving issues concerning fine scale accuracy of Koala habitat mapping.

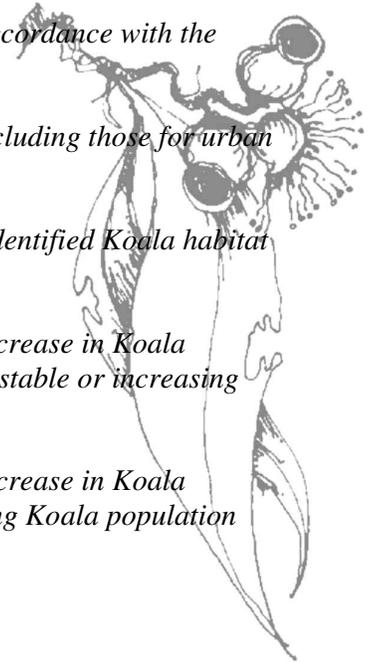
15.3 Performance Indicators

This section identifies the performance indicators to be used by the CKPoM Implementation Committee (as presented in the Implementation Chapter) to periodically evaluate the CKPoM. The performance indicators consist of a number of specific conservation outcomes that will be used to assess the success or failure of the plan's recommendations. These conservation outcomes are:

- ❖ *Preferred Koala Habitat areas together with the associated habitat links and buffers have*

been successfully protected and managed throughout the LGA in accordance with the 'Habitat Conservation' measures specified in the CKPoM.

- ❖ *Annual Koala population estimates indicate that Koala numbers including those for urban areas are stable or increasing.*
- ❖ *Habitat restoration programs have been successfully initiated for identified Koala habitat linking areas over cleared or heavily degraded lands.*
- ❖ *Annual statistics either do not indicate an increase or indicate a decrease in Koala mortality due to collisions with motor vehicles, in conjunction with stable or increasing Koala population estimates for identified black spot areas.*
- ❖ *Annual statistics either do not indicate an increase or indicate a decrease in Koala mortality due to dog attacks, in conjunction with stable or increasing Koala population estimates for identified high risk dog attack areas.*



15.4 Monitoring Program

The monitoring program will aim to periodically update the status of the Koala population and available Koala habitat within the Campbelltown LGA. The status of the Koala population will be assessed in terms of estimated Koala numbers, evidence of breeding activity, records of mortality, and estimated distribution of Koalas within the LGA. The program will also seek to record changes in the amount and quality of available Koala habitat as well as changes in the levels of habitat utilisation. The impact of threatening processes upon the Koala populations will be monitored to determine the level of success or failure of the measures in the CKPoM. The relative significance of each threatening process will also need to be regularly assessed to assure resources are focused in the highest priority areas.

15.4.1 Koala Habitat

The vegetation and Koala habitat mapping show the distribution of plant associations and Koala habitat across the Campbelltown LGA at the time of survey. It will be necessary to periodically update the vegetation map to incorporate subsequent clearing or regrowth of native vegetation and to allow for any fine-scale refinement of plant association classifications and mapping. Amendments to the vegetation map may necessitate changes to the Koala habitat mapping. Because the process to amend these maps is complex it is proposed that this procedure be carried out no more frequently than once a year, to allow all necessary amendments to be incorporated together. In the interim it will be necessary to make Council's planners, the NPWS Sydney Zone Team and **planningNSW** aware of any necessary amendments to ensure that any proposed development or activity likely to affect that area can be assessed accordingly.

It is proposed that the procedure for this notification will be as follows. Where it is likely that changes to the vegetation and Koala habitat mapping will be necessary, the relevant areas will be cross-hatched to denote the need for revision. This will be done on the digital copy of these maps held by Council. Hard copies of the maps showing the areas in question will be distributed to the NPWS Sydney Zone Team and **planningNSW**, along with a written description of the property details and the recommended reclassification of the vegetation.

It is recommended that Council purchase the latest available satellite imagery for the Campbelltown LGA at four-year intervals to assist with ongoing monitoring and review of the CKPoM and with 'State of the Environment' reporting. These images should be interpreted in consultation with the Australian Koala Foundation to identify changes in the extent of each category of Koala habitat resulting from incremental habitat loss, degradation or fragmentation and over the longer term, with habitat restoration works.

