Colac Grey-headed Flying-fox Management Plan

2019 - 2024

Prepared by Colac Otway Shire Council in conjunction with:

- Ecosure Consultants
- Enspec Consultant Arborists
- The Victorian Department of Environment, Land, Water and Planning;
- The Commonwealth Department of Environment and Energy; and
- NSW Office of Environment and Heritage 'Flying-fox Management Plan standard template'

Contact Details:
Colac Otway Shire Council
2-6 Rae St, Colac, VIC 3250
Phone: 03 5232 9400
Email: inq@colacotway.vic.gov.au

CONTEXT OF THIS DOCUMENT

The basis of this document has been developed from the NSW Office of Environment and Heritage 'Flying-fox Camp Management Plan Template 2016.[1]' The Commonwealth Department of the Environment and Energy cites this template as the recommended template in its document 'Referral guideline for management actions in grey-headed and spectacled flying-fox camps.'

Title	Colac Botanic Gardens flying-fox management plan
Project Managers	Stan Antczak Alison Blacket
Organisation	Colac Otway Shire Council
Prepared by	Colac Otway Shire Council in conjunction with Ecosure Consultants, Enspec Consultant arborists
Reviewed by	Stan Antczak Jess Bracks (Ecosure)
Approved by	Frank Castles
Date	July 2019

Revision history

Revision date	Version No.	Author	Description of changes
25 May 2020	1.0	S.Antczak	Responses from DELWP and initial IPE meeting comments
13 July 2020	2.0	S.Antczak	IPE review recommendations included

[1] https://www.environment.nsw.gov.au/publications/nativeanimals/flying-fox-camp-management-plan-template-160240.htm

Acknowledgements

Colac Otway Shire Council would like to thank everyone who was involved in the preparation of this Management Plan and gratefully acknowledge input to the Management Plan by land managers and regulators experienced in flying-fox management

Colac Otway Shire Council acknowledges the template provided by the NSW Office of Environment and Heritage, and consultants Ecosure, in developing the template on which this Flying-fox Management Plan was based. Dr Peggy Eby also provided advice which was included in the template.

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Acronyms, abbreviations and glossary

Acronym	Definition
ABLV	Australian bat lyssavirus
CBG	Colac Botanic Gardens
Camp	Used to describe the location where a group of flying-foxes are roosting. See also 'roost' (note these terms may be used interchangeably).
COSC	Colac Otway Shire Council
DoEE	Commonwealth Department of the Environment and Energy
DELWP	Department of Environment, Land, Water and Planning (Vic)
EEC	Endangered Ecological Communities
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FFG Act	*Flora and Fauna Guarantee Act 1988* (Vic)
FFMP	Flying-fox Management Plan
Flying-fox expert	The flying-fox expert referenced throughout this plan must have the following minimum expertise: • Knowledge of flying-fox habitat requirements • Knowledge and experience in flying-fox camp dispersal • Knowledge of flying-fox behaviour, including ability to identify signs of flying-fox stress • Ability to differentiate between breeding and non-breeding females • Ability to identify females in final trimester • Ability to estimate age of juveniles • Experienced in flying-fox population monitoring including static and fly-out counts, demographics and visual health assessments. • ABLV-vaccinated and trained in flying-fox rescue.
GHFF	Grey-headed flying-fox (*Pteropus poliocephalus*)
the Guideline	Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015 (Commonwealth)
HeV	Hendra virus
LGA	Local Government Area
MAV	Municipal Association of Victoria
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage (NSW)
PEPs	Protection of the Environment Policies
POCT Act	*Prevention of Cruelty to Animals Act 1986* (NSW)
Roost	Used to describe the act of roosting (verb). See also 'camp'.
TEC	Threatened ecological community
Wildlife A	*Wildlife Act 1975* (Vic)

Executive Summary

The Colac Botanic Gardens flying-fox camp is located on the southern aspect of Lake Colac in the Shire of Colac Otway, Victoria. The Colac Botanic Gardens are managed by Colac Otway Shire Council. The gardens are popular for locals and a primary destination for visitors coming to Colac. Land uses surrounding the gardens include a caravan park immediately to the east and established residential areas to the south and west.

The camp was first formally recorded in December 2016. It has been intermittently occupied since that time. Whilst the number of flying-foxes has varied since initial occupation, numbers have reached up to 6,500 in early 2019.

The Gardens are listed on the Victorian Heritage Register. Trees of individual significance are listed in the Statement of Significance and some of these trees have become preferred roosting habitats. In general the flying-fox camp has had a significant impact on the amenity of the botanic gardens in terms of tree health, defecation and noise.

Flying-foxes are considered 'keystone' species in Australia given their contribution to the health, longevity and diversity among and between vegetation communities. They often roost in large numbers and are increasingly moving into urban areas across eastern and southern Australia.

Grey-headed flying-foxes are listed as a vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and are listed as threatened under the *Victorian Flora and Fauna Guarantee Act 1988*. The management of flying-foxes and their habitat is directly guided by these legislative requirements.

Supporting the EPBC Act is the Commonwealth Department of the Environment and Energy Referral guidelines. The number of grey-headed flying-foxes at the Colac Botanic Gardens does not meet the 'nationally-important' criteria. As a result, no referral is required for management actions including dispersal (as confirmed by the Department). Council is proceeding with this Management Plan to ensure that best practice requirements and mitigation standards are met, to respond to community concerns and support the application for an Authority to Control Wildlife from the Victorian Department of Environment, Land, Water and Planning.

The objectives of the Plan are to:

- enable long-term conservation of flying-foxes in appropriate locations
- minimise adverse impacts to the community from the annual visitation of flying-fox colonies
- develop alternative roosting sites within the region
- provide a reasonable level of amenity for the surrounding community
- manage public health and safety risks
- effectively communicate with stakeholders during planning and implementation of management activities (including Level 3 dispersal actions) to ensure management is sympathetic to flying-fox behaviours and requirements
- improve community understanding and appreciation of flying-foxes, including their critical ecological role
- ensure flying-fox welfare is a priority during all actions.

The Plan applies the accepted standard template for flying-fox management developed by the Office of Heritage and Environment (New South Wales) which is the recommended template to be used as noted in the Department of the Environment and Energy referral guideline.

1 Overview

1.1 Introduction

Colac Otway Shire Council Plan 2017-2021 seeks to ensure that its places are managed for long term sustainability and to ensure good management practices in relation to the natural environment.

The Shire is committed to conserving its unique biodiversity and achieving improved environmental management particularly on Council-owned and managed land.

The historically significant Colac Botanic Gardens (CBG) is managed by Council and is on the Victorian Heritage Register. Since December 2016 a colony of grey-headed flying-foxes (*Pteropus poliocephalus*) (GHFF) have used the CBG intermittently as a camp. This has negatively impacted on the health of the historic trees and amenity value of the CBG. Some visitors are also concerned about potential human health risks.

Whilst Council has a duty of care for the historic gardens and to apply best practice arboriculture to ensure the ongoing health of the trees, the GHFF welfare is central to Council's response to biodiversity management.

The grey-headed flying-fox is a threatened species at a national and NSW level and is protected under State and Commonwealth legislation.

1.1.1 Key stakeholders

In response to the issues associated with the CBG flying-fox camp, Council has proactively led the development of this management plan and has worked collaboratively with the following key stakeholders and consultants:

- Department of Environment, Land, Water and Planning (Victoria) (DELWP)
- the Department of the Environment and Energy (Commonwealth) (DoEE)
- specialist flying-fox consultants, Ecosure
- specialist arborists, Enspec
- Council's CBG maintenance team
- community interest groups (refer also Section 3 Community Engagement).

1.1.2 Key technical documents applied in this Plan

Central to this Plan is the **Flying-fox Management Plan Template 2016**[2] and its technical data developed by the Office of Heritage and Environment (NSW).

Despite the fact that Colac Otway Shire does not fall within the NSW jurisdiction, the template is accepted as best practice by the Commonwealth DoEE. Accordingly this has been used in the development of this Plan, with the addition of local detail and the most-up-to-date information available.

[2] https://www.environment.nsw.gov.au/research-and-publications/publications-search/flying-fox-camp-management-plan-template-2016 Accessed 30 July 2019

A summary of authors of this Colac Flying-fox Management Plan is provided in Table 1.

Table 1 Summary of Plan authors

Section of this report	Author
Acknowledgements Executive Summary, Sections 1, 2, 3, 4.2, 4.3, 4.4 Appendix A, B, C	**Colac Otway Shire Council** The Flying-fox Management Plan standard template was used with local up to date data inserted.
Appendix E, F, H, I, K	**NSW Office of Environment and Heritage** Key sections of the NSW Flying-fox Management Plan standard template are reproduced in whole or part in this document
Sections 4.1, 5, 6, 7, 8, 9 Appendix D, J	**Flying-fox consultants, Ecosure** The Flying-fox Management Plan template was updated with technical data by Ecosure Consultants
Appendix G	**Specialist arborist consultants, Enspec** Specialist arborist advice provided by Enspec

In 2017 the Commonwealth Government published the **Draft Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus***[3] (refer also Section 4.1). The Plan addresses management and research actions necessary to stop the decline of, and support the recovery of, the GHFF.

The draft plan notes the following social and economic impacts:

> *The Grey-headed Flying-fox is capable of causing significant damage to commercial fruit crops, public gardens and native vegetation….*
>
> *In recent years Grey-headed Flying-foxes have been reported in areas where they were previously only rarely seen…..*
>
> *Camps in urban areas can have localised negative impacts on amenity when they are located near centres of human activity such as close to schools, or in areas of special cultural significance, such as botanic gardens. Some people living adjacent to camps complain about the noise, smell and perceived disease risk associated with flying-fox camps. Management of these camps can cause conflict between members of the community, government regulators and animal welfare advocates. Foraging flying-foxes have been implicated in the Hendra Virus outbreaks in Queensland and NSW, which aside from infection and subsequent death of domesticated horses, can also potentially lead to the death of humans via infected horses*.

1.2 Purpose of this Management Plan

This Management Plan provides a framework for Council in the management of flying-foxes within Colac Shire Council local government area. Council is cognisant of the ecological importance of flying-foxes and its obligation to develop sustainable alternative locations within the region.

This Plan aims to:

- protect and manage the flying-fox population in the Shire
- minimise risks associated with flying-foxes in the Shire

[3] http://environment.gov.au/biodiversity/threatened/recovery-plans/comment/draft-recovery-plan-grey-headed-flying-fox. Accessed 30 July 2019

- provide best practice short, medium and long-term management actions for the management of the flying-fox population in Colac
- contains information to support licence applications for flying-fox camp management actions where required
- seeks to preserve the CBG, amenity of the CBG for visitors, adjacent residents and the wider Colac Otway community.

The Plan seeks to establish a balance in managing the flying-fox population, preserving the CBG and ensuring the health of the heritage-listed trees.

1.3 Objectives

Objectives of this Plan are to:

- enable long-term conservation of flying-foxes in appropriate locations
- minimise adverse impacts to the community from the annual visitation of flying-fox colonies
- develop alternative roosting sites within the region
- provide a reasonable level of amenity for the surrounding community
- manage public health and safety risks
- effectively communicate with stakeholders during planning and implementation of management activities to ensure management is sympathetic to flying-fox behaviours and requirements
- improve community understanding and appreciation of flying-foxes, including their critical ecological role
- ensure flying-fox welfare is a priority during all actions.

Figure 1 Grey-headed flying-fox

2 Context

2.1 Site and surrounds

The CBG flying-fox camp is located on the southern aspect of Lake Colac in the Shire of Colac Otway, Victoria (refer Figure 2 below).

Colac is approximately 80 km south-west of Geelong and approximately 150 km south-west of Melbourne (refer Figure 3).

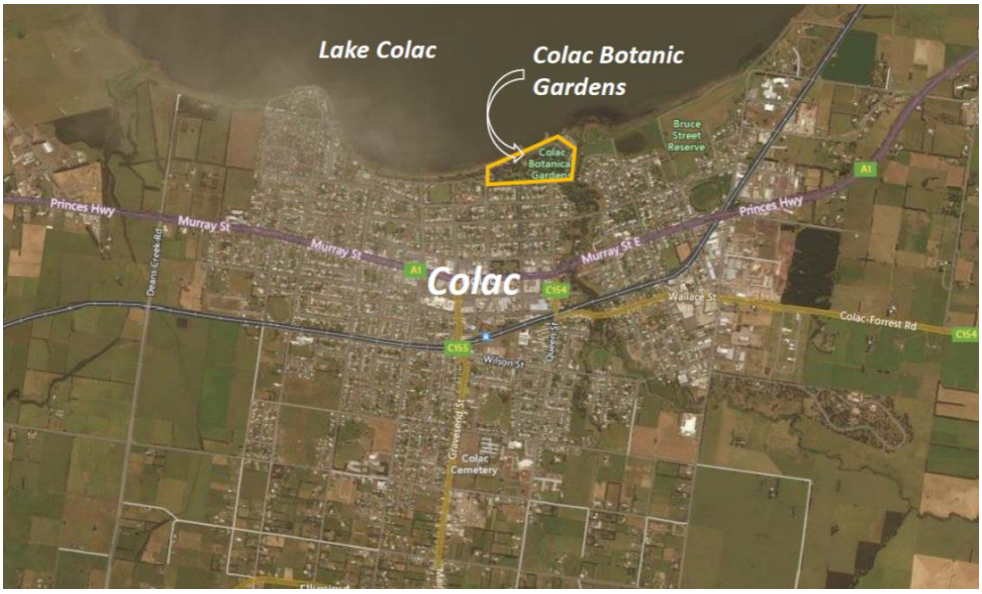


Figure 2 Local context. Source: Google maps

Figure 3 Regional context. Source: Google maps

The CBG are managed by Colac Otway Shire Council. The gardens are popular for locals and are a primary destination for visitors coming to Colac. Land uses surrounding the gardens include a caravan park immediately to the east and established residential areas to the south and west (refer Figure 4).

Key features of the CBG include a café, barbecue area and picnic shelter, an historic cannon, a feature pond, a children's playground and car park that services the Gardens and visitors to the lake (refer Figures 7-8 and Visitor Map Appendix A).

The camp was first formally recorded in December 2016 and intermittently used since this time, with numbers reaching up to 6,500 in January 2019 (see Section 2.4.1).

The two closest known flying-fox camps to CBG are more than 50 km away, Lower Gellibrand to the south-west and Geelong to the south-east (refer Figure 9).

Figure 4 Colac Botanic Gardens average flying-fox camp extent

Figure 5 Flying-foxes at CBG showing tree damage

Figure 6 Flying-foxes at CBG showing tree defoliation

Figure 7 Walking paths at CBG

Figure 8 Lake frontage at CBG

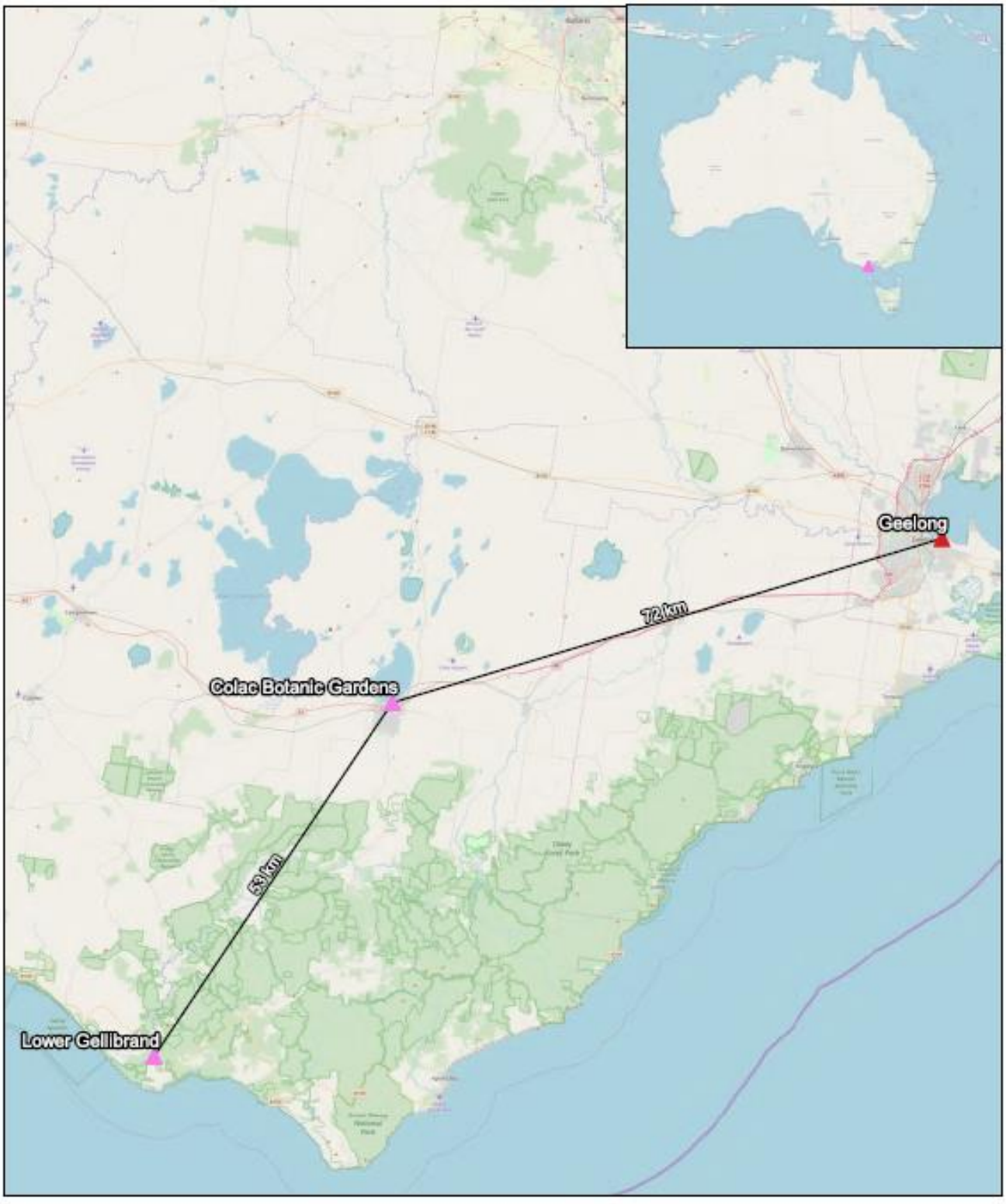


Figure 9: Closest known camps to CBG

Colac Otway Shire Council

Flying-fox expert consultancy support

▲ Nationally Important Flying-fox Camp

▲ Other Flying-fox Camp

ecosure

Job number: PR4527
Revision: 0
Author: SR
Date: 31/07/2019

0 10 20 km

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

The following Statement of Significance from the Victorian Heritage Register[4] provides a detailed description of the site:

What is significant?