Council should undertake to maintain a register of any Koala habitat clearing activities and habitat restoration projects within the LGA. Matters listed on the register that indicate substantial disturbance to Preferred Koala Habitat should be investigated and included in six-monthly monitoring reports to the CKPoM Implementation Committee.

15.4.2 Koala Population

The following methods should be used to assist with the establishment of population estimates for urban areas, to detect animals in areas where they had not previously been reported and for the purposes of the ongoing monitoring program:

Urban Populations

Koala Hotline

The UWSM have established a Koala Hotline (available 24 hours every day) with members of the public encouraged to phone-in all Koala sightings. The hotline is advertised regularly in the local media and signs have been installed near Koala habitat areas. Additional advertising is recommended during each spring.

The records database will be made available for analysis in conjunction with any additional Koala records and the amount of each category of Koala habitat to estimate change in the likely size, status and distribution of urban Koala populations in the LGA.

[see notes](#)

Non-urban Populations

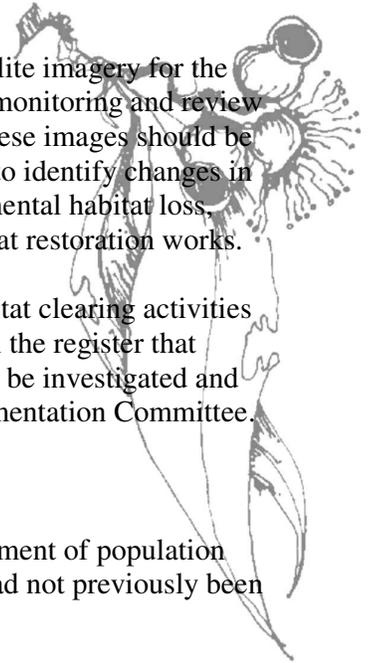
Transect Searches

Annual transect-based searches of designated sites will be co-ordinated by Council and/or the UWSM. These searches will be conducted during daylight hours using volunteers from SMWS, NPA, members of other local groups and the local community.

[see notes](#)

Transect-based searches will be conducted during mid-spring each year. Search sites should be determined by Council in conjunction with the UWSM and should be replicated each search period. The conduct of searches including areas searched, search procedures and search effort should be consistent for each search period, although there may be justification for identifying additional search areas over time.

Search areas should be selected to incorporate identified areas of Preferred Koala Habitat and wherever possible should include areas where evidence of known Koala



activity and preferably where breeding females have been recorded.

Detailed search protocols and procedures for distribution to potential participants should be prepared by Council in conjunction with the UWSM and AKF. A training session would be required for search team leaders prior to each annual search, which would include methodology and techniques for conducting searches for Koalas, communication protocols and emergency procedures in the event of injury.

Council should record the location of each Koala observation together with other relevant details in both map form and on a database at Campbelltown City Council following each search period. The data should be analysed and interpreted in conjunction with UWSM and AKF to estimate the likely maximum size and apparent status of non-urban Koala populations within the LGA. The outcomes of these analyses should be included in the annual CKPoM monitoring reports.

Spot Assessment Technique (SAT)

In addition to the above surveys, the distribution and status of Koala populations in the LGA will be assessed and reported annually through systematic application of the Australian Koala Foundation's Spot Assessment Technique (Phillips & Callaghan 1995; see Appendix 3). This technique relies upon the recording of Koala faecal pellet evidence and consequent Koala activity levels at assessment sites.

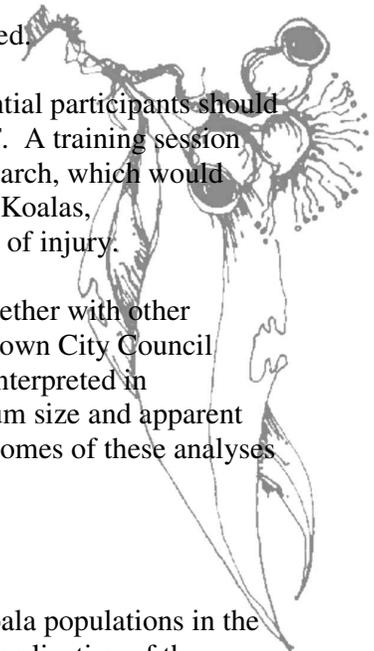
A minimum of ten SAT sites should be established by Council in consultation with the AKF and UWSM in each of the Preferred, Supplementary and Marginal Koala Habitat categories. Five of the spot assessment sites within each habitat category should be located within areas where Koala activity and/or Koalas have previously been recorded. The remaining sites within each habitat category should be located in areas where there is no evidence of use by Koalas. Where possible, the latter sites should be located within two kilometres of an area of habitat where the activity level recorded during Koala Habitat Atlas fieldwork suggested occupation by a stable breeding aggregation.