The Colac Botanic Gardens occupy an elevated site of approximately 16 hectares north-east of the town centre bounded by the southern shores of Lake Colac, Gellibrand Street, Fyans Street and Barongarook Creek.

The main entrance to the Colac Botanic Garden is through the south-west entrance Bilson gates (1962) on the corner of Fyans Street and Gellibrand Street where a carriage drive, lined with predominantly Quercus robur (English Oak) and few Quercus cerris (Turkey Oak), forms a row around the perimeter of the Gardens and is open to vehicle access. The area enclosed by the drive has a network of winding paths and is mainly open lawn with specimen trees, shrubberies, some bedding plants together with a palm bed, rose garden, rose arbour, pond and fountain, and cannon (acquired 1904) near the south eastern gate. The curator's cottage (c.1924, now a café) is located at the western end of the gardens with playground equipment, picnic facilities and car parking at the eastern end. A caravan park occupies the north-east corner along Barongarook Creek adjacent to the lake shore.

A steep escarpment planted with Pinus radiata (Monterey Pines) and specimen trees runs between the botanic gardens and the flat area around the shore of Lake Colac which contains remnant terracing, an old brick toilet block with castellated roof (c1930s), a walking track, a fire brigade asphalt training track and shed, rotunda (1999), car parks, a rowing club, angling club, public toilets, boat ramp (1968) and jetty (1971). The escarpment provides separation between the two areas and provides extensive views from the Botanic Gardens over Lake Colac.

The site was temporarily reserved in 1865 for botanical and recreational purposes after a request from local residents. Little progress was made until 1868 when Daniel Bunce, Director of the Geelong Botanic Gardens, was approached to lay out a plan for the garden. Implementation of the plan was slow with the construction of a carriageway and planting of trees the only known details.

Between c1875 -80, curators Reeves and McDonald made changes to the carriageway and introduced garden beds, curved paths, lawns and shady arbours. In the 1890s structures added to the gardens included a pavilion overlooking the lake a conservatory in the south-eastern corner and a permanent rowing clubhouse on the edge of the lake joining the existing structures of piers, baths and a boat shed. Most of these structures have been removed.

In 1910 William Guilfoyle, Director of the Melbourne Botanic Gardens, prepared a plan and a 'Report on the remodelling and development of the Colac Botanic Gardens', which are extant, suggesting some improvements and remodelling to take advantage of the slope and vistas across over the lake which he considered had been ignored. This included simplifying the existing path system within the circular drive, and removal of borders and crowded areas in favour of larger trees and clumps of shrubs and a palm and cordyline bed all of which were implemented. Curators Archibald Campbell (1911-40) and Dugald Leitch (1940-55) were responsible for implementation of part of the Guilfoyle plan and maintaining the maturing Gardens but, with Guilfoyle's death in 1912, any further influence ended. The last resident curator Donald Greenwood (1955-65) was responsible for the addition of many native plants and in more recent times the gardens have more simplified planting and a park-like character.

The Colac Botanic Gardens contains many rare plant species only found in historic gardens and several significant and uncommon trees including four Cupressus forbesii (Tecate Cypress), a very large Sophora japonica (Pagoda Tree), a Pittosporum tenuifolium 'Eila Keightley' (Kohuhu), a large

[4] http://vhd.heritage.vic.gov.au/places/result_detail/147162

Araucaria bidwillii (Bunya Pine) and an outstanding Ulmus x hollandica 'Vegeta' (Huntington Elm). In March 1996, James Guilfoyle, grandson of William Guilfoyle, planted an Arbutus caneriensis (Canary Island Strawberry Tree). In 2004 the Australian Plant Society planted an Otway Flora Bed on the eastern side of the Gardens.

This site is on the land of the traditional owners.

How is it significant?

Colac Botanic Gardens are of historical, aesthetic, and scientific (botanical) significance to the State of Victoria.

Why is it significant?

Colac Botanic Gardens are of historical significance as an important example of a regional botanical garden, established in the nineteenth century in response to the increased wealth of Victoria with the discovery of gold and the desire to provide a place for recreation and education in keeping with European trends.

The Colac Botanic Gardens are of historical importance through the association with Daniel Bunce and William Guilfoyle, two pioneers of botanic gardens and garden design in Victoria.

The Colac Botanic Gardens are of aesthetic significance due to their park – like character and elevated location immediately above the southern shore of Lake Colac, providing vistas across the lake. The gardens are of aesthetic significance for the sub-tropical plant groups supported by Guilfoyle together with his gardenesque style. They are of aesthetic significance for the contrasting form and variety of trees and plants which includes conifers, evergreen and deciduous plantings, together with the leaf shapes, colours and flowers, also contribute to the Garden's aesthetic quality and appeal.

The Colac Botanic Gardens are of scientific (botanical) significance for a number of rare plants and trees including four Cupressus forbesii (Tecate Cypress), the only known examples in Victoria, a large Sophora japonica (Pagoda Tree), Pittosporum tenuifolium 'Eila Keightley' (Kohuhu), and large Araucaria bidwillii (Bunya Bunya Pine) and an outstanding Ulmus x hollandica 'Vegeta' (Huntingdon Elm).

Table 2 shows trees that are listed on both the Heritage Victoria Statement of Significance and the National Trust of Australia Tree Register.

Correspondence from both Heritage Victoria and the National Trust have raised their concerns regarding damage to the trees within the CBG and support Council's plans to disperse the flying-fox population.

Table 2 Trees on significant tree registers

	Common name	Individual listing on the Victoria Heritage Register	Individual listing on the National Trust Tree register (1984)
Cupressus forbesii	Tecate cypress	✓	✓
Sophora japonica	Pagoda Tree	✓	✓
Pittosporum tenuifolium	Eila Keightley (Kohuhu)	✓	✓
Ulmus x hollandica 'Vegeta'	Huntington elm	✓	✓
Arbutus canariensis	Canary Island Strawberry Tree	✓	Not listed
Araucaria bidwillii	Bunya pine	✓	✓
Quercus robur	English oak	✓	Not listed
Quercus cerris	Turkey oak	✓	Not listed
Pinus radiata	Monterey pines	✓	Not listed

2.3 Land tenure

The 16 ha site is a Crown Reserve and managed by the Shire of Colac Otway Council on behalf of DELWP.

The land is identified as:

- Crown allotment 25B and 25C, Township of Colac and
- Part of Crown allotment 62A, Parish of Colac.

The extent of the Crown land parcels are provided in Appendix B.

2.4 Flying-fox population and impacts on the local environment

2.4.1 Population

The GHFF was first recorded by Council in December 2016. Since then numbers have fluctuated substantially (refer Table 3 and Figure 10).

Table 3 Changes recorded in the CBG flying-fox camp since 2016

Date	Change recorded in the colony
December 2016	Numbers initially 100 increasing to 3,000
June 2017	Colony left the Gardens. None recorded
November 2017 – February 2018	Colony did not return
March 2018	300 returned and resided in Pagoda Tree
January 2019	Numbers increased to 6,500
March 2019	Numbers reduced to 3,000
May 2019	Numbers reduced to 2,500
July 2019	Numbers reduced to 384
January 2020	Numbers increased to 6,500
May 2020	Numbers reduced to 400
July 2020	Numbers reduced to200

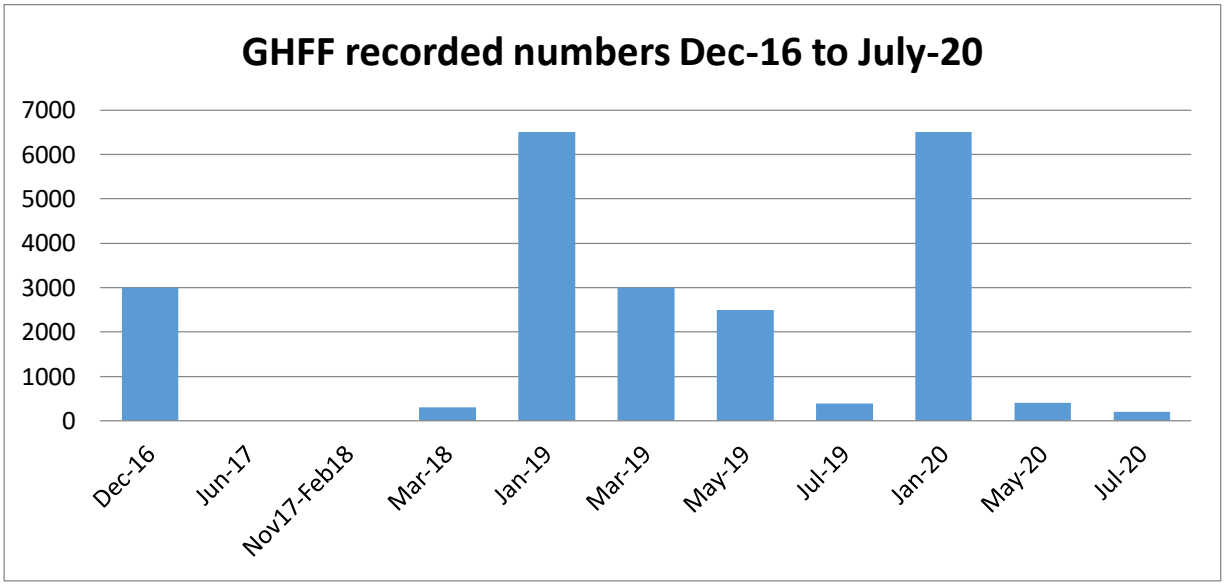


Figure 9 CBG count data since 2016. Source: Colac Otway Shire Council 2019

2.4.2 Impacts on trees

A detailed assessment of the trees at CBG was been undertaken in 2019[5]. Key findings include:

- *Affected trees, including the heritage trees, are mainly introduced deciduous amenity species. These trees are particularly vulnerable to permanent damage and decline as the maximum defoliation occurs over the growing season of these trees in spring and summer. Evergreen trees have some chance of recovery in autumn and winter that these deciduous ornamental species do not.*
- *If the flying-fox camp remains in the gardens it is certain that some trees will be permanently damaged. At best, dieback of the upper canopy will occur with a commensurate decline in amenity and health.*

[5] Refer Appendix G: Arborist Report undertaken by Enspec Consultant Arborists, 2019

– *Two National Trust classified heritage trees as well as up to 15 other high value amenity trees are currently affected and at significant risk of permanent damage. Given their age, the defoliation could eventually lead to tree death of the larger and older amenity trees.*

Table 4 Individual trees listed in the statement of significance impacted by the flying-foxes

Tree	Common name	Flying-fox impact
Cupressus forbesii	Tecate cypress	-
Sophora japonica	Pagoda Tree	Significant impact
Pittosporum tenuifolium	Eila Keightley (Kohuhu)	-
Ulmus x hollandica 'Vegeta'	Huntington elm	Significant impact
Arbutus canariensis	Canary Island Strawberry Tree	-
Araucaria bidwillii	Bunya pine	-
Qhercus robur	English oak	Impacted
Quercus cerris	Turkey oak	-
Pinus radiata	Monterey pines	-

2.5 Management response to date

Council has taken a conservative approach in managing the flying-fox population due to the need to monitor conditions and the fluctuating population of the camp. For example, in March 2018, 300 GHFF returned but by January 2019 the population had increased to 6,500. In the winter months the population significantly reduced.

In response, Council has:

- monitored the flying-fox numbers and condition of the CBG by staff
- undertaken a stakeholder meeting on 6 March 2019 to discuss options available to Council and the community. Community engagement was initiated when flying-foxes first arrived at CBG and was escalated in order to gain community feedback on this Camp Management Plan.
- undertaken a community awareness program through Council's website
- developed a Communications Plan for providing information to the community (refer Appendix C)
- In response to the changing conditions, Council has progressed with a more detailed approach that includes:
    - preparation of this Management Plan to provide a framework for managing the flying-fox visitations;
    - external advice from flying-fox experts, both in government and in the private sector;
    - arbor advice on the damage to the heritage listed trees; and
    - leading ongoing discussions with DELWP and DoEE regarding licence application requirements and the relevance of the NSW Flying-fox Management Plan standard template.

3 Community engagement

Community engagement was initiated shortly after the arrival of flying-foxes at the CBG in 2016. Key findings are provided in Section 3.1 below.

In 2019 engagement was then escalated in order to further inform this Camp Management Plan. A community engagement plan is attached as Appendix C and summarised below.

3.1 Initial community observations pre-2019

The following list is a collation of the issues related to the camp that have been reported by the community from 2016 to early 2019. The list has been compiled from information collected by staff and from residents contacting Councillors.

Reported issues include:

- noise as flying-foxes depart or return to the camp
- noise from the camp during the day particularly to users of the Gardens
- faecal drop on outdoor areas, cars and private property
- smell particularly to users of the Gardens
- fear of disease
- reduced general amenity
- damage to vegetation, particularly to a number of heritage listed trees in the Gardens
- the need to establish alternative camp sites within the region to encourage the flying-fox population away for the Gardens through increased tree planting programs
- impacts on other fauna species
- possible impact on adjacent businesses.

3.2 Stakeholders in the development of this Plan[6]

The community engagement process drew on the following stakeholders who were directly or indirectly affected by the flying-fox visitations or who were interested in Council's management approach. Refer also attached engagement plan.

Key stakeholders

- Residents close to the gardens
- Friends of the Colac Botanic Gardens
- Shire wide residents and businesses
- Business owners
- Colac Turf Club
- Colac Pony Club
- Shire wide vets
- Friends of Bats & Bushcare

[6] The key issues form this Section has been taken from the Flying Fox Camp Management Plan Template. NSW. Page 11 https://www.environment.nsw.gov.au/research-and-publications/publications-search/flying-fox-camp-management-plan-template-2016

Government stakeholders

- Departments within Council
- Other councils
- Heritage Victoria
- DELWP.

3.3 Need for engagement

Consistent with the Draft Recovery Plan for the Grey-headed Flying-fox 2017 (Section 4.1.4), community engagement has centred around the need to:

- understand the issues directly and indirectly affecting the community
- raise awareness within the community about flying-foxes
- correct misinformation and allay fears
- share information and invite feedback about management responses to date
- seek ideas and feedback about possible future management options.
- Continued education of the community on GHFFs

3.4 Engagement methods

Engagement methods undertaken in early-mid 2019 encompassed:

- Media: newspaper, local radio and TV
- Community meetings with Friends of Botanic Gardens
- Online: Facebook, online questionnaire (from the 20 June to the 12 July)
- Hard copy information distributed: both in libraries, customer services centres and direct mail (from the 20 June)
- Face to face and telephone meetings at CBG and by telephone.

3.5 Engagement outcomes

Council had a strong response to the engagement process undertaken in mid 2019.

A summary of outcomes and the key issues is provided below

A total of 132 respondents completed the questionnaire.

The majority reside in Colac/ Elliminyt.

In terms of the impact that the flying-foxes have on the Colac Botanic Gardens visitor experience:

- 25% of respondents found the experience to be positive
- 66% of respondents found the experience to be negative
- 9% of respondents found the experience to be neither positive or negative (neutral).

Table 5 Engagement outcomes: summary of positive and negative issues

Nature of feedback		
Positive	-	recognise the landscape-scale benefits flying-foxes provide through seed dispersal and pollination
	-	acknowledge the need to conserve flying-foxes as an important native species
	-	enjoy watching flying-foxes at the camp and/or flying out or in
	-	appreciate the intrinsic value of having flying-foxes in Colac
	-	see the value of the camp as a tourism opportunity/attraction
	-	feel the camp does not negatively impact on their lifestyle
	-	value the opportunity the camp provides for them and their family to get close to nature
	-	recognise the need for people and wildlife to live together
	-	feel that there is a need to improve education
Negative	-	are concerned about the health of the heritage trees
	-	are concerned about the spread of disease
	-	faecal drop is offensive
	-	noise is excessive
	-	adults/ children are scared of the flying-foxes
	-	very smelly.

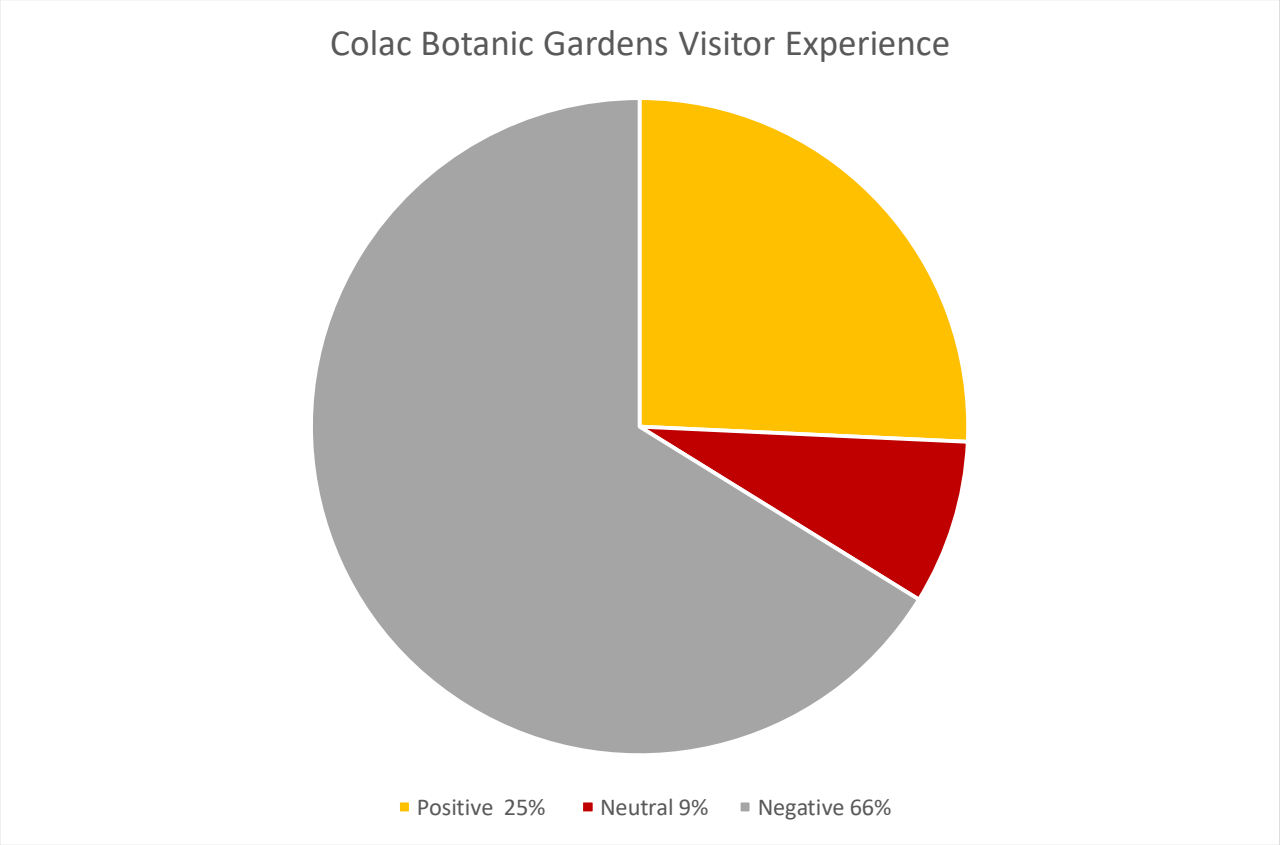


Figure 10 Colac Botanic Gardens visitor experience (as at 12 July 2019)

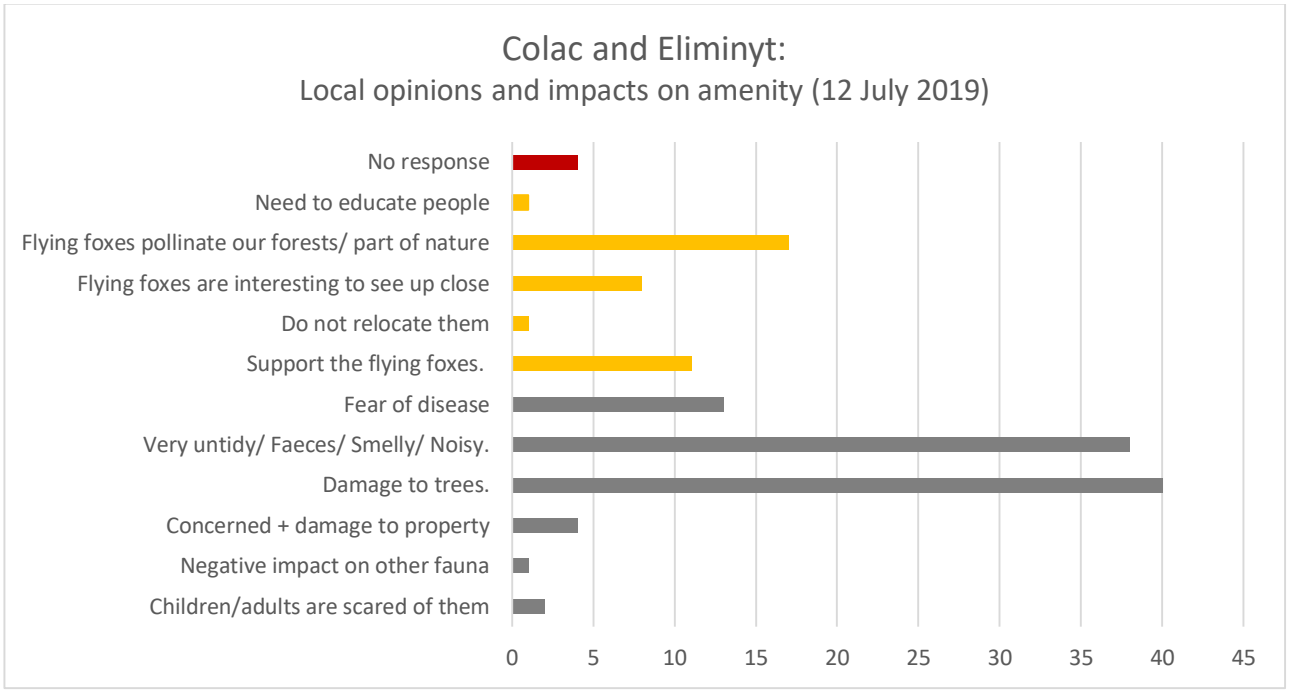


Figure 11 Colac and Elliminyt: local opinions and impacts on amenity (as at 12 July 2019)

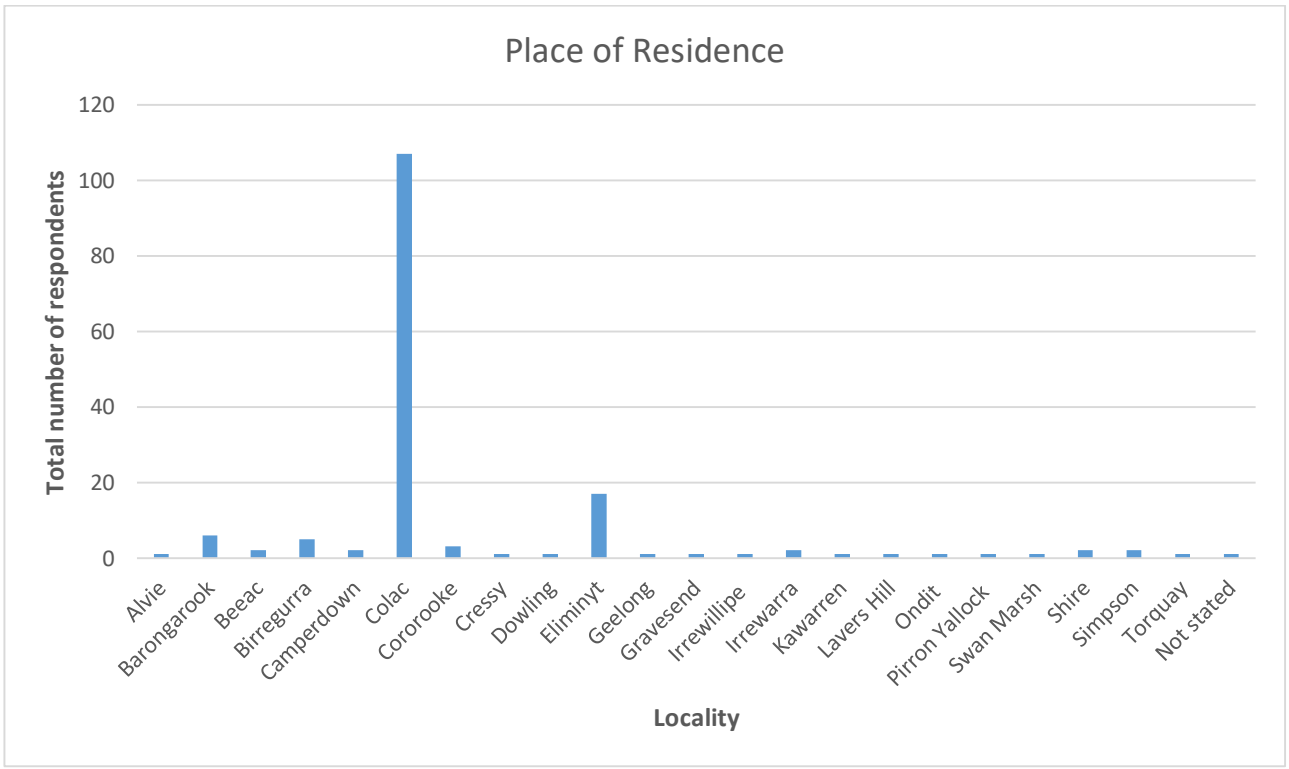


Figure 12 Respondent's place of residence (as at 12 July 2019)

4 Legislation and policy

4.1 Commonwealth

4.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the Commonwealth DoEE is required under the EPBC Act for any action that is likely to significantly impact on an MNES.

MNES under the EPBC Act that relate to flying-foxes include:

- world heritage sites (where those sites contain flying-fox camps or foraging habitat)
- wetlands of international importance (where those wetlands contain flying-fox camps or foraging habitat)
- nationally threatened species and ecological communities.

The GHFF is listed as a vulnerable species under the EPBC Act, meaning it is an MNES. It is also considered to have a single national population. DoEE has developed the Referral guideline for management actions in GHFF and SFF[7] camps[8] (the Guideline) to guide whether referral is required for actions pertaining to the GHFF.

The Guideline defines a nationally important GHFF camp as one that has either:

- contained ≥10,000 GHFF in more than one year in the last 10 years, or
- been occupied by more than 2500 GHFF permanently or seasonally every year for the last 10 years.

The CBG does not meet either of these criteria (see Section 2.4.1 for historic camp data) and is therefore not considered a nationally important camp. As such, management of this camp (including dispersal) are unlikely to significantly impact on the GHFF and do not need to be referred under the EPBC Act. This was confirmed by DoEE (pers. com. 25 July 2019). See also Figure 14.

Council is committed to best practice, and therefore has incorporated mitigation standards for nationally important camps into those that will be used to avoid impacts during management actions at CBG (see Section 6).

Referral will be required if a significant impact to any other MNES is considered likely as a result of management actions outlined in the Plan. Self-assessable criteria are available in the Significant Impact Guidelines 1.1[9] to assist in determining whether a significant impact is likely; otherwise consultation with DoE will be required. Table 6 outlines other MNES. See also Sections 4 and 7.

[7] spectacled flying-fox (*P. conspicillatus*)

[8] http://www.environment.gov.au/system/files/resources/6d4f8ebc-f6a0-49e6-a6b6-82e9c8d55768/files/referral-guideline-flying-fox-camps.pdf Accessed 31 July 2019

[9] http://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance Accessed 31 July 2019

Table 6 Matters of National Environmental Significance – Colac Botanic Gardens summary

Matter of national environmental significance where the EPBC Act applies	CBG site specific response	Standard has or will be met in this Plan
World heritage sites	The Colac Botanic Gardens is not a world heritage site, it does not contain a nationally significant flying-fox camp or nationally significant foraging habitat	Not required
Wetlands of international importance	Lake Colac is not a wetland of international importance, it does not contain a nationally significant flying-fox camp or nationally significant foraging habitat	Not required
Nationally threatened species and ecological communities	The grey-headed flying-fox is listed as a vulnerable species under the EPBC Act list of threatened fauna.	

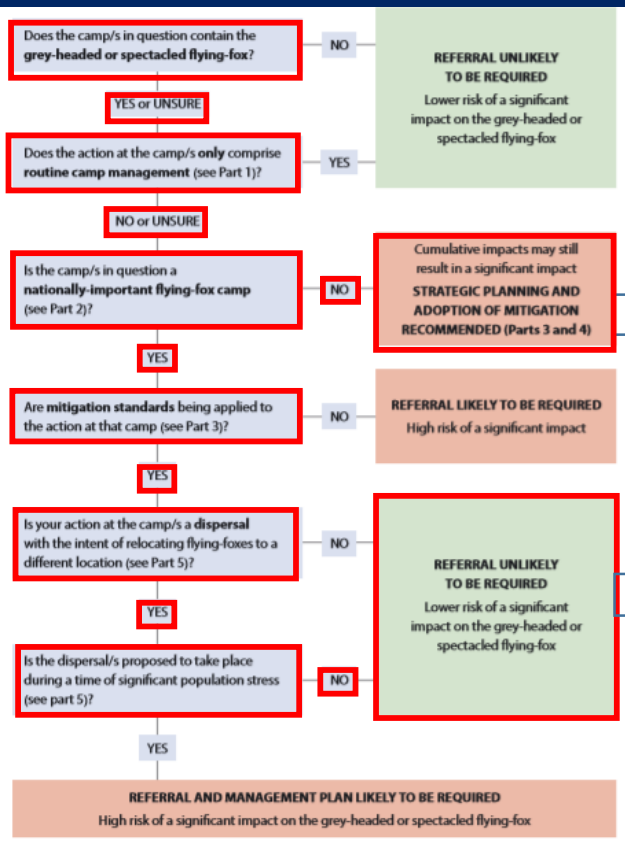
Self assessment process[10]	CBG site-specific response
	CBG requirements are outlined in red. Parts 3 and 4 are responded to in Section 6 ✓ **Approval is not required** to disperse the flying-fox population at the Colac Botanic Gardens from the Australian Government environment minister. Accordingly, DELWP do not need to refer this matter to the DoEE

Figure 13 Summary of the referral decision-making process for proponents

The GHFF is listed as a vulnerable species under the EPBC Act and is therefore a MNES. However the CBG is not a nationally important camp and therefore referral under the EPBC Act is not required. An ATCW from DELWP is required for camp dispersal or other non-routine camp management.

[10] http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

4.1.2 Draft Recovery Plan for the Grey-headed Flying-fox 2017

The Draft Recovery Plan provides a suite of objectives, performance criteria and actions to be used in management plans for the national flying-fox population. Despite the fact that the CBG is not a nationally important camp, Council has responded to the objectives and actions in Table 7.

Table 7 Draft Recovery Plan for the grey headed flying-fox. Summary of objectives and actions

	Objective	Action	Standard has or will be met in this Plan
1	Identify, protect and enhance native foraging habitat critical to the survival of the GHFF.	Actions associated with this objective seek to increase foraging habitat in Australia by 100km2.	✓
2	Identify, protect and enhance roosting habitat of GHFF camps.	Actions associated with this objective seek to protect ten nationally significant camps and provide legislation for this.	✓
3	Determine population trends in GHFF so as to monitor the species' national distribution and conservation status.	Actions associated with this objective include improved monitoring and a more detailed understanding of the population.	✓
4	Build community capacity to coexist with GHFF and minimise the impacts on urban settlements from existing camps without resorting to dispersal.	Actions associated with this objective include improving community engagement and information centred on living with flying-foxes to avoid dispersal numbers.	✓
5	Increase public awareness and understanding of GHFF and the recovery program and involve the community in the recovery program where appropriate.	Actions associated with this objective include improved community education resulting in reduced numbers of camp dispersals.	✓
6	Improve the management of GHFF camps in sensitive areas	Actions associated with this objective include the need to increase public awareness on the referral guideline.	✓
7	Significantly reduce levels of deliberate GHFF destruction associated with commercial horticulture.	Actions associated with this objective seek to limit the impact on crops through non-destructive methods.	✓
8	Support research activities that will improve the conservation status and management of GHFF	Actions associated with this objective seek to increase awareness of the GHFF	✓
9	Assess and reduce the impact on GHFF of electrocution on power lines, and entanglement in netting and on barbed-wire.	Actions associated with this objective include reducing the extent of man-made obstacles that may impact on the health of the GHFF	✓

This flying-fox management plan will respond to the objectives, performance criteria and actions outlined above.

4.2 State

4.2.1 Flora and Fauna Guarantee Act 1988

The *Flora and Fauna Guarantee Act 1988* (FFG Act) is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The Act is designed to protect species, genetic material and habitats, to prevent extinction and allow maximum genetic diversity. The Act's objectives aim to conserve all of Victoria's native plants and animals.

The Act establishes a range of mechanisms to achieve this objective, including:

- listing threatened species, communities and threats to native species
- requiring an overarching strategy for Victoria's biodiversity
- enabling the declaration of habitat critical to the survival of native plants and animals
- placing a duty on public authorities to have regard to the objectives of the Act in their operations
- requiring permits for activities that could harm threatened plants and animals and their communities.

As at 2013, the GHFF was listed as a threatened species under the Victorian *Flora and Fauna Guarantee Act 1988*.

Penalties apply if a dispersal is not handled correctly.

4.2.2 Protecting Victoria's environment – Biodiversity 2037

Victoria's biodiversity strategy, Protecting Victoria's Environment 2037 was released in April 2016. Required under the FFG Act the Plan states that:

- *Native plants and animals have an intrinsic right to exist, thrive and flourish. Multiple life forms contribute to biodiversity and have significant intrinsic value. Victorians have a duty to protect biodiversity, regardless of whether it provides tangible benefits to humans.* [11]
- *There will be continuing changes to species numbers and distribution, and to the extent and quality of their habitats.*[12]
- *Human-induced changes to the environment have, in some situations, led to native species …becoming locally overabundant, often to the detriment of other native species. Coordinated planning and implementation may be needed to address over-abundance where there are significant impacts on biodiversity assets. In some circumstances, however, targeted action at a local level may be sufficient to mitigate the impact.*[13]

[11] https://www.environment.vic.gov.au/__data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf Accessed 6 June 2019. Page 6

[12] https://www.environment.vic.gov.au/__data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf Accessed 6 June 2019. Page 8

[13] https://www.environment.vic.gov.au/__data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf Accessed 6 June 2019. Page 47

There is a need to respond to the impact of the flying-fox in the local area and at the same time, support the ongoing sustainability of the species.

4.2.3 Wildlife Act 1975

All native wildlife is protected in Victoria. The sustainable use of wildlife is provided for under the *Wildlife Act 1975* (Wildlife Act)[14].

The purposes of this act are:

a) to establish procedures in order to promote-
   i. the protection and conservation of wildlife; and
   ii. the prevention of taxa of wildlife from becoming extinct; and
   iii. the sustainable use and access to wildlife; and
b) to prohibit and regulate the conduct of persons engaged in activities concerning or relating to wildlife.

It is an offence to kill, take, control or harm wildlife under the Wildlife Act. Severe penalties (including imprisonment and fines) apply to those found guilty of an offence under the Wildlife Act.

Anyone wishing to control wildlife must have an authorisation from DELWP. The most common authorisation is an Authority to Control Wildlife (ATCW).

Under the Act, causing the death of a flying-fox can result in a fine of up to $37,310 and/or 24 months' imprisonment. Further penalties under the *Prevention of Cruelty to Animals Act 1986* may also apply.

The ATCW is currently under review[15].Outcomes of the community engagement process that will influence future processes include:

- support for a streamlined ATCW process; and
- the acknowledgement that wildlife can be destructive and that appropriate management is needed.

ATCW for the GHFF in Victoria:

DELWP is transparent with the community about issuing ATCW licenses. DELWP typically issue ATCW approvals for matters such as Corellas and Grey Kangaroos, both of which are abundant species and not listed as threatened on the State or Commonwealth lists. ATCWs can be issued for the non lethal control of threatened species, for example, to scare GHFF to avoid the destruction of property.

In recent years the following ATCW permits have been issued to manage the GHFF in Victoria[16]:

[14] https://www.wildlife.vic.gov.au/managing-wildlife/wildlife-management-and-control-authorisations

[15] https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/2315/4095/0012/ATCW_Consultation_Response_Summary-FINAL.pdf Accessed 6 June 2019

[16] ATCW data annual data 2009-2018, DELWP

Table 8 ATCW permits issued for the GHFF in Victoria

Year	Number of ATCW permits issued by DELWP	Number of animals
2018	8	11,700
2017	5	10,300
2016	4	3,400
2015	2	1,800
2014	7	8,560
2013	3	5,200
2012	1	1,000
2011	1	1,000
2010	2	9,000
2009	3	200

Council requires approval from DELWP for an ATCW license.