SAT results should be compared with those from previous monitoring periods and should be used, together with the estimates for urban and non-urban populations and the total amount of each category of habitat within the LGA, to estimate the likely status of the LGA-wide Koala population. These results and estimates should be incorporated into the annual CKPoM monitoring reports.

The estimated status of the Koala population in the LGA should be assessed each reporting period in terms of changes in local and LGA-wide population estimates, evidence of breeding activity, the recorded distribution of Koalas in the LGA, mortality statistics and potentially in the future, the outcome of a Population Viability Analysis.

Population Viability Analysis (PVA)

Population Viability Analysis is a process that aims to provide an indication of the likelihood that a particular population of a species will become extinct within a specified time, and under a certain set of circumstances (Possingham *et al.* 1993). While PVA can be carried out using various methods including experimentation, observation or by comparison with other species that have similar life histories, this



process often involves the application of complex computer simulation models (Possingham 1995). These simulation models provide as output the probability of extinction of the population for the given time and set of circumstances (Possingham 1995). The necessary items for input will vary according to the model used for the analysis and the objectives of the simulation, but can include attributes such as home range size, population densities, fecundity, mortality, population growth and movement (see for example; Lindenmeyer and Possingham 1996). These models can also incorporate the impact of catastrophes such as bushfire (Possingham 1995).

According to Possingham (1995), PVA can provide new insights into the conservation requirements of a particular species as well as highlighting aspects of a species' biology requiring further research. Use of PVA involves the application of 'sensitivity analysis' to the results generated from computer simulation models. Sensitivity analysis is carried out by repeating PVA simulations while systematically varying the values of input parameters to determine which cause significant change to the probability of a population extinction (Possingham 1995). PVA can potentially be used to rank management options, in conjunction with a sensitivity analysis to test the ranking (Possingham *et al.* 1993).

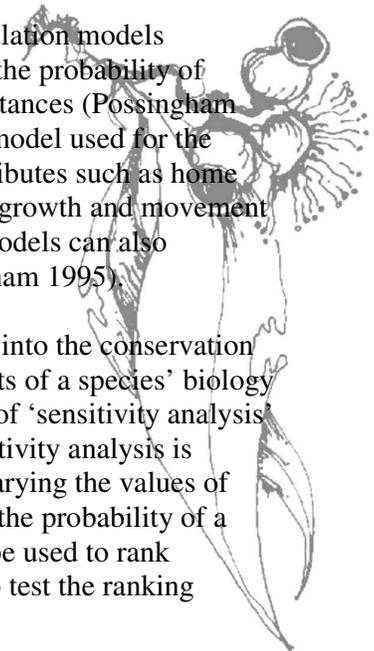
While the necessary data may not be available at present to undertake a comprehensive Koala Population Viability Analysis, the approach could be employed to demonstrate that a number of factors are likely to effect the long-term viability and persistence of the Campbelltown Koala population. As more information becomes available for the local Koala population, the potential for effectively using PVA will be enhanced as will the potential for such a model to guide the future refinement of management strategies.

It is suggested that Council liaise with the UWSM to investigate the potential for developing a Koala specific model for undertaking PVA for the Campbelltown LGA, which could form an important component of the monitoring program.

15.4.3 Threatening Processes

The impacts of threatening processes, in addition to those associated with land clearing, will also be reported on an annual basis including road mortality, dog attacks, feral predators, bushfires, and incidence of disease. It is proposed that information from the UWSM (including the Koala Hotline) and SMWS could contribute to this aspect of the monitoring program.

A register should be maintained to record any cases dealt with by Council Dog Control Officers or Environmental Protection Officers involving domestic dog attacks on Koalas. Council road maintenance staff should be encouraged to report any sightings of dead Koalas by the roadside.



15.5 Funding and Participants

Funding will be required for monitoring programs including promotion, foot-based searches, spot assessments, data base management, and data analysis. Campbelltown City Council will be responsible for seeking the necessary funding, assistance, resources and sponsorship to implement the ongoing monitoring program. In the future, Environmental Trust Grants may provide a potential funding source for aspects of the monitoring program. An Environmental Levy could be introduced in the future by Council to contribute funding for the CKPoM monitoring program.