To support Council's ATCW application, DELWP require additional information on the flying-fox in Colac Otway Shire, its habitats, threats and proposed management actions.

Table 9 ATCW permit requirements

Requirements of the ATCW application process	Standard has or will be met in this Plan
Property details	✓
Species and number of wildlife recorded	✓
Type and extent of damage	✓
The actions taken that do not require an ATCW	✓
Proposed control method	✓

4.2.4 Prevention of Cruelty to Animals Act 1986

The purpose of this Act is to:

- prevent cruelty to animals; and
- to encourage the considerate treatment of animals; and
- to improve the level of community awareness about the prevention of cruelty to animals.

The Minister for Agriculture is responsible for The *Prevention of Cruelty to Animals Act 1986* (POCT Act). It is administered by staff in the Biosecurity Division of the department and consists of the principal Act, Regulations and a large number of Codes of Practice.

The Act does not permit cruelty to animals to occur.

Penalties apply under the *Protection of Cruelty to Animals Act 1986* if a dispersal is not handled correctly.

4.2.5 Heritage Act 2017

The *Heritage Act 2017* is administered by Heritage Victoria. It is the central piece of legislation to manage Victoria's cultural heritage. The Act (and its register) identifies and protects heritage places including trees and gardens that are of state level significance.

The Minister for Planning is responsible for the Heritage Act and the associated Victorian Heritage Register. The Colac Botanic Gardens are listed on this register as VHR H2259[17]. As the land manager for the gardens, Council has a formal obligation and duty of care to ensure that:

- the cultural heritage significance of the gardens is upheld;
- the plantings are managed to ensure that they are in a healthy state and free of pests and disease; and
- that all physical elements such as pathways, buildings fences and other features are conserved.

The entire site is subject to the Heritage Act. Individual trees are listed on the Statement of Significance.

Council, as land manager, has an obligation under the Heritage Act to conserve and maintain the CBG. In light of the impacts of the flying-fox population on the CBG, the management plan should respond to the ongoing health of the trees.

No permit is required under the Heritage Act for regular maintenance.

Heritage Victoria will consider exemptions for the removal of dead, diseased or dangerous trees.

4.2.6 The Planning and Environment Act 1987

The *Planning and Environment Act 1987* sets out the objectives for land use planning in Victoria and the legislative framework for achieving these objectives.

The Act:

- sets out to 'provide for the protection of natural and manmade resources and the maintenance of ecological processes and genetic diversity'
- requires municipalities to prepare and administer local planning schemes and protection of the natural environment
- sets out processes for enforcing planning schemes.

[17] Colac Botanic Gardens Statement of Significance. Heritage Council of Victoria

Table 10 Colac Otway Planning Scheme. State planning controls impacting on flying-fox management

Clause	Name of control	Impact of planning control
12.01-1S	Protection of biodiversity	Consideration of loss of habitat, particularly rare or threatened species.

The key State clause is:

There is a state government requirement to consider habitat loss of threatened species.

4.3 Approvals pathway summary (Federal and State)

Approvals from the Australian Government environment minister.

Approval is not required to disperse the flying-fox population at the Colac Botanic Gardens from the Australian Government environment minister.

Accordingly, DELWP do not need to refer this matter to the Department of Energy and Environment.

Approvals from the Victorian Government: DELWP

Council require approval from the Department of Environment, Land, Water and Planning for an Authority to Control Wildlife license.

To support Council's ATCW application, DELWP require additional information on the flying-fox in Colac Otway Shire, its habitats, threats and proposed management actions.

This includes:

- property details;
- species and number of wildlife recorded;
- type and extent of damage;
- the actions taken that do not require an ATCW; and
- proposed control method.

This information will be provided in the GHFF Management Plan for the Colac Botanic Gardens that will support the ATCW application.

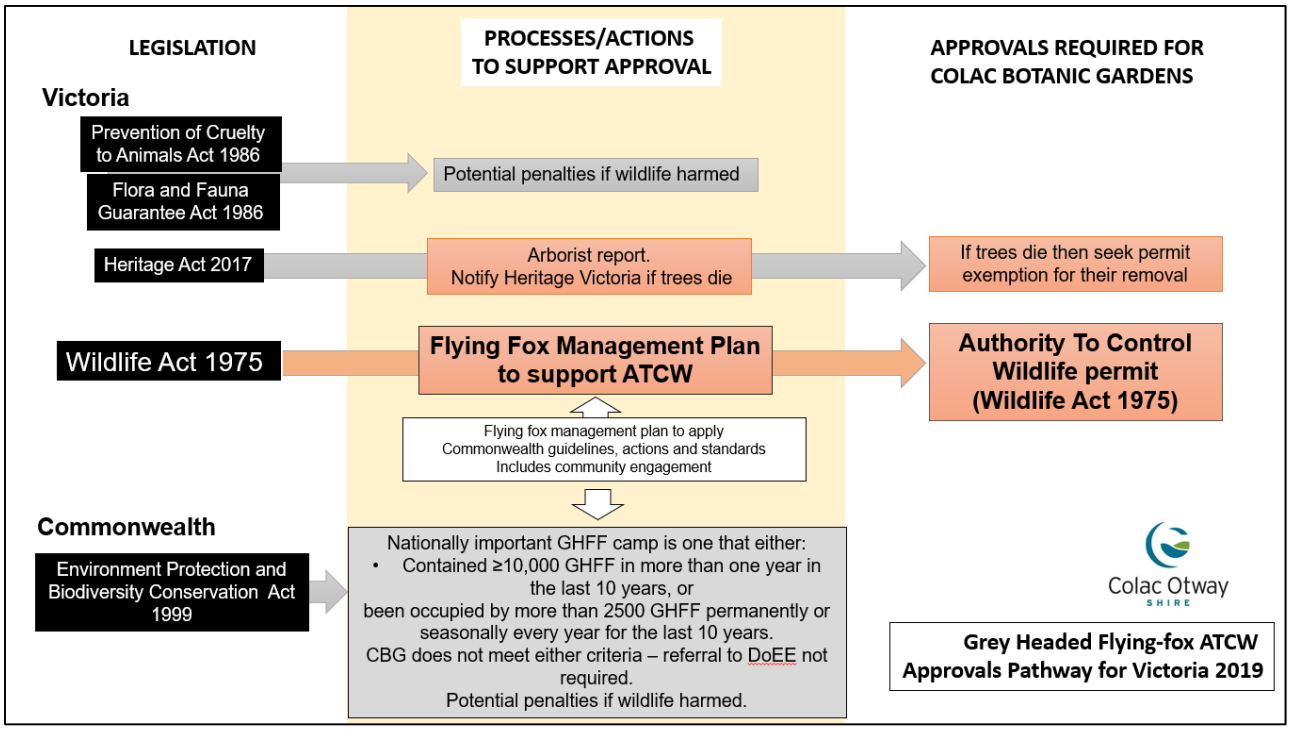


Figure 14 Approvals pathway for CBG

4.4 Local

Meeting local provisions is not a formal requirement of the Wildlife Act or the EPBC Act processes. A summary is provided below to demonstrate that the proposal meets the requirements of the local policy platform of the Colac Otway Shire.

4.4.1 The Colac Otway Planning Scheme

The Colac Otway Planning Scheme provides the following provisions for the CBG. They are listed below with their relevance provided:

Table 11 Colac Otway Planning Scheme. Local Planning controls. Colac Botanic Gardens site

Clause	Name of control	Impact of planning control	Standard has or will be met in this Plan
21.04-9	Municipal Strategic statement Cultural Heritage	The MSS notes the importance of the historic places and landscapes (the CBG) as being key to the identity of Colac.	✓
36.02	PPRZ Public park and recreation zone	No permit is required for planting, landscaping or maintenance works.	✓
42.01	ESO2 Environment significance overlay 2	No permit is required for maintenance works of non-native vegetation.	✓
43.01	HO Heritage Overlay (ref 113)	Exempt due to the site being on the Heritage Register	Not required

No permits are required under the Colac Otway Planning Scheme for flying-fox management.

4.4.2 Council Plan 2017-2021

Relevant to the management of the flying-foxes at the CBG is the following goal and corresponding action[18]:

4: Leadership in natural environment through good management practices.

enabled through:

15. Ensure best practice guides planning and management of the natural environment and associated assets, and Council's response to climate change.

Council will meet its commitment to its community by ensuring that best practice standards and management of the flying-fox colonies are applied.

4.4.3 Lake Colac Foreshore Masterplan 2016-2026

The adopted masterplan notes the environmental sensitivity of the shallow lake and its ecosystem and seeks to reinstate native vegetation.

By reinstating native vegetation on the shores of Lake Colac there may be opportunities to establish new flying-fox habitats away from the township that will support the flying-fox.

4.4.4 Colac Botanic Gardens Masterplan review 2012[19]

The masterplan provides short, medium and long-term actions for the gardens that take into account its heritage status, micro climate, capacity for additional canopy trees and environmental risks. The latter addresses weed management and climate change impacts on plantings. No commentary is provided on flying-foxes. Suggestions for improved signage and a stronger on line presence are noted.

Education and awareness on flying-foxes can be included in any signage updates at the gardens.

4.4.5 Colac Otway Shire Environment Strategy 2017

The Strategy and the Action Plan identifies Council managed land as a key focus area for improved environmental management although there is a strong focus on native vegetation rather than European landscapes. It also notes the importance of education and awareness programs to assist in environmental management.

Education and awareness will be central to Council's approach to community engagement in developing the flying-fox strategy.

[18] Council Plan 2017-2021 Page 16

[19] Richard Barley, Open Gardens Australia

5 Other ecological values of the site

Vegetation is mapped as Ecological Vegetation Community Grassy Woodland, with the most north-eastern extent mapped as Swamp Scrub (refer Figure 16). However this is based on modelling and was inconsistent with vegetation on site, which is a highly modified planted environment consisting mainly of non-native vegetation with a mown understorey.

NatureKit and Vic Biodiversity Atlas were searched for state-listed species but none have been recorded.

MNES identified as potentially occurring are shown in Appendix D. Given the nature of the CBG it is considered highly unlikely this site would be important for any MNES.

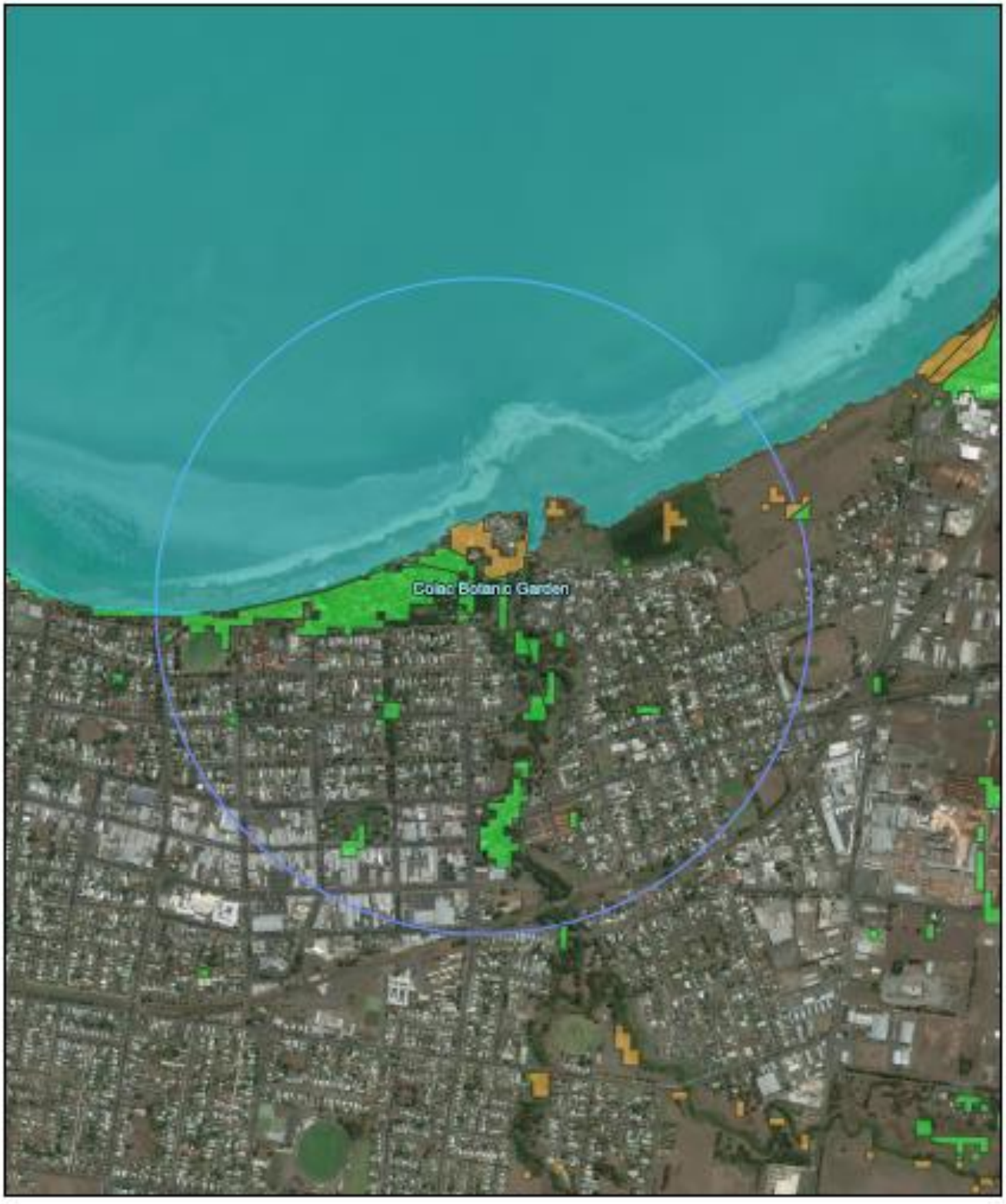


Figure 16: Ecological Vegetation Class

Colac Otway Shire Council

Flying-fox expert consultancy support

1km buffer

Ecological vegetation class

Grassy Woodland

Swamp Scrub

Water body - salt

ecosure

Job number: PR4527
Revision: 0
Author: SR
Date: 31/07/2019

0 150 300 450 m

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

6 Management approach

6.1 Management options and planned actions

An overview of all management options available and considered for Colac is provided in Appendix E. Management actions are categorised as Level 1, 2 or 3:

- Level 1: Routine camp management actions (approval for actions not required)
- Level 2: Creation of buffers (DELWP approval required)
- Level 3: Camp disturbance or dispersal (DELWP approval required).

Table 12 provides an overview of options and planned management actions for flying-foxes in Colac. A dispersal strategy is detailed in Section 6.2.