Local community organisations should be encouraged to contribute to the ongoing monitoring program and could provide a critical resource. Potential post-graduate research projects involving aspects of the monitoring program should be promoted through the UWSM.

15.6 Reporting

The findings of the ongoing monitoring program should be reported annually by Council for the CKPoM Implementation Committee, following adoption of the CKPoM.

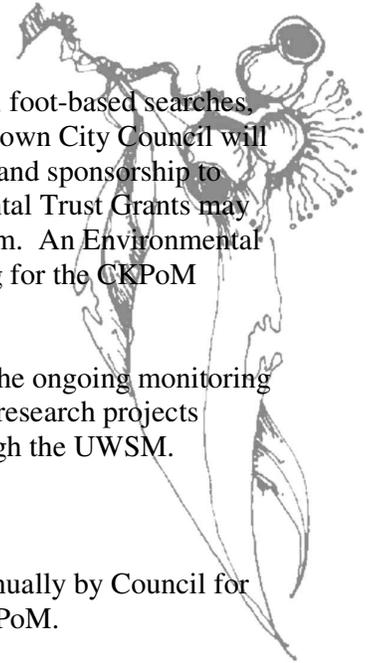
Reporting on the estimated status of Koalas within the LGA, together with actions taken to implement recommendations from the CKPoM and findings of the ongoing monitoring program, should also be undertaken as a component of council's annual State of the Environment Report under the *Local Government Act 1993*.

15.7 CKPoM Review and Amendment

The CKPoM should be formally reviewed by the CKPoM Implementation Committee at the end of each twelve month period following adoption. Where failure to meet any one or more of the Performance Indicators has been reported, the CKPoM Implementation Committee should determine whether the measures established by the CKPoM require amendment.

It will also be necessary for the CKPoM Implementation Committee to undertake an annual review of the established Performance Indicators, the monitoring program and the extent to which the recommendations of the CKPoM have been implemented. Failure to meet Performance Indicators could potentially indicate that measures proposed by the CKPoM are either not adequate or are not being effectively implemented or alternately, that the indicators selected are unrealistic. In either case, action should be taken by the CKPoM Implementation Committee to ensure that necessary amendments are made to measures and/or their implementation, or to the Performance Indicators. It may be necessary to amend the Performance Indicators as more information is collected and collated, particularly with respect to the estimated status or size of the local Koala population.

Any proposed amendments to the CKPoM, for example revision of the vegetation and Koala habitat maps, should be determined by Council in consultation with the Implementation Committee and the Director General of **NSW National Parks and Wildlife Service**. Amendments to the CKPoM will require the approval of both the Director General of **planningNSW** and Council before they take effect.



16. IMPLEMENTATION

16.1 Introduction

This Comprehensive Koala Plan of Management (CKPoM) has been prepared by the Australian Koala Foundation on behalf of Campbelltown City Council with the co-operation and support of a number of agencies, organisations and individuals from the local community. It is considered essential to provide for the ongoing involvement of these agencies, organisations and individuals for the effective implementation and updating of the CKPoM.

16.2 Objectives

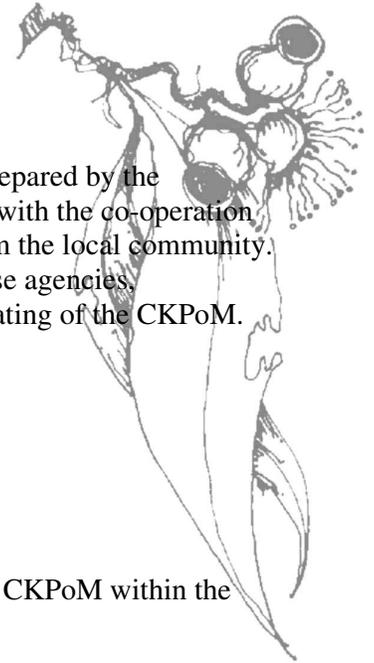
The objectives of this chapter are to:

- i) Provide a formal framework for implementation of the CKPoM;
- ii) Facilitate the ongoing involvement, support and promotion of the CKPoM within the local community; and
- iii) Provide for ongoing monitoring, evaluation and updating of the CKPoM.