Table 12 Analysis of management options. Detail about management options is provided in Appendix E.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 1 actions					
Education and awareness programs	Fear of disease Noise Smell Faecal drop	$	Low cost, increasing awareness will help the community understand the ecology of flying-foxes, providing options for landholders to reduce impacts. This is an effective long-term solution, can be undertaken on an ongoing basis and based on community concerns.	Education and advice itself will not mitigate all issues, and on its own would not be acceptable to the community.	Council has engaged with the community in the development of this Plan (see Section 3), and will continue to provide information via Council's website and the provision of fact sheets. Council's flying-fox awareness program will focus on alleviating community concern, including how to effectively mitigate the low health risk associated with flying-foxes, the ecological importance of flying-foxes, options available to reduce impacts from roosting and foraging flying-foxes, information about flying-fox behaviour and numbers at Colac, and management actions being undertaken.
Property modification	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$–$$	Property modification is one of the most effective ways to reduce amenity impacts of a camp, promotes conservation of flying-foxes, is a long-term option, can be undertaken quickly, will not impact on the site and may add value to the property.	May be cost-prohibitive for private landholders, however subsidies would assist	At this stage the impact on property has been minimised and property modifications have not been required. Appendix E provides options for landholders to modify their properties to reduce the impact of foraging flying-foxes if required. If roosting flying-foxes impact properties in the future, Council will liaise with affected landholders regarding available management options, and will investigate a subsidies program for property modification or services (e.g. cleaning) if the community is being significantly impacted.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 1 actions					
Routine management	Health/wellbeing	$	Will allow property maintenance, likely to improve habitat, could improve public perception of the site, will ensure safety risks of a public site can be managed. Weed removal has the potential to reduce camp availability and reduce numbers of roosting FFs. To avoid this, weed removal should be staged and alternative camp habitat planted, otherwise activities may constitute a Level 3 action.	Will not generally mitigate amenity impacts for nearby landholders. Impact on the heritage listed trees is a high priority for Council and removal of trees within the CBG is not a preferred strategy.	Council's park maintenance regime will continue, including: • removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist • weed removal • trimming of understorey vegetation or the planting of vegetation at alternative sites • application of mulch or removal of leaf litter or other material on the ground • mowing grass and similar groundskeeping actions that will not create a major disturbance to roosting flying-foxes. Private landholders are also permitted to undertake routine property maintenance activities provided flying-foxes are not disturbed and actions are in line with measures in Section 6. Council is preparing a Standard Operating Procedure for working around flying-foxes based on information in this Plan to ensure human health and safety and flying-fox welfare during management activities.
Alternative habitat creation	All	$$–$$$	If successful in attracting FFs away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts, promotes FF conservation. Rehabilitation of degraded habitat that is likely to be suitable for FF use could be a more practical and faster approach than habitat creation.	Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract FFs to a new site have not been known to succeed.	Council has identified potential alternative flying-fox camp sites in the Colac area (see Section 6.2.1) and is commencing a program of restoration and planting with a view of creating alternative flying-fox roosting habitat in low conflict locations. This is part of a strategic and long-term approach to make inappropriate sites (e.g. the CBG) less attractive whilst concurrently improving appropriate sites.
Provision of artificial roosting habitat	All	$–$$	Artificial roosting habitat could be considered to supplement vegetation damaged by large numbers of flying-foxes.	No guarantee that flying-foxes would use artificial habitat, but collaborating with a researcher on varying design options would increase the likelihood of success.	The provision of artificial roosting habitat has had limited success in the past and is unlikely to sufficiently reduce impacts to heritage trees in the CBG. The open vegetation structure in the CBG with individual or small clusters of mature trees is also not well suited to this option, with artificial roost structures more likely to be utilised by flying-foxes in more dense and connected vegetation. For these reasons this option is not currently being considered further with Council's preferred option being to establish alternative sites and continue an appropriate tree planting regime.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 1 actions					
Protocols to manage incidents	Health/wellbeing	$	Low cost, will reduce actual risk of negative human/pet–FF interactions, promotes conservation of FFs, can be undertaken quickly, will not impact the site.	Will not generally mitigate amenity impacts.	A Flying-fox Rescue Protocol is provided in Appendix F. Council is also developing a Standard Operating Procedure for working around flying-foxes to ensure human health and safety and flying-fox welfare.
Research	All	$	Supporting research to improve understanding may contribute to more effectively mitigating all impacts, promotes FF conservation.	Generally cannot be undertaken quickly, management trials may require further cost input.	Council has commenced discussions with other Victorian authorities to improve internal understanding of flying-fox behaviour and results of dispersal programs.Council will provide in-kind support and stay up-to-date on contemporary research, particularly projects that inform effective management of flying-fox impacts. Relevant findings will be incorporated in this Plan during annual reviews.
Appropriate land-use planning	All	$	Likely to reduce future conflict, promotes FF conservation. Identification of degraded sites that may be suitable for long-term rehabilitation for FFs could facilitate offset strategies should clearing be required under Level 2 actions.	Will not generally mitigate current impacts, land-use restrictions may impact the landholder.	Council may consider including buffer zones and recommendations for appropriate mitigation provisions in reviewing applications for development around flying-fox camps.
Property acquisition	All for specific property owners Nil for broader community	$$$	Will reduce future conflict with the owners of acquired property.	Owners may not want to move, only improves amenity for those who fit criteria for acquisition, very expensive.	Cost prohibitive and not likely to be a feasible option for Colac Otway Shire.
Do nothing	Nil	Nil	No resource expenditure.	Will not mitigate impacts and unlikely to be considered acceptable by the community.	As detailed in the arborist report (Appendix G), if the flying-foxes continue to camp in the CBG some trees will be permanently damaged, including National Trust classified heritage trees, and tree losses are likely. Council has a responsibility to protect these trees and the option of doing nothing is not appropriate.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 2 actions					
Buffers through vegetation removal	Noise Smell Health/wellbeing Property devaluation Lost rental return	$–$$	Creates a buffer between roosting flying-foxes and sensitive sites to reduce associated impacts.	Will impact the site, will not generally eliminate impacts, vegetation removal may not be favoured by the community, can increase visibility into the camp and noise issues for neighbouring residents which may create further conflict.	Buffers are suited where flying-foxes are roosting in close proximity to sensitive receivers (e.g. residents). This option is not applicable to the CBG camp and would not mitigate impacts to heritage trees. Buffers may be evaluated in consultation with DELWP should flying-foxes establish at a new site near sensitive receivers.
Buffers without vegetation removal	Noise Smell Health/wellbeing Damage to vegetation Property devaluation Lost rental return	$$	Successful creation of a buffer will reduce impacts, promotes FF conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community.	May impact the site, buffers will not generally eliminate impacts, maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.	While buffers are not suited to the CBG (see above), non-harmful deterrents (as detailed in Appendix E and Section 6) will be installed at the CBG to deter flying-foxes from re-establishing and limit the need for ongoing active dispersal.
Noise attenuation fencing	Noise Smell Health/wellbeing Property devaluation Lost rental return	$$	Will eliminate/significantly reduce noise impacts, will reduce other impacts, limited maintenance costs.	Costly, likely to impact visual amenity of the site, will not eliminate all impacts, may impact other wildlife at the site.	Noise attenuation fencing is suited where noise from a camp is impacting nearby sensitive receivers. This option is not applicable to the CBG camp and impacts to heritage trees, however may be evaluated in consultation with DELWP should flying-foxes establish at a new site near sensitive receivers.
Level 3 actions					
Nudging	All	$$–$$$	If nudging is successful this may mitigate all impacts.	Costly, FFs will continue attempting to recolonise the area unless combined with habitat modification/ deterrents.	There is no habitat contiguous to the CBG that is suitable for a flying-fox camp and therefore this option is not being considered for the CBG at this stage. If flying-foxes relocate to another site where nudging may be suitable, Council will notify DELWP of planned modifications to the timing and intensity of dispersal actions from moderate intensity at dawn to low intensity later in the day (e.g. 8am) to nudge flying-foxes in contiguous habitat while minimising the risk of inadvertent dispersal.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 3 actions					
Passive dispersal through vegetation management	All at that site but not generally appropriate for amenity impacts only	$$–$$$	If successful can mitigate all impacts at that site, compared with active dispersal: less stress on FFs, less ongoing cost, less restrictive in timing with ability for evening vegetation removal.	Costly, will impact site, risk of removing habitat before outcome known, potential to splinter the camp creating problems at other locations (although less than active dispersal), potential welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see Section 6.2.5), potential to impact on aircraft safety.	Not appropriate at the CBG, however this option may be evaluated in consultation with DELWP should flying-foxes establish at a new undesirable site.
Passive dispersal through water management	All at that site but not generally appropriate for amenity impacts only	$$–$$$	Potential advantages as per with passive dispersal through vegetation removal, however likelihood of success unknown.	Potential disadvantages as per passive dispersal through vegetation removal, however likelihood of success unknown.	This option may be suited to an undesirable site with a small waterbody but is not applicable to the CBG which is located immediately adjacent to Lake Colac.
Active dispersal	All at that site but not generally appropriate for amenity impacts only	$$$	If successful can mitigate all impacts at that site, often stated as the preferred method for impacted community members.	May be very costly, often unsuccessful, ongoing dispersal generally required unless combined with habitat modification, potential to splinter the camp creating problems in other locations, potential for significant animal welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see Appendix H), potential to impact on aircraft safety.	This is Council's preferred option in conjunction with establishing alternate sites within the region. Flying-foxes have only been irregularly observed at the CBG for three years and are likely to have a relatively low site fidelity, which should improve the likelihood of a successful dispersal. A detailed dispersal strategy is provided in Section 6.2.

Management option	Relevant impacts	Cost	Advantages	Disadvantages	Site-specific detail and actions
Level 3 actions					
Early dispersal before a camp is established at a new location	All at that site	$$–$$$	Potential advantages as per other dispersal methods, but more likely to be successful than dispersal of a historic camp.	Potential disadvantages as per other dispersal methods, but possibly less costly and slightly lower risk than dispersing a historic camp. Potential to increase pressure on FFs that may have relocated from another dispersed camp, which may exacerbate impacts on these individuals.	Any new camp in Colac will be assessed as per Section 6.2.11, and flying-foxes roosting in undesirable locations will be dispersed in accordance with the dispersal strategy in Section 6.2 before a camp establishes.

6.2 Dispersal strategy

There is a range of risks associated with camp dispersal. These include:

- shifting or splintering the camp into other locations that are equally or more problematic
- impacts on animal welfare and flying-fox conservation
- impacts on the flying-fox population including disease status and associated public health risk
- impacts to the community associated with ongoing dispersal attempts
- high initial and/or ongoing resource requirement and financial investment
- negative public perception form community members opposed to dispersal
- increased risk of aircraft strike associated with altered flying-fox movements during or after dispersal
- conditions or restrictions specified by private landholders which may reduce the likelihood of dispersal succeeding.

This strategy aims to manage these risks as best as possible, however it must be recognised that dispersals are always unpredictable and the ability for trained personnel to adaptively manage is critical to effectively minimising risk.

This approach is also based on best practice and aligns with Parts 3, 4 and 5 of the Referral Guideline.

6.2.1 Alternative camp habitat

Council has identified five potential alternative sites on Council-managed or Crown land which may be suitable for a permanent camp (see Figure 17 and Appendix B) and is consulting with landholders surrounding these sites with the aim of planting at multiple locations to improve them for roosting flying-foxes. Vegetation at Deanes Creek is considered suitable in its current state but would benefit from additional planting.

As outlined in Appendix I, when dispersed flying-foxes often relocate to within 600 m of the original camp, and almost always within six kilometres. These areas are shown on Figure 17. Four of the five potential alternative sites identified by Council and considered for improvement are within six kilometres of CBG.

There are numerous locations assessed by Ecosure as being suitable camp habitat in their current state. These have been categorised based on site assessment as having high, moderate or low potential habitat values currently (shown on Figure 17). Some of these have high potential for conflict given proximity to sensitive receivers, however there are several with moderate-high habitat suitability and low potential for conflict.

Prior to dispersal commencing a target site will be identified and DELWP notified (likely either Deanes Creek 2.6 km to the west or Joseph Paatsch Nature Reserve / Colanda St 1.7 km and 2.1 km respectively to the SE). However, given the unpredictable nature of flying-fox dispersals, locations where flying-foxes relocate will be assessed on a case-by-case basis (see Section 6.2.11). Planting of appropriate alternative locations will continue concurrently to ensure there is a low conflict available for the long-term persistence of flying-foxes in Colac.

A number of locations have been determined as unsuitable as alternative sites. These include

- Barongarook Creek Precinct (except Joseph Paatsch Reserve)
- Colac Memorial Square
- Colac Racecourse
- Educational facilities
- Queens Ave Colac Lake Foreshore
- Child Care Centres

In establishing locations that are deemed unsuitable Council considers the following principles to be relevant in decision making;

- Proximity to educational facilities and Child Care Centres
- Impact on residents in new roosting area
- Suitability of area to be further treated with additional tree planting
- Ability for new area to support flying-foxes through heat stress events

Figure 17: CBG, sensitive receivers and potential alternative sites

Colac Otway Shire Council

Flying-fox expert consultancy support

Potential alternative sites
Pre-school/child care
Primary School
Combined Primary/Secondary
Secondary School
Hospital
Parks
Equine facilities
Sporting grounds
600m buffer
1km buffer
6km buffer
Potential roost habitat
Low likelihood
Moderate likelihood
High likelihood
Unknown likelihood (not ground-truthed)

ecosure

Job number: PR6527
Revision: 0
Author: SR
Date: 31/01/2019

0 500 1000 1500 m

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

6.2.2 Dispersal methods

A range of tools can be used to actively disperse flying-foxes as they attempt to return to the camp pre-dawn after nightly foraging. Appendix J outlines available tools and their suitability for use in Colac.

Dispersal tools should vary and be used at unexpected locations to avoid flying-foxes habituating, which may render that tool ineffective for the mid to long term. Each dispersal team member should have multiple tools (visual and aural) that can be used intermittently, and changed as required in response to flying-fox behaviour. If flying-foxes are not responding to a dispersal tool, it should be immediately replaced to avoid habituation.

Smoke is one of the most effective dispersal methods (Ecosure pers. obs. 2010-2019) and, compared to unexpected bursts of loud noise, it is considered relatively passive given that fires are a natural phenomenon and flying-foxes become aware of the disturbance from some distance away. **N.B.** Materials must not include anything that may create toxic smoke e.g. toxic vegetation, paint, treated wood etc. The number and location of smoke drums will be determined on a daily basis in response to flying-fox movement and behaviour, as well as weather conditions.

6.2.3 Roles and responsibilities

Table 13 provides a description of roles and responsibilities.

The following is an indicative dispersal resource allocation (the number of personnel may be downscaled if appropriate, or conversely, additional resources may be required):

- Dispersal Supervisor roaming between sites – flying-fox expert[20] to roam between dispersal sites.
- CBG - four or more dispersal personnel on all dispersal days (at least one flying-fox expert[20], in addition to the Program Coordinator).
- Foreshore adjacent the CBG – two or more dispersal personnel on all dispersal days.
- Attractive habitat in high conflict locations to the east and south of the CBG between Lake Colac Caravan Park and Sculpture Park - three or more personnel on all dispersal days. Note if flying-foxes move behind the Visitor Centre or near Eastern Reserve dispersal should be paused and the location assessed. Some of these areas may be suitable for a camp with good buffers to sensitive receivers, or if not, a nudging program should be considered over dispersal to encourage flying-foxes to Joseph Paatsch Nature Reserve.
- An additional stand-by team (three people) should a splinter colony form in an undesirable location.

All team members should be in regular communication over two-way radio, providing information on flying-fox behaviour and movements to the Dispersal Supervisor who will coordinate and direct activities. It is critical that the dispersal approach is continually adapted in a strategic way in response to flying-fox behaviour, changes to risk based on location etc. and other variables (e.g. weather, community concerns).

[20] see glossary definition

Table 13 Roles, responsibilities, authority and communication lines between the management team.

Role	Who	Required competencies	Responsibilities/authority	Communication lines
Program Coordinator	Council/Contractor	As required by Council.	· Stakeholder consultation · Landholder liaison and access · Report to DELWP · Inform and consult with the community and interested parties · Determine management actions in consultation with Dispersal Supervisor · Evaluate program	Reports to: Council and stakeholders Direct reports: Dispersal Supervisor
Dispersal Supervisor* (roams between dispersal teams)	Council/ Contractor	Flying-fox expert (see glossary definition); able to take general fauna spotter catcher role responsible for rescuing other fauna if required.	· Coordinate field teams · Train all team members and endorse as competent · Induct all personnel to the program · Coordinate daily activities for each team · Collect and collate data · Liaise with DELWP · Liaise with wildlife carers/veterinarians (for orphaned/injured wildlife only) · Report daily to Program Coordinator	Reports to: Program Coordinator Direct reports: Team Supervisors
Team Lead** (per dispersal site)	Council/ Contractor	All to be endorsed as competent by Dispersal Supervisor. CBG Team Lead (in addition to the roaming Dispersal Supervisor) must also be a flying-fox expert (see glossary definition) and able to take general fauna spotter catcher role responsible for rescuing other fauna if required.	· Pre- and post-dispersal monitoring · Coordinate daily site briefings · Monitor flying-fox behaviour · Rescue flying-foxes if required (and no carer/vet on site) · Determine daily dispersal end point · Participate in dispersal activities	Reports to: Dispersal Supervisor Direct reports: Team Members
Team Member	Council/ Contractor	All to be endorsed as competent by Dispersal Supervisor.	· Participate in Dispersal Supervisor training · Attend daily site briefings · Participate in dispersal as directed by Dispersal Supervisor	Reports to: Supervisor Direct reports: Nil
Observer/support	Wildlife Carer/Veterinarian	Relevant qualifications and licences	· Provide care of injured/orphaned wildlife if required	Reports to: Supervisor Direct reports: Nil

6.2.4 Timing

6.2.4.1 Seasonal timing

Initial dispersal will avoid periods when females are in the late stages of pregnancy, or when dependent young are present. Peak mating periods will also be avoided. Appendix K provides indicative timeframes of the GHFF breeding cycle which shows that dispersal should generally be timed between May and August to avoid impacting the breeding season. However, as the breeding season is influenced by a range of variables and out-of-season breeding is not uncommon, dispersal timing should be based on assessment by a flying-fox expert20 rather than through confinement to pre-determined times of the year.

Note that maintenance dispersal[21] to prevent camp re-establishment or early intervention dispersal to prevent a new camp establishing in an undesirable location may occur during the GHFF breeding season (September – May) provided a flying-fox expert[20] determines that breeding and animal welfare will not be impacted. Maintenance dispersal during this time will be restricted to low intensity methods only (e.g. smoke and recorded sounds played consistently) to minimise the risk of stressing and impacting more susceptible individuals that may join the camp at any time (e.g. pregnant females, females carrying pups). No intentional disturbance, including maintenance dispersal, will occur if crèched young are present (as assessed by a flying-fox expert[20]). Dispersal monitoring must be rigorous at all times, but especially at times when breeding animals may join the camp.

6.2.4.2 Daily timing

Dispersal teams should be in position prior to flying-foxes returning to the camp, which is generally approximately half an hour before first light. While the CBG camp does not meet the criteria for a nationally important camp, Council is committed to following best practice and as such, in accordance with mitigation standards in the EPBC Referral Guideline for Management of GHFF Camps (Part 3), active disturbance will be limited to a maximum of 2.5 hours in any 12 hour period.

Other standards aligned with Part 3 and Part 5 of the Referral Guideline are detailed in Section 6.2.8 and 6.2.10).

6.2.5 Human health and safety

Flying-foxes may carry pathogens with the potential to cause disease in humans. Australian Bat Lyssavirus (ABLV) is a rabies-like virus that may be transmitted to humans through exposure to saliva of an infected flying-fox (or other bat). All known cases have been through a bite or scratch, however exposure to mucous membranes (eyes, mouth) could potentially also lead to infection. While ABLV is fatal if it develops, effective pre- and post-exposure vaccinations and other simple measures to prevent the disease in humans are available.

Council and contractors will need to complete their own risk assessments to determine whether pre-exposure vaccinations are required. The following precautions should be adopted:

- only appropriately trained personnel with ABLV pre-exposure vaccinations, wearing puncture resistant gloves and forearm protection, are to attempt to handle or capture an animal

[21] Maintenance dispersal refers to active disturbance following a successful dispersal to prevent the camp from re-establishing. It differs from initial dispersal by aiming to discourage occasional over-flying individuals from returning, rather than attempting to actively disperse animals that have been recently roosting at the site.

- all personnel to wear appropriate PPE: long sleeves and pants, eye protection and hat
- all personnel working underneath the active camp to wash clothes daily
- all personnel working underneath the camp during machine operations that aerosol (e.g. cause dust) the substrate or camp vegetation to also wear protective breathing equipment (P3 breathing mask)
- appropriate hygiene practices must be adopted such as hand washing with soap and water before eating and smoking
- local public health authorities be made aware that the dispersal/vegetation management is occurring and that ABLV exposure may be possible
- if a person is bitten or scratched by a bat, the wound should immediately be washed with soap and water for at least five minutes, followed by application of an antiseptic with anti-viral action (i.e. Betadine) and immediate medical attention (post-exposure vaccinations may be required). Medical attention should also be immediately sought if a person is exposed to an animal's saliva or excreta through the eyes, nose or mouth.

Flying-foxes are also a natural host for HeV, which can be transmitted to horse, likely through contaminated feed or water. Infected horses have been known to amplify the virus and humans can be infected through close contact with an infected horse. There has been no recorded case of direct transmission of HeV from flying-foxes to humans.

This disease is preventable with an effective vaccination available for horses.

Council will consult with horse owners in Colac to ensure HeV risk is appropriately managed.

Further information on bats and human and animal health is provided in Appendix H.

6.2.6 Consultation prior to and during dispersal

6.2.6.1 DELWP

Council will consult with DELWP regularly in the lead-up to dispersal and will provide DELWP with a dispersal schedule prior to commencing.

During dispersal Council will provide DELWP regular updates at least weekly or as conditioned in the ATCW.

Council will notify DELWP at least the day before any planned early intervention dispersal.

In the unlikely event a flying-fox is injured during dispersal, or there is an increase in the number of flying-fox rescues that may be associated with the dispersal, all dispersal activities will be temporarily ceased and DELWP will be immediately consulted to discuss a way forward.

6.2.6.2 Community

The Colac community will be informed of planned dispersal activities, including:

- methods and timeframes
- desired/acceptable outcomes

- program evaluation process (e.g. criteria for further dispersal/stop work triggers)
- contingency planning
- procedures to follow in the event an injured, orphaned or dead flying-fox is located
- precautions to consider during dispersal (e.g. adjacent residents bringing noise-phobic pets inside on dispersal days)
- additional HeV precautionary measures for horse owners
- contact information for the Program Coordinator.

Council will encourage the community to report unusual flying-fox behaviour or activity. Council staff fielding phone calls need to clearly identify whether flying-foxes were likely to have been roosting or foraging (i.e. by time of day/night), so that reports of foraging activity are not mistakenly investigated as possible new camps.

It is critical the community is aware not to interfere with management in any way, both from a statutory perspective but also to allow the program to be properly assessed and strategically managed without impacts from other activities (e.g. unauthorised dispersal).

Council will ensure all landholders have consented where access to non-Council managed land is required.

6.2.6.3 Other stakeholders

In addition to the above, the following stakeholders will also be informed prior to the dispersal:

- local police
- airports and airfields within 20 km of the CBG
- Colac Racecourse - to increase HeV precautionary measures and immediately report daytime flying-fox sightings given the highly attractive habitat on site
- Colac Golf Club - to immediately report daytime flying-fox sightings given the highly attractive habitat on site
- wildlife carers and veterinary staff - to be on stand-by during dispersal
- the Victorian Department of Health and Human Services - to determine ABLV post-exposure vaccination availability if required.

6.2.7 Managing community impacts

Some level of impact is likely for residents within 150 m of dispersal locations (CBG and surrounding suitable habitat), and possibly up to 300 m. Impacts may include:

- sleep disruption on dispersal days (potentially from 0300)
- stress to noise-phobic pets
- irritation associated with smoke used for dispersal (Council will ensure during dispersal planning that residents have relevant contact details to ensure susceptible people, such asthmatics, will not be impacted)
- disturbance during installation of deterrents (which may occur in the evening while flying-foxes are away foraging)
- increased flying-fox vocalising during the day

- flying-foxes roosting in new and potentially undesirable locations (these will be assessed and managed as per Section 6.2.11).

Residents will have contact details for the Program Coordinator/Dispersal Supervisor should any significant issues be experienced and Council will work affected residents to minimise these issues as much as possible.

6.2.8 Monitoring and stop work triggers

A robust monitoring program around the dispersal is required to evaluate its success, ensure flying-fox welfare, and manage cascade risks (e.g. splinter colonies) in a timely and appropriate manner.

Static counts at the camp during the day are the simplest and most resource effective method of monitoring. These also allow an assessment of species composition, breeding status and body condition, which are not possible during a fly-out count.

Monitoring personnel will be experienced in flying-fox identification and biology, and they should be limited in number to minimise the effects of observer bias. Council and contractors will need to complete their own risk assessment to determine requirements for pre-exposure vaccinations against ABLV for personnel (see also Section 6.2.5).

Pre-dispersal and daily monitoring should include:

- a visual flying-fox health and body condition assessment
- breeding status i.e. whether pregnant flying-foxes are in final trimester, dependent young are present or mating behaviour is observed
- age estimates of any sub-adults present
- signs of morbidity or mortality
- camp extent
- a total count. Where parts of the camp are not visible and cannot be accessed, each roost tree that can be seen should be counted and then extrapolated to the estimated total number of roost trees/area of the camp to obtain a total count.

Suitable flying-fox habitat (as shown in Figure 17) will be monitored:

- within three kilometres of the CBG (and other dispersal sites) weekly during and after dispersal
- within one kilometre, or at any high conflict locations within six kilometres (e.g. the Colac Racecourse) daily during dispersal and for the week following dispersal (as shown on Figure 17).

Engaging the community to report unusual flying-fox sightings during and following the dispersal will assist in monitoring potential camp habitat within Colac.

While no other camps are known in a 20 km radius of the CBG (see Figure 9), in the event that one establishes this should also be monitored:

- at least once prior to scheduling the dispersal

- on two consecutive days immediately prior to dispersal. These data can then be compared with counts during and following dispersal to provide an indication of flying-fox movement between camps.
- each day during dispersal
- at least weekly for two weeks following dispersal.

Relevant staff at local aerodromes within 20 km of CBG will be alerted to the program and encouraged to observe changes in flying-fox movement patterns and report back to Council.

Team Leads will be responsible for monitoring flying-foxes during dispersal and triggering the appropriate action as detailed in Table 14 in consultation with the Dispersal Supervisor.

Table 14 Planned action for potential impacts during management.

Welfare trigger	Signs	Action
Unacceptable levels of stress	If any individual is observed: • panting • saliva spreading • located on or within 2 m of the ground • unusual vocalisations	Works to cease for the day.
Fatigue	In-situ management (relates to daily maintenance activities in the CBG) • more than 30% of the camp takes flight • individuals are in flight for more than 5 minutes • flying-foxes appear to be leaving the camp Dispersal • low flying • laboured flight • settling despite dispersal efforts	In-situ management(relates to daily maintenance activities in the CBG) Works to cease and recommence only when flying-foxes have settled* / move to alternative locations at least 50 m from roosting animals. Dispersal Works to cease for the day.
Risk of injury/death	• crèching young present • loss of condition evident • any flying-fox mortality is reported within 1 km of the dispersal site that appears to be related to the dispersal • loss of condition evident; flying-fox appears to have been injured/killed on site (including aborted foetuses)	Works to cease immediately and DELWP notified AND rescheduled OR adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by flying-fox expert (see glossary definition) OR stopped indefinitely and alternative management options investigated.

*maximum of two unsuccessful attempts to recommence work before ceasing for the day.

6.2.9 Maintenance program

Council will regularly monitor the CBG following dispersal (at least weekly for the first three months and fortnightly for the following nine months, reducing as appropriate after the first year). Maintenance dispersal will be undertaken as needed, in accordance with the above dispersal strategy.

Permanent or semi-permanent non-harmful deterrents may also be installed in the CBG to deter flying-foxes from previously unoccupied locations and/or prevent them returning following successful dispersal. These may include:

- Visual deterrents – Visual deterrents such as plastic bags, fluoro vests[22] and balloons in roost trees[23] have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The type and placement of any visual deterrent needs to be varied regularly to avoid habituation. Standard lights and strobes have had limited success at deterring flying-foxes in the past[23], however new technology has been developed by researchers and lighting experts PROVolitans aimed at harmlessly interrupting flying-fox sight to deter them from specific trees. This new technology has been trialled at one flying-fox camp in Queensland with reported good results and may be investigated for CBG in consultation with DELWP.
- Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. Directional speakers could be investigated to minimise impacts to nearby sensitive receivers.
- Canopy-mounted water sprinklers – Canopy sprinklers have been effective in deterring flying-foxes during dispersals[23], and successfully used at numerous camps to deter flying-foxes from designated buffer zones. Design and use of sprinklers need to be considerate of animal welfare and features of the site. For example, misting may increase humidity and exacerbate heat stress events, and overuse may impact other environmental values of the site.
- Physical exclusion – Netting or wires may be used to deter or exclude flying-foxes from returning to heritage trees in the CBG. Physical exclusion must be designed and monitored carefully to ensure flying-foxes and other wildlife do not become entangled.

A flying-fox expert[20] will be consulted prior to the installation of any deterrent to ensure flying-fox welfare is not at risk, and will advise any monitoring requirements for deterrent use (e.g. physical exclusion may require daily monitoring to ensure flying-foxes and other wildlife do not become entangled). DELWP will be notified of the type and placement of deterrents, and any monitoring requirements recommended by the flying-fox expert[20], prior to installation.

6.2.10 Additional flying-fox impact mitigation measures

In addition to those detailed above, the following mitigation measures will be complied with at all times during Plan implementation to align with Parts 3, 4 and 5 of the Referral Guideline:

- All personnel will be appropriately experienced, trained and inducted. Induction will include each person's responsibilities under this Plan.
- All personnel will be briefed prior to the action commencing each day, and debriefed at the end of the day.
- Works will cease and DELWP consulted in accordance with 'stop work triggers' in Section 6.2.8.
- Non-critical maintenance activities will ideally be scheduled when the camp is naturally empty. Where this is not possible they will be scheduled for the best period for that camp (e.g. when the camp is seasonally lower in numbers and breeding will not be interrupted, or during the non-breeding season, generally May to August).

[22] GeoLINK 2012

[23] Ecosure 2016-2017 pers. obs.

- Works will not take place in periods of adverse weather including strong winds, sustained heavy rains, in very cold temperatures or during periods of likely population stress (e.g. food bottlenecks). Wildlife carers will be consulted to determine whether the population appears to be under stress.
- Works will be postponed on days predicted to exceed 35°C, and for one day following a day that reached ≥35°C. If an actual heat stress event has been recorded at the camp or at nearby camps, a rest period of several weeks will be scheduled to allow affected flying-foxes to fully recover. See the OEH fact sheet on Responding to heat stress in flying-fox camps.
- If impacts at other sites are considered by DELWP to be a result of management actions under this Plan, Council will assist the relevant land manager to ameliorate impacts. Details of this assistance are to be developed in consultation with DELWP.
- Any proposed variations to works detailed in the Plan will be approved by DELWP in writing.
- Any additional requirements conditioned in the ATCW will be complied with at all times.
- DELWP may require changes to methods or cessation of management activities at any time.
- Monitoring will be in accordance with Section 6.2.8 and recorded to inform future planning.
- At least one flying-fox rest day with no dispersal or other management will be scheduled fortnightly.

6.2.10.1 Additional measures for vegetation trimming/removal

- Trimming will be in accordance with relevant Australian Standards (e.g. AS4373 Pruning of Amenity Trees), and best practice techniques used to remove vegetation in a way that avoids impacting other fauna and remaining habitat.
- No tree in which a flying-fox is roosting will be trimmed or removed. Works may continue in trees adjacent to roost trees only where a flying-fox expert[20] assesses that no flying-foxes are at risk of being harmed. A flying-fox expert[20] is to remain on site to monitor when canopy trimming/removal is required within 50 m of roosting flying-foxes or when this person considers disturbance of roosting flying-foxes is likely.
- While most females are likely to be carrying young (generally October – January) vegetation removal within 50 metres of the camp will only be done in the evening after fly-out, unless otherwise advised by a flying-fox expert[20].

6.2.10.2 Additional measures for Level 3 actions

- Dispersal methods will be limited to non-harmful methods only, as marked as suitable for use in Colac in Appendix J.
- Dispersal may continue for up to a total of 2.5 hours in a 12-hour period, early morning and/or in the evening. Evening dispersal (if incorporated) will not begin before sunset. If flying-foxes are showing signs of distress or are tiring, dispersal will cease for the day as per 'stop work triggers' in the Plan.
- A section of the camp will be designated as a rest area for flying-foxes during dispersal, to be progressively reduced in size over time, unless the nominated flying-fox expert[20] justifies a reason not to do so.
- Council will liaise with wildlife carers to monitor whether there is an increase in the number of flying-foxes being taken into care or showing signs of stress. If increases

are apparent and coincide with dispersal activities, DELWP will be consulted before continuing dispersal.

- Maintenance dispersal activities (i.e. deterring flying-foxes from recolonising a dispersed or otherwise empty camp) may be undertaken during the breeding season. No dispersal will be undertaken if creched young are in the camp, which will be confirmed September to February by a flying-fox expert[20]. While females are likely to be in final trimester or carrying young (generally September to January), maintenance dispersal will be implemented at a reduced intensity using smoke, lights, continuous noise (no sudden noises) and passive non-harmful deterrents (e.g. canopy-mounted sprinklers turned on prior to fly-in, visual deterrents, etc.).
- Residents will be notified of a planned maintenance action within a timeframe as agreed to by the residents.

6.2.11 Contingency planning

Any new location where flying-foxes are observed roosting during the day will be assessed as per Figure 18.

Early intervention dispersal (concurrent with dispersal at the CBG) will likely be employed to prevent camp establishment if flying-foxes attempt to roost in one of the following locations:

- in close proximity (e.g. 50 m) to residents
- where flying-fox movements are likely to increase the risk of flying-fox/aircraft strike
- adjacent to schools or daycare
- in close proximity to aged care facilities
- in close proximity to equine centres or horse paddocks where HeV risk cannot be sufficiently managed
- where it is likely to cause any other significant conflict.

The dispersal program will be regularly evaluated as detailed in Section 8 and may be adapted (including re-evaluating alternative options) in consultation with DELWP if required.

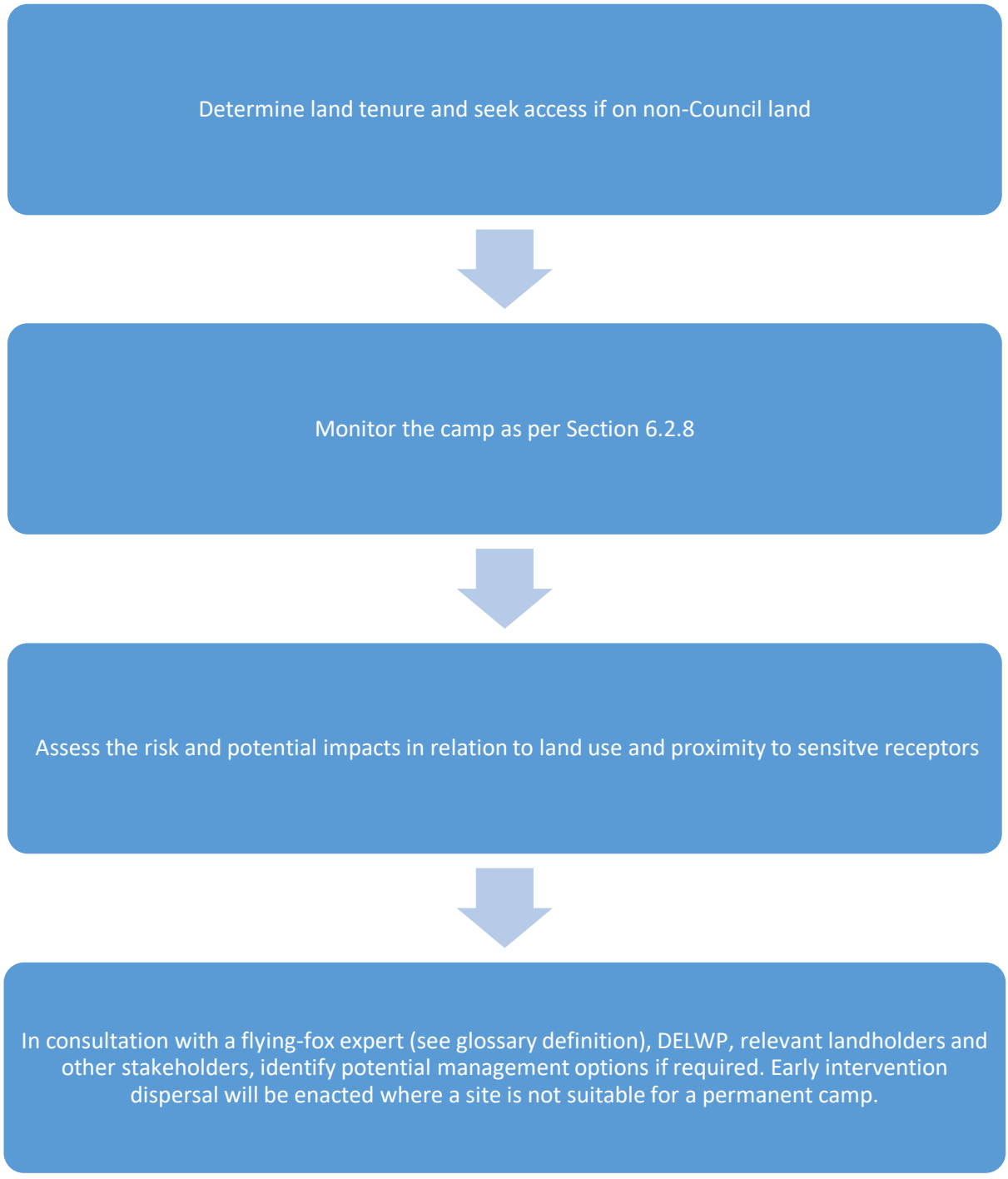


Figure 15 Guideline for assessing a new flying-fox roosting location

7 Assessment of impacts

7.1 Grey-headed flying-fox

The GHFF is highly nomadic and travels long distances in response to flowering and fruiting, moving between camps across its range. Given this nomadic lifestyle, all GHFF individuals are considered to form part of a single population[24].

The CBG has been irregularly used by roosting GHFF since it was first recorded in December 2016, present in 3 of 4 years and 6 of 32 months (used in 75% of years but only 19% of the time). It usually supports between 300 and 3,000 animals, and peaked for one month (January 2019) at 6,500. This peak represents less than 1% of the GHFF population (estimated at 700,000 in November 2018[25]). There are no records of flying-foxes birthing or rearing young at the CBG or elsewhere in Colac Otway Shire. As detailed in Section 4.1, it does not meet the criteria for a nationally important GHFF camp and is not currently counted in the NFFMP.

The aim of the management program is to exclude flying-foxes from roosting in the CBG. However, there are numerous alternative locations in and around Colac that are currently suitable for GHFF roosting (and breeding) (see Section 6.2.1). Council is also initiating a planting program at other potential sites in low conflict locations which will directly offset loss of the CBG camp habitat at a ratio of at least 1:1.

Measures outlined in this plan will ensure impacts to individual flying-foxes are also avoided.

In summary, actions outlined in this plan will not have a significant impact on flying-foxes in Colac or the GHFF national population.

7.2 Other ecological values

Actions in this plan are aimed at protecting mature trees from significant damage and preventing tree losses predicted by arborists if flying-foxes continue to camp in the CBG (see Appendix G). Actions in this plan with the potential to impact ecological values are:

- temporary disturbance using non-harmful flying-fox dispersal methods (e.g. noise, smoke, lights) to deter flying-foxes from the CBG (and other unsuitable locations) for up to 2.5 hours per 12 hour period
- installation of non-harmful deterrents (e.g. lights, speakers, canopy-mounted sprinklers) in the CBG
- planting at alternative locations.

There will be no removal of vegetation (other than routine maintenance/trimming), and planting at alternative sites will result in a net vegetation gain in Colac.

[24] DoEE 2017 Draft Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*, Department of Environment and Energy, Canberra.

[25] CSIRO 2018 The National Flying-fox Monitoring Program Report on the Nov 2018 survey, CSIRO.