16.3 Implementation Strategy

A CKPoM Implementation Committee should be established to ensure the recommendations of the CKPoM are effectively implemented. Core members should include an Officer from each of Campbelltown City Council (CCC), University of Western Sydney Macarthur (UWSM), **NSW National Parks and Wildlife Service (NPWS)**, Sydney Metropolitan Wildlife Services Inc. (SMWS), Tharawal Local Aboriginal Land Council (TLALC), Cubbitch Barta Native Title Claimants (CBNTC), the Macarthur National Parks Association (NPA), **Department of Land and Water Conservation (DLWC)**, Department of Defence (DD) and Sydney Water (SW). A Councilor should be invited to Chair the Implementation Committee.

Representatives from other organisations including the Roads and Traffic Authority (RTA), the Rural Fire Service (RFS) and researchers should be called upon for input as required by the Implementation Committee.



Principal areas of responsibility for each representative are outlined below:

Core Members **Principal Areas of Responsibility**

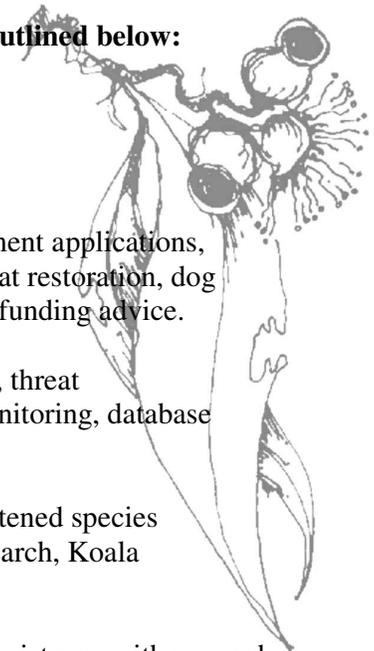
- Councilor**..... Chairperson.
- Council**..... land use planning, rezoning and development applications, habitat protection and management, habitat restoration, dog control, traffic management, ecotourism, funding advice.
- UWSM**..... habitat protection, population assessment, threat management, expert advice, research, monitoring, database management.
- NPWS**..... habitat protection and management, threatened species legislation, conservation agreements, research, Koala welfare, new area acquisitions.
- SMWS**..... Koala care and rehabilitation, volunteer assistance with research and monitoring, publicity and promotion.
- TLALC and CBNTC**..... historical and cultural perspective, Koala management on D’harawal lands.
- NPA**..... habitat protection issues, publicity and promotion.
- DLWC**..... Native vegetation conservation, Koala management on **DLWC** lands.
- DD**..... Koala management on Army lands.
- SW**..... Koala management on Sydney Water lands.

Occasional Members

- RTA**..... advice on relevant projects and road mortality relief measures.
- RFS**..... advice on Hazard Reduction and bushfire management.
- Researchers**..... advice on outcomes from local Koala research.

The Implementation Committee should convene immediately following formal endorsement and adoption of the CKPoM and should meet at least quarterly over the first twelve month period and then as often as considered necessary by the Committee.

The Implementation Committee should seek to ensure the relevance of the CKPoM over time through revision as necessary. Any amended CKPoM will require formal approval from the Director General of **planningNSW**.



The Implementation Committee should seek to promote and publicise any major events concerning implementation of the CKPoM including any opportunities for involvement of the local community.

REFERENCES

Auld, T.D. & O'Connell, M.A. (1991) *Predicting patterns of post-fire germination in 35 eastern Australian Fabaceae* in Australian Journal of Ecology. **16**: 53-70.

Bates, G.M. (1992) Environmental Law in Australia (3rd Ed.). Butterworths, Sydney.

Benson, D.H. (1985) *Maturation for fire-sensitive shrub species* in Hawkesbury Sandstone Vegetation. Cunninghamia. **1**: 339-349.

Benson, D. & Howell, J. (1994) Sydney Bushland: Two Centuries of Change. Royal Botanic Gardens, Sydney.

Benson, D. & Howell, J. (1990) Taken for Granted: The bushland of Sydney and its suburbs Kangaroo Press (with the Royal Botanic Gardens). Sydney.

Benson, D. & McDougall, L. (1991) Rare Bushland Plants of Western Sydney. Royal Botanic Gardens. Sydney.

Binning, C. E., Young, M. D. & Cripps, E. (1999) Beyond Roads Rates and Rubbish: Opportunities for local government to conserve native vegetation. National R & D Program on Rehabilitation, Management and Conservation of Remnant Vegetation. Environment Australia, Canberra.

Bradstock, R., Keith, D. and Auld, T. (1995) Fire and conservation: imperatives and constraints on managing for diversity. NSW National Parks and Wildlife Service, Hurstville. NSW.

Callaghan, J., Leathley, S. & Lunney, D. (1994). Port Stephens Koala Management Plan (Draft for Public Discussion). NSW National Parks & Wildlife Service, Port Stephens Council & Hunter Koala Preservation Society, Raymond Terrace.

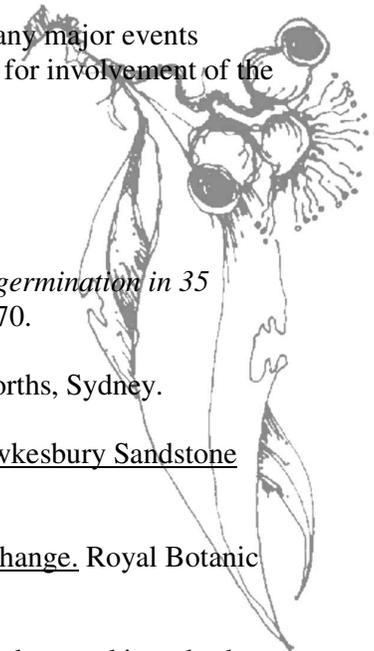
Campbell, N. (1996) A History of Bush Fire Brigades in the Campbelltown District. Grist Mills. Vol. 9 No. 3. Campbelltown City Council.

Campbell, N. (1996) Fire Fighters of Kentlyn: History of the Kentlyn Bush Fire Brigade (1946-1996). Campbelltown City Council.

Campbelltown City Council. (1971) History of Campbelltown.

Campbelltown City Council. (1994) Campbelltown Heritage Study.

Catling, P. (1991) *Ecological effects of prescribed burning practices on the mammals of southeastern Australia* in Conservation of Australia's Forest Fauna. Royal Zoological Society of NSW, Mossman.



Close, R. (August 1993) Campbelltown Koalas: What is their future? National Parks Journal. **37**(4).

Cremer, K.W. (1973) *Ability of Eucalyptus regnans and associated evergreen hardwoods to recover from cutting or complete defoliation in different seasons* in Australian Forest Research. **6**: 9-22.

Currey, J. (ed.) (1966) George Caley: Reflections on the Colony of New South Wales (Explorer and Natural History Collector for Sir Joseph Banks). Lansdowne Press. Melbourne.

Department of Science/Bureau of Meteorology. (June, 1975) Meteorological Survey: Holsworthy-Campbelltown District. Australian Government Publishing Service, Canberra.

Farrier, D. (1993) The Environmental Law Handbook-Planning and Land Use in New South Wales. Second edition. Redfern Legal Centre Publishing, NSW.

Friend, J.A. (1990) *Local decline, extinction and recovery: relevance to mammal populations in vegetation remnants* pp.53-64 in Nature Conservation: the role of remnants of native vegetation. D.A. Saunders, G.W. Arnold, A.A.Burbidge and A.J.M. Hopkins (eds) Surry Beatty & Sons, Sydney.

Gill, A.M. (1975) *Fire and the Australian Flora: A Review* in Australian Forestry. **38**: 4-25.

Hobbs, R.J. (1993) *Can revegetation assist in the conservation of biodiversity in agricultural areas?* in Pacific Conservation Biology. **1**: 29-38.

Hobbs, R.J. & Hopkins, A.J.M. (1990) *From frontier to fragments: European impact on Australia's vegetation* in Proceedings of the Ecological Society of Australia. **16**: 93-114.

Hume, I.D. (1990) *Biological Basis for the Vulnerability of Koala to Habitat Fragmentation* pp. 32-35 in Koala Summit: Managing Koalas in New South Wales, Proceedings of the Koala Summit held at the University of Sydney, 1-8 November, 1988. Lunney, D., Urquhart, C.A. and Reed, P. (eds.). New South Wales National Parks and Wildlife Service, Sydney.