Other fauna may be temporarily disturbed by dispersal activities, however these impacts are expected to be minimal due to the limited time and focussed area(s) of dispersal, and it is not anticipated that any species would be displaced from their entire home range. A wildlife expert will be onsite during dispersal activities (see Section 6.2.3) and will monitor for impacts to native wildlife, and the program will be adapted as required. If any MNES or MSES is recorded using the dispersal site(s) DEWLP will be contacted to discuss appropriate impact mitigation measures.

A suitably qualified wildlife expert will also assess each tree in the CBG to identify any hollows, nests or dreys prior to installation of deterrents to ensure other fauna is not impacted.

8 Evaluation and review

The Plan will have a scheduled review annually, which will include evaluation of management actions against objectives in Section 1.3. Annual review will include flying-fox expert assessment of the potential for cumulative impacts, to ensure alignment with Part 4 of the Referral Guideline. If at any point criteria for consideration as a nationally important camp are met by a camp being managed in Colac, all dispersal activities at that location will cease and Council will consult with DELWP and DoEE to reconsider the need for referral and update this Plan as required.

A reactive review will be triggered by any significant incident associated with Plan implementation (e.g. human health/safety, flying-fox welfare).

Results of each review will be available to DELWP as required.

Guidelines for when the dispersal can be considered a success include when:

- after a 12 month period without additional management there is an acceptably low number of flying-foxes on site
- newly established camp(s) are:
  - in an acceptable location
  - of sufficient area, nature and quality to support at least 6,500 GHFF
  - with sufficient vegetation cover to ensure that mortality from extreme weather conditions (e.g. heat stress events) are minimised.
- Council determines that impacts have been sufficiently mitigated
- negative impacts are not created or exacerbated at other locations (including neighbouring LGAs).

Dispersal will be permanently abandoned and alternative management strategies re-considered if:

- there is an ongoing proliferation of splinter colonies in unsuitable locations
- impacts are created or exacerbated at other locations that cannot be suitably managed
- allocated resources are exhausted.

9 Plan administration

This Flying-fox Management Plan has been prepared by Colac Otway Shire Council as the land manager of the Colac Botanic Gardens and public space within the Shire. This plan will be solely managed by Council and will involve stakeholders as required.

A Standard Operating Procedure is being developed in conjunction with this Plan to ensure that staff are aware of their obligations and procedures relating to the welfare of the animals.

9.1 Monitoring of the camp

Council will monitor the CBG and other camps as detailed in Section 6.2.8, and will contact CSIRO to request that camp(s) in Colac are added to the quarterly NFFMP census program.

9.2 Reporting

Council will prepare quarterly reports that will detail the management activities being undertaken, progress of approved/licenced actions and flying-fox monitoring data.

9.3 Funding commitment

Council is responsible for providing appropriate funding to undertake the actions included in this Plan. The Plan will be in operation from 2019 to 2024 and will require resourcing for each 5 year review and implementation of agreed actions.

The actions identified in this Plan will form part of Council's annual budget process.

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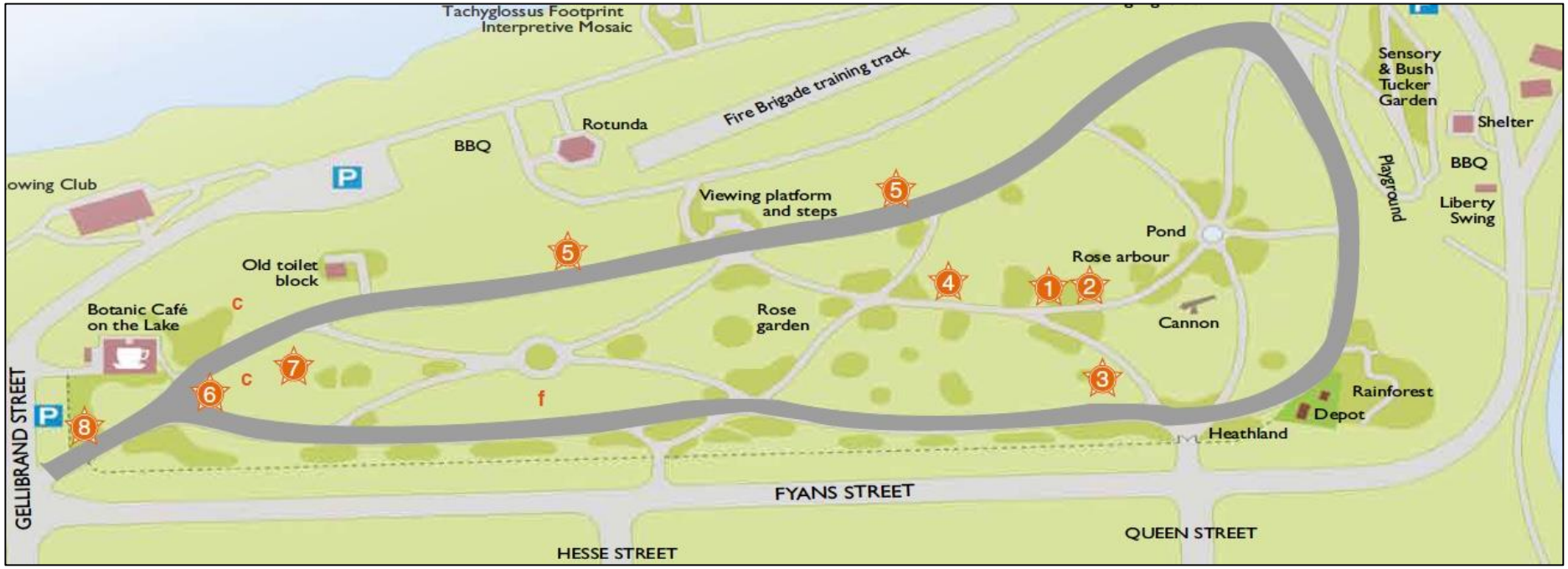
Appendix A Colac visitor map



Colac Botanic Gardens Visitor map (Source: Colac Botanic Gardens Information Flyer)

Appendix B Colac sites

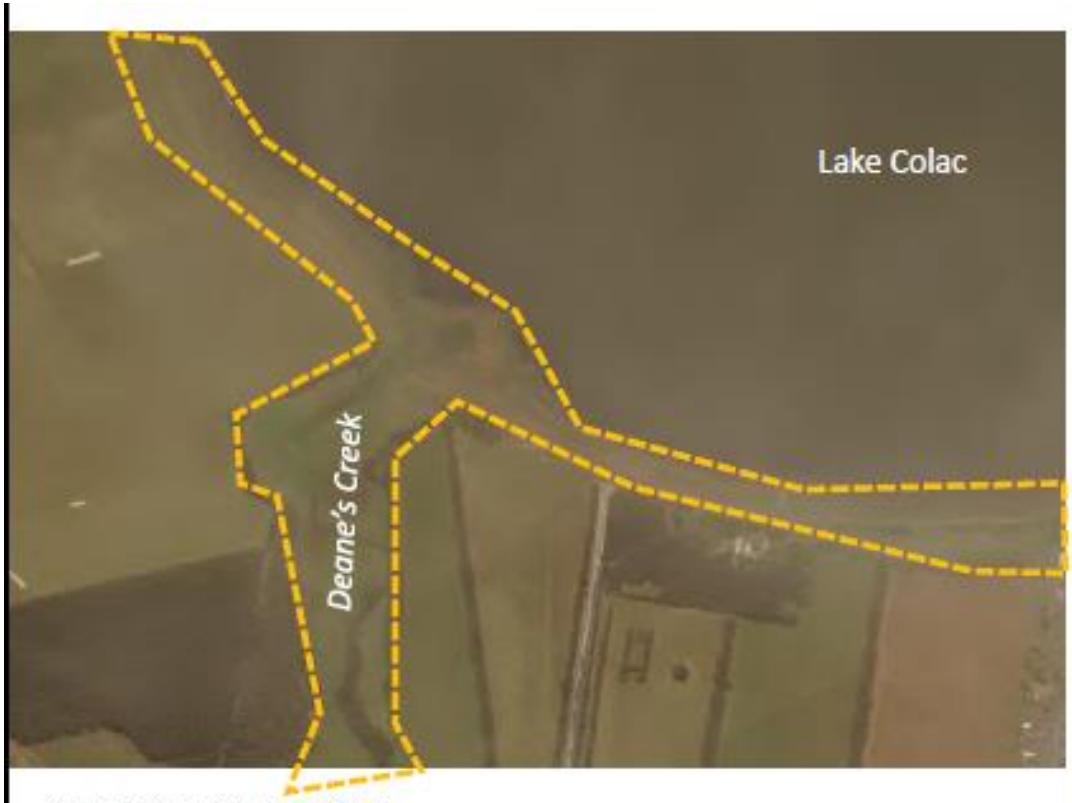
SITE OPTIONS FOR A FLYING FOX HABITAT LAKE COLAC

1. **Colac Botanic Gardens (Existing location)**
2. **Deanes Creek, Colac**
3. **Delaneys Road, Baltinore**
4. **Meredith Park, Ondit**

Extent of Crown land (Shown green and pink)
Subject land (outlined in black)

Site #1: Colac Botanic Gardens, COLAC

RECOMMENDATION FOR SITE #1
Encourage the relocation of the flying fox population due to negative impacts on the historic trees and public amenity

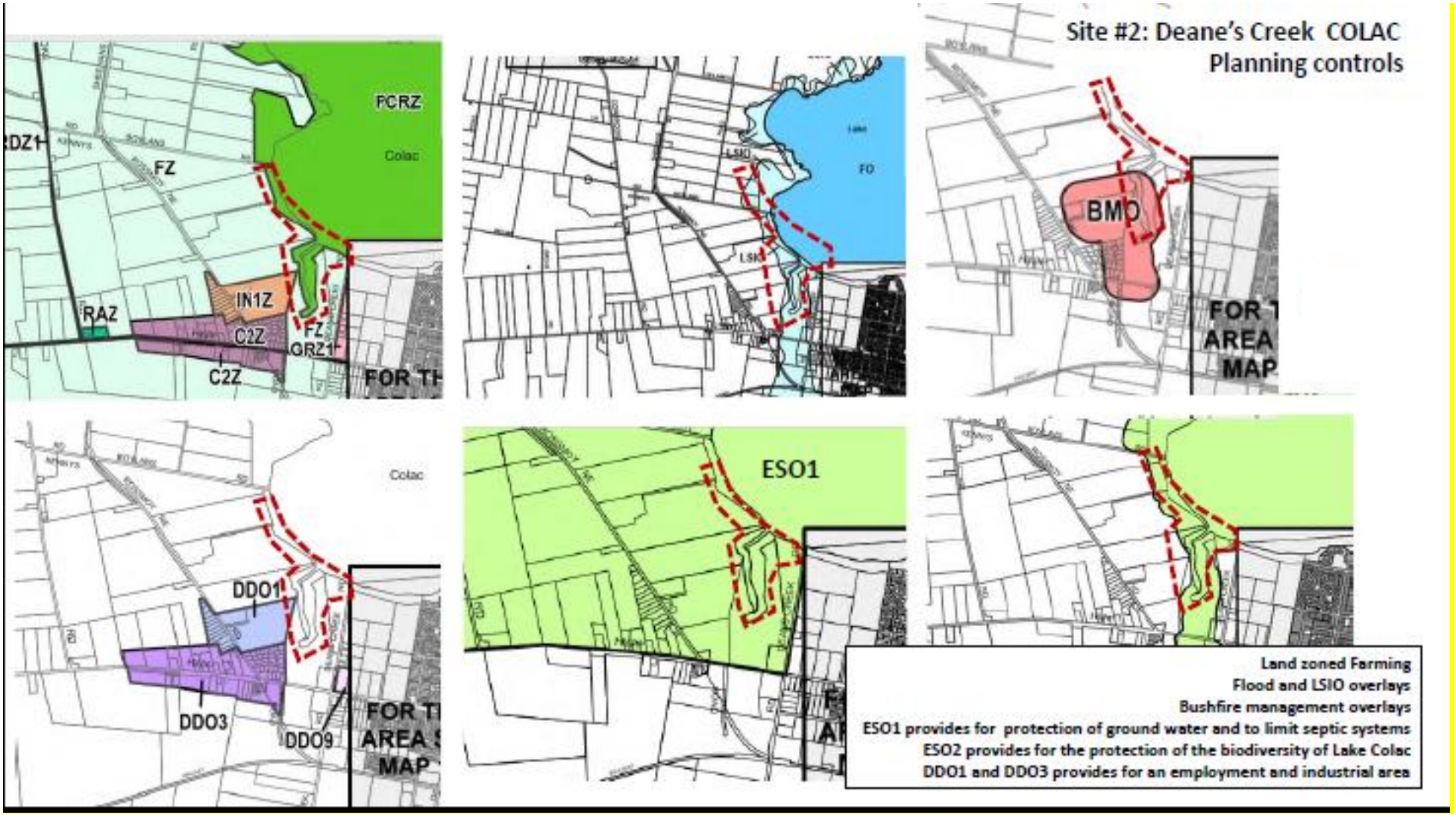


Extent of site (outlined in yellow)

Site #2: Deane's Creek COLAC

Extent of Crown land (Shown green)
Subject land (outlined in black)

RECOMMENDATION FOR SITE #2
Crown land managed by Council
Further investigate


Site #2: Deane's Creek COLAC
Planning controls
FCRZ
Colac
FZ
IN1Z
RAZ
C2Z
FZ
GRZ1
C2Z
FO
BMO
ESO1
DDO1
DDO3
DDO9
Land zoned Farming
Flood and LSIO overlays
Bushfire management overlays
ESO1 provides for protection of ground water and to limit septic systems
ESO2 provides for the protection of the biodiversity of Lake Colac
DDO1 and DDO3 provides for an employment and industrial area

Extent of site (outlined in yellow)

Site #3: Delaneys Road

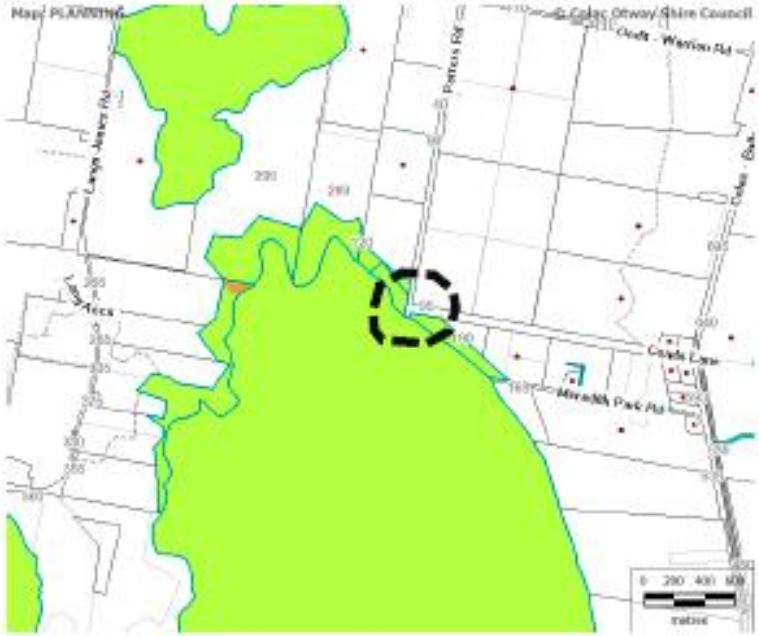
Extent of Crown land (Shown green)
Subject land (outlined in black)

RECOMMENDATION FOR SITE #3
Largely private land
There may be Crown land along the edges of the lakes managed by Council
Further investigate


Site #3: Delaneys Road
Planning controls
FZ
PCRZ
FZ
LSIO
LSIO
LSIO
FO
ESO1
ESO2
ESO2
Land zoned Farming
Flood and LSIO overlays
ESO1 provides for protection of ground water and to limit septic systems
ESO2 provides for the protection of the biodiversity of Lake Colac

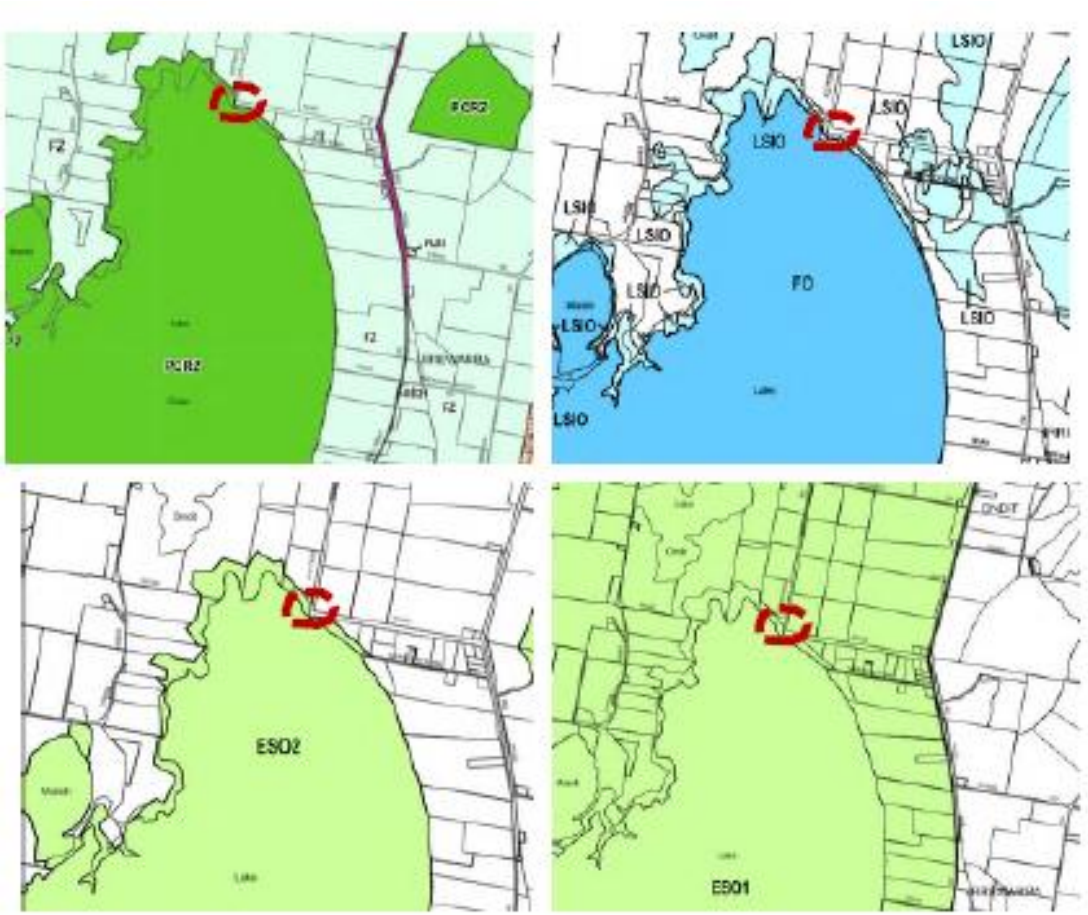
Site #4: Meredith Park, ONDIT

Extent of site (outlined in yellow)



Extent of Crown land (Shown green)
Subject land (outlined in yellow)

RECOMMENDATION FOR SITE #4
Crown land managed by Council
Further investigate



Site #4: Meredith Park, ONDIT
Planning controls

Land zoned Farming
Flood and LSIO overlays
ESO1 provides for protection of ground water and to limit septic systems
ESO2 provides for the protection of the biodiversity of Lake Colac

Appendix C Colac Botanic Gardens Flying-fox Management Plan Community Engagement Strategy June 2019

COLAC BOTANIC GARDENS
FLYING FOX MANAGEMENT PLAN

Community Engagement Strategy

June 2019

Version #3
Final

COLAC BOTANIC GARDENS FLYING FOX MANAGEMENT PLAN

Engagement Strategy

1. CONTEXT

The Colac Botanic Gardens (CBG) flying-fox camp is located on the southern aspect of Lake Colac in the Shire of Colac Otway, Victoria. The CBG are managed by Colac Otway Shire Council. The gardens are popular for locals and a primary destination for visitors coming to Colac. Land uses surrounding the gardens include a caravan park immediately to the east and established residential areas to the south and west.