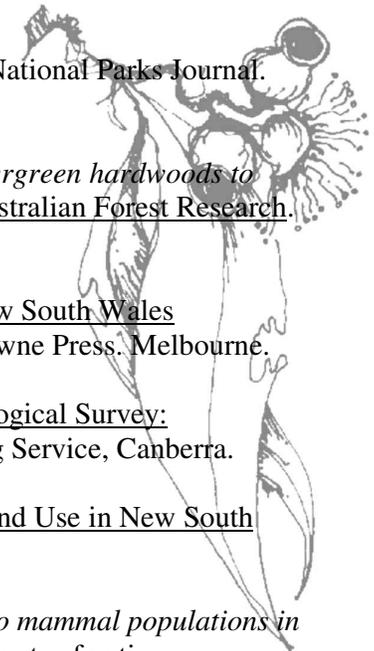
Kartzoff, M. (1969) Nature and a City: The Native Vegetation of the Sydney Area. Edwards & Shaw Pty Ltd. NSW.

Keith, D.A. (1994) Floristic Structure and Diversity of Natural Vegetation in the O'Hares Creek Catchment, South of Sydney. Cunninghamia. **3**(3): 543-54.

Keith, D.A. (1996) *Fire-driven extinction of plant populations: a synthesis of theory and review of evidence from Australian vegetation* in Proceedings of the Linnaean Society of New South Wales. **116**: 37-78

Krockenberger, A.K. (1994) Energetics and nutrition during lactation in the Koala, *Phascolarctos cinereus*: how does an arboreal folivore meet its energy requirements for reproduction?. Ph.D. Thesis. University of Sydney.

Lendenmeyer, D.B. & Possingham, H.P. (1996) *Ranking conservation and timber management*



options for Leadbeater's Possum in southeastern Australia using population viability analysis, pp.235-251 in Conservation Biology. **10**.

Liston, C. (1988) Campbelltown: The Bicentennial History. Allen & Unwin. North Sydney.

Longhurst, Keith. (March 21, 1997) Personal Communication.

Lunney, D., Krockenberger, A., Curtin, A. and Matthews, A. (1997) Procedures for preparing comprehensive plans of management for Koalas under State Environmental Planning Policy 44 – Koala Habitat Protection. NSW National Parks & Wildlife Service. Hurstville. NSW.

Macarthur Advertiser. (June 8, 1988) Campbelltown, NSW.

Macarthur Chronicle. (June 14, 1988) (Feb. 28, 1995) Campbelltown, NSW.

Mcgille, J. (1993) Campbelltown Clippings. Campbelltown City Council.

Mary-Ann. (Nov, 1853) Correspondence to Mother. Yass.

Melzer, A & Lamb. D. (1994). *Low Density Populations of the Koala (Phascolarctos cinereus) in Central Queensland* in Proceedings of the Royal Society of Queensland. **104**: 89-93. Brisbane.

National Parks and Wildlife Services. (October 29, 1997) Personal Communication. Sydney.

Natural Conservation Council of NSW. (Sept. 1991) Western Sydney Urban Bushland Survey - Vol. 1. - Vegetation Survey Reports. Natural Conservation Council of NSW.

Newsome, A. (1991) *Feral Cats: An Overview* in The Impact of Cats on Native Wildlife Proceedings of a Workshop Held on 8-9 May 1991. Australian National Parks and Wildlife Service, Canberra.

Payne, R.J. (1994). Vegetation Mapping-City of Campbelltown. Report prepared for the Australian Koala Foundation. Brisbane.

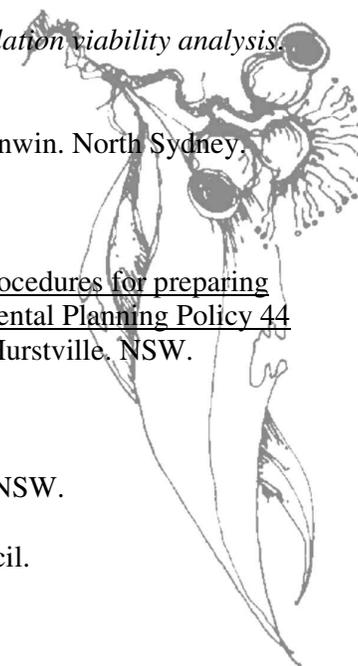
Perry, T.M. (1965). Australia's First Frontier: the spread of settlement in NSW 1788-1829. Halstead Press. Kingsgrove, NSW.

Phillips, S & Callaghan J. (1995) The Spot Assessment Technique for Determining the Significance of Habitat Utilisation by Koalas. Australian Koala Foundation, Brisbane.

Phillips, S. & Callaghan, J. (1998) Koala Habitat Atlas: Campbelltown Local Government Area. Australian Koala Foundation, Brisbane.

Phillips, S. & Callaghan, J. (2000) *Tree species preferences of koalas (Phascolarctos cinereus) in the Campbelltown area south-west of Sydney, New South Wales* in Wildlife Research **27**: 509-516.

Phillips, S., Callaghan, J., Parnaby, H. & Fitzgerald, M. (1996) Wedderburn Fauna Planning Study. Australian Koala Foundation, Brisbane.



Pickett, S.T.A. & White, P.S. (1985) *Patch dynamics: a synthesis in The Ecology of Natural Disturbance and Patch Dynamics*. S.T.A Pickett and P.S. White (eds). Academic Press, New York, pp:371-384.

Pollon, F. (1988) The Book of Sydney Suburbs. Angus & Robertson. North Ryde, NSW.

Possingham, H., Lindenmayer, D. and Norton, T. (1993) A framework for the improved management of threatened species based on Population Viability Analysis (PVA). Department of Applied Mathematics. University of Adelaide, SA.

Possingham, H. (1995) The practical application of population viability analysis for conservation planning. Department of Applied Mathematics. University of Adelaide, SA.

Prevett, P.T. (1991) Utilisation of Urban Areas by Koalas – Phase 4. A report to the Australian National Parks and Wildlife Service. Ballarat Univeristy College. Victoria.

Saunders, D.A. & Hobbs, R.J. (1995) *Habitat reconstruction: the revegetation imperative*. pp.104-112 in Conserving Biodiversity: Threats and Solutions. R.A. Bradstock, T.D. Auld, D.A. Keith, R.T. Kingsford, D. Lunney and D.P. Sivertsen (eds) Surrey Beatty and Sons, Chipping Norton.

Soule, M.E. & Gilpin, M.E. (1991) *The theory of wildlife corridor capability* pp.3-8 in Nature Conservation 2: The Role of Corridors. D.A. Saunders and R.J. Hobbs (eds.). Surrey Beatty and Sons, Chipping Norton.

Specht, R. L. (1981) *Foliage projective cover and standing biomass in Vegetation Classification in Australia* eds. A.N. Gillison and D.J. Anderson. CSIRO, Canberra.

Sydney Gazette. (January 18, 1822) Sydney, NSW.

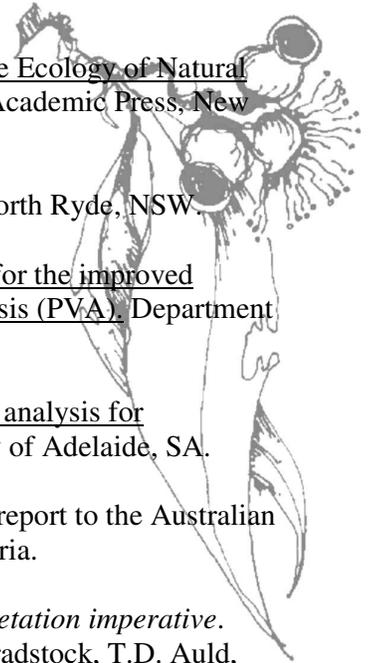
Terry, J. *et. al.* (Sept. 1991) Western Sydney Urban Bushland Survey. Nature Conservation Council of NSW. Sydney.

The Campbelltown Herald. (September 9, 1903) Campbelltown, NSW.

The Town and Country Journal (June 21 1905) Sydney, NSW.

Ward, S.J. (2002) Koalas and the Community: A Study of Low Density Populations in Southern Sydney. Ph.D. Thesis. University of Western Sydney.

Williams, J. & Gill, A. (1995) The Impact of Fire Regimes on Native Forests in Eastern New South Wales. Forest Issues 1. NSW National Parks and Wildlife Service, Hurstville, NSW.



APPENDICES

APPENDIX 1: COMMUNITY-BASED KOALA SURVEY FORM

APPENDIX 2: SPOT ASSESSMENT TECHNIQUE

APPENDIX 3: BUSHFIRES IN CAMPBELLTOWN LGA FROM 1920 – 1997