The roost was first formally recorded in December 2016. It has not yet been confirmed if it is a permanent camp but it has been intermittently occupied the majority of days since July 2016. Whilst the number of flying-foxes has varied since initial occupation, numbers have reached up to 6,500 in early 2019.

The CBG are listed on the Victorian Heritage Register. Trees of individual significance are listed in the Statement of Significance and some of these trees have become preferred roosting habitats. In general the flying fox camp has had a significant impact on the amenity of the botanic gardens in terms of tree health, defecation and noise.

Flying-foxes are considered "keystone" species in Australia given their contribution to the health, longevity and diversity among and between vegetation communities. They often roost in large numbers and are increasingly moving into urban areas across eastern and southern Australia.

Grey-headed flying-foxes are listed as a vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and are listed as threatened under the *Victorian Flora and Fauna Guarantee Act 1988*. The management of flying-foxes and their habitat is directly guided by these legislative requirements.

Council is proceeding with this Management Plan to ensure that best practice requirements are met and to respond to community concerns.

The approach to community engagement will inform the Management Plan and will identify:

- the community concerns and issues relating to the flying-fox visitation to the CBG;
- the need for awareness and education programs to be developed regarding grey-headed flying-foxes;
- Short term actions Council proposed to respond to community concerns; and
- Medium and long term actions Council that consider alternative roost sites and Level 3 dispersal actions.

2. COMMUNITY ENGAGEMENT STRATEGY

Colac Otway's Community Engagement Strategy 2013 reflects the 6 key principles for public participation[1] which will be embraced in the CBG Flying Fox Management Plan. They are:

PUBLIC PARTICIPATION PRINCIPLE	ENGAGEMENT APPROACH
Responsiveness	Being open and honest with the community to support constructive conversations
Transparency and Integrity	Provide accessible information about the review and how it will impact on the community
Openness	Give the community time to digest information, understand the project and make informed decisions
Accountability	Involve stakeholders so they have the opportunity to play a part in decisions that affect them
Inclusiveness	Maximise benefits and minimise adverse effects by listening to stakeholders and incorporating their needs where possible into project planning
Awareness	Provide opportunities for ongoing two way dialogue that allows for detailed timely discussions and provides a continuous feedback loop

2.1 Purpose statement

The purpose of this community engagement process is:

- Inform the residents, CBG interest groups, property and business owners that the Colac Otway Shire Council (with final approval from the DELWP), is responding to the impacts of the flying fox population at the CBG;
- To ensure clarity in understanding the nature of the issue and to focus community and stakeholder discussion towards areas where the community can have the most impact ' such as the 'must haves', the 'nice to haves' and 'not a priority' on the ongoing management of the flying fox population at the CBG and the local area; and
- Inform locals about the next steps.

2.2 Scope of the engagement process

The scope of the engagement will focus on how Council can manage the impacts of the flying fox population on the local environment and to further inform the community about its behaviours. Matters can cover impacts of the flying foxes on:

- Visitor's enjoyment of the botanic gardens;
- local businesses such as orchardists and the local farming area generally and the extent to which the flying fox population travels to feed;
- equestrian owners and their knowledge of the risks and access to vaccines;

[1] The Victorian Auditor General's Office. "Public participation and community engagement Local Government Sector" . May 2017.

- the approvals processes, likely time frames and Council's ongoing approach.

2.3 Managing public impact

Consistent with Colac Otway's Engagement Strategy 2013, the key principles of public impact are provided below[2]:

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public participation goal				
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and solutions	To obtain public feedback on analysis, alternatives and/or decisions	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered	To partner with the public in each aspect of the decision, including the development of alternatives and the identification of the preferred solution	To place final decision making in the hands of the public
Promise to the public				
We will keep you informed	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision	We will look to you for direct advice and innovation formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible	We will implement what you decide
How we will do this				
A community engagement process in mid-2019 communicated through:				

- **Hard copy information sheets** provided at Colac and Council offices (Colac and Apollo Bay) on the nature of the flying fox and its behaviors. (Published documentation provided by DELWP and the DoEE)
- **Facebook**: an opportunity for the community to provide posts on the issue;
- **Council's website**: information, key contacts for further enquiries and a questionnaire.
- **Direct mail notification**

[2] IAP2 model (for managing public impact)

2.4 Detailed consultation programme

ACTIVITY	RATIONALE
WEEK COMMENCING THE 10 JUNE 2019	
Facebook page	Invites the community to have their say on the impacts of the flying fox
WEEK COMMENCING THE 17 JUNE 2019	
Place information article in the local newspapers that circulate in Colac inviting the community to inform themselves. Make the published literature available on Council's website.	Informs the broader community about the information available.
Hard copies of information sheets and literature placed at Colac library, Council's customer service centres at Apollo Bay and Rae St service centre	Informs the community about the nature of the flying fox, its behaviours, the potential risks and key contacts and emergency contact numbers Reaches members of the community who do not regularly use a computer or councils' website.
Establish a brief on line questionnaire on Council's website	Enables council to collect valuable information about the extent of the problem, to make contact with the community and respond to their concerns
WEEK COMMENCING THE 24 JUNE 2019	
Mail out to key equine stakeholders	Inform the Colac Pony Club , Colac Turf Club and 3 Colac vets by providing technical information
WEEK COMMENCING THE 1 JULY 2019	
Check data results for trends	Inform the consultants, Ecosure and DELWP Colac about data trends
WEEK ENDING THE 13 JULY 2019	
End of consultation *Collate data from questionnaire and Facebook*	Data from the questionnaire and Facebook can be used to inform the management strategy.

2.4 Key stakeholders

Council will consult with the following key stakeholders:

STAKEHOLDER	POTENTIAL IMPACTS AND ISSUES	HOW WE WILL DO THIS
Residents close to the gardens	Affected by the location of the flying foxes in the Gardens, the roosting in Heritage listed trees and foraging of the flying-foxes.	Facebook On line survey News release Radio interviews with Council General media to deliver timely and correct information to the local community
Friends of the Colac Botanic Gardens	Amenity impacts on the gardens. Tree management	Monthly FOCBG meetings Direct notification

STAKEHOLDER	POTENTIAL IMPACTS AND ISSUES	HOW WE WILL DO THIS
Shire wide residents and businesses	General information only	Facebook On line survey News release Radio interviews with Council General media to deliver timely and correct information to the local community.
Business owners	Café within the Gardens and adjacent Caravan Park	Direct notification
Colac turf club. Colac pony club. Shire wide vets	Equine facility managers and local vets should be aware of Hendra virus risk and appropriate mitigation measures. Where feasible, all horse owners within 20 km of the camp should be included in such communications.	Direct mail notification to provide technical information.
GOVERNMENT AND OTHER STAKEHOLDERS		
Other departments within Colac Otway Shire Council	Council has responsibilities to the community and environment. It is also responsible for facilitating necessary approvals to manage the flying fox camp.	Internal monthly PCG meetings to report on progress and to ensure a whole of organisation approach
Other Councils	Council will review flying fox management approaches taken by other councils both in Victoria and NSW.	Phone and email contact
Heritage Victoria	Heritage Victoria is the statutory authority for the CBG. Individual trees are listed in the Statement of Significance and their health needs to be safeguarded	Phone and email to check if they have a formal response to the issue
National Trust of Australia (Victoria)	Trees impacted by the flying foxes are on the National Trust register	Phone and email to check if they have a formal response to the issue
Department of Environment, Land, Water & Planning (DELWP)	DELWP is responsible for administering legislation relating to (among other matters) the conservation and management of native plants and animals, including threatened species and ecological communities.	Meetings at key points of the project to check in and ensure project is on track and DELWP expectations are met
Commonwealth Department of the Environment and Energy (DoEE)	DoEE is responsible for administering federal legislation relating to matters of national environmental significance, such as the grey-headed flying-fox and any other federally-listed values of the camp site.	Email to check in and ensure project is on track and DELWP expectations are met

The following were not directly engaged in the development of this management plan:

ORGANISATION	REASON FOR NOT ENGAGING
Colac airfield	Very small airfield with less than 2000 movements per year. No night time landings. (This is typically when flying foxes are mobile) Reliance on Facebook and on line survey feedback
Colac hospital	Broader community canvassed through Facebook and surveys
Colac schools	Broader community canvassed through Facebook and surveys
MAV	Not a key stakeholder
Researchers/universities/CSIRO	Reliance on DELWP and consultants for technical advice
Civic leaders and influencers (including local, state and federal politicians)	Need to be responsive to community concerns and manage legislative risk through Council's management activities.
Indigenous community	Broader community canvassed through Facebook and surveys Reliance on DELWP and consultants for technical advice
Wildlife and conservation groups	Reliance on DELWP and consultants for technical advice

2.6 Risks

RISK	LIKELIHOOD	STRATEGY
The Community think that flying foxes should remain in the gardens, even at the expense of the health of the heritage trees	Possible	Clear communication about the significance of the trees to Victoria's heritage and the need to maintain the amenity of the gardens for all to enjoy
Community is 'over consulted' on the flying fox issue and debate becomes polarized between saving the trees versus saving the flying foxes. Council starts being lobbied.	Possible	Clear communication about Council's role in the process and the fact that flying fox management is highly regulated by both the State and Federal governments.
The flying fox population grows rapidly and starts to impact on other parts of Colac, destroying personal property and placing the local horse population at risk.	Possible	Provide information on what foliage flying foxes prefer to ensure property owners are aware of the risks. Explain that the flying fox is a protected species and farmers and the local community are not allowed to harm them. Educate horse owners about risk and provide an immediate 'go to' action plan should the virus be detected in the region.
The flying fox population significantly declines in coming months. Engaging the community on a 'conceptual' topic can cause confusion and mistrust of Council. If the flying foxes return then Council will have to again consider a second phase of community engagement	Possible	Best practice community engagement does not preface with 'we thought that there was a problem but now there isn't'. Council can clearly communicate what we know to date and identifying that the flying foxes might return. We can ask the community to keep us informed should the situation change and provide clear communication channels between Council and the community.

END OF DOCUMENT

Appendix D Matters of National Environmental Significant Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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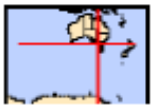
This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	28
Listed Migratory Species:	22

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	31
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	33
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area
Frogs		

Name	Status	Type of Presence
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat may occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Species or species habitat likely to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area
Poa sallacustris Salt-lake Tussock-grass [24424]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum frenchii Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat likely to occur within area
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat may occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat may occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area

Reptiles

Name	Status	Type of Presence
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat may occur within area
Eulamprus tympanum marnieae Corangamite Water Skink, Dreeite Water Skink [64487]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - COLAC TRAINING DEPOT

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Foraging, feeding or related behaviour known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
West Victoria RFA	Victoria

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area

Mammals	
Canis lupus familiaris Domestic Dog [82654]	Species or species habitat likely to occur within area
Capra hircus Goat [2]	Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]	Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]	Species or species habitat likely to occur within area
Mus musculus House Mouse [120]	Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]	Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]	Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]	Species or species habitat likely to occur within area
Sus scrofa Pig [6]	Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]	Species or species habitat likely to occur within area

Plants		
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.332695 143.587145,-38.332628 143.587059,-38.331954 143.589377,-38.330675 143.59178,-38.331079 143.594698,-38.33357 143.592082,-38.333705 143.587145,-38.332695 143.587145

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Appendix E Flying-fox camp management options

Below is an overview of commonly used management options to consider in the development of your Plan. These are categorised as Level 1, 2 or 3 in accordance with the Policy. The text can be tailored according to the needs of your Plan, or moved into an appendix to the Plan.

Level 1 actions: routine camp management

Education and awareness programs

This management option involves undertaking a comprehensive and targeted flying-fox education and awareness program to provide accurate information to the local community about flying-foxes.

Such a program would include managing risk and alleviating concern about health and safety issues associated with flying-foxes, options available to reduce impacts from roosting and foraging flying-foxes, an up-to-date program of works being undertaken at the camp, and information about flying-fox numbers and flying-fox behaviour at the camp.

Residents should also be made aware that faecal drop and noise at night is mainly associated with plants that provide food, independent of camp location. Staged removal of foraging species such as fruit trees and palms from residential yards, or management of fruit (e.g. bagging, pruning) will greatly assist in mitigating this issue.

Collecting and providing information should always be the first response to community concerns in an attempt to alleviate issues without the need to actively manage flying-foxes or their habitat. Where it is determined that management is required, education should similarly be a key component of any approach.

An education program may include components shown to the right.

Possible components of an education program

The likelihood of improving community understanding of flying-fox issues is high. However, the extent to which that understanding will help alleviate conflict issues is probably less so. Extensive education for decision-makers, the media and the broader community may be required to overcome negative attitudes towards flying-foxes.

It should be stressed that a long-term solution to the issue resides with better understanding flying-fox ecology and applying that understanding to careful urban planning and development.

Property modification without subsidies

The managers of land on which a flying-fox camp is located would promote or encourage the adoption of certain actions on properties adjacent or near to the camp to minimise impacts from roosting and foraging flying-foxes (note that approval may be required for some activities, refer to Section 4 for further information):

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. BBQs and tables) within close proximity to a camp or foraging tree to avoid contamination by flying-foxes.
- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.
- Follow horse husbandry and property management guidelines provided at the NSW Department of Primary Industries Hendra virus web page (DPI 2015a).
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Turn off lighting at night which may assist flying-fox navigation and increase fly-over impacts.
- Consider removable covers for swimming pools and ensure working filter and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase camp noise.

The cost would be borne by the person or organisation who modifies the property; however, opportunities for funding assistance (e.g. environment grants) may be available for management activities that reduce the need to actively manage a camp.

Property modification subsidies

Fully funding or providing subsidies to property owners for property modifications may be considered to manage the impacts of the flying-foxes. Providing subsidies to install infrastructure may improve the value of the property, which may also offset concerns regarding perceived or actual property value or rental return losses.

The level and type of subsidy would need to be agreed to by the entity responsible for managing the flying-fox camp.

Service subsidies

This management option involves providing property owners with a subsidy to help manage impacts on the property and lifestyle of residents. The types of services that could be subsidised

include clothes washing, cleaning outside areas and property, car washing or power bills. Rate reductions could also be considered.

Critical thresholds of flying-fox numbers at a camp and distance to a camp may be used to determine when subsidies would apply.

Routine camp maintenance and operational activities

Examples of routine camp management actions are provided in the Policy. These include:

- removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist
- weed removal, including removal of noxious weeds under the *Noxious Weeds Act 1993*, or species listed as undesirable by a council
- trimming of understorey vegetation or the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals
- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or removal of leaf litter or other material on the ground.

Protocols should be developed for carrying out operations that may disturb flying-foxes, which can result in excess camp noise. Such protocols could include limiting the use of disturbing activities to certain days or certain times of day in the areas adjacent to the camp, and advising adjacent residents of activity days. Such activities could include lawn-mowing, using chainsaws, whipper-snippers, using generators and testing alarms or sirens.

Revegetation and land management to create alternative habitat

This management option involves revegetating and managing land to create alternative flying-fox roosting habitat through improving and extending existing low-conflict camps or developing new roosting habitat in areas away from human settlement.

Selecting new sites and attempting to attract flying-foxes to them has had limited success in the past, and ideally habitat at known camp sites would be dedicated as a flying-fox reserve. However, if a staged and long-term approach is used to make unsuitable current camps less attractive, whilst concurrently improving appropriate sites, it is a viable option (particularly for the transient and less selective LRFF). Supporting further research into flying-fox camp preferences may improve the potential to create new flying-fox habitat.

When improving a site for a designated flying-fox camp, preferred habitat characteristics detailed in Appendix K should be considered.

Foraging trees planted amongst and surrounding roost trees (excluding in/near horse paddocks) may help to attract flying-foxes to a desired site. They will also assist with reducing foraging impacts in residential areas. Consideration should be given to tree species that will provide year-round food, increasing the attractiveness of the designated site. Depending on the site, the potential negative impacts to a natural area will need to be considered if introducing non-indigenous plant species.

The presence of a water source is likely to increase the attractiveness of an alternative camp location. Supply of an artificial water source should be considered if unavailable naturally, however this may be cost-prohibitive.

Potential habitat mapping using camp preferences (see Section 6.2.1) and suitable land tenure can assist in initial alternative site selection. A feasibility study would then be required prior to site designation to assess likelihood of success and determine the warranted level of resource allocated to habitat improvement.

Provision of artificial roosting habitat

This management option involves constructing artificial structures to augment roosting habitat in current camp sites or to provide new roosting habitat. Trials using suspended ropes have been of limited success as flying-foxes only used the structures that were very close to the available natural roosting habitat. It is thought that the structure of the vegetation below and around the ropes is important.

Protocols to manage incidents

This management option involves implementing protocols for managing incidents or situations specific to particular camps. Such protocols may include 'bat watch' patrols at sites that host vulnerable people, management of pets at sites popular for walking dogs or heat stress incidents (when the camp is subjected to extremely high temperatures leading to flying-foxes changing their behaviour and/or dying).

Participation in research

This management option involves participating in research to improve knowledge of flying-fox ecology to address the large gaps in our knowledge about flying-fox habits and behaviours and why they choose certain sites for roosting. Further research and knowledge sharing at local, regional and national levels will enhance our understanding and management of flying-fox camps.

Appropriate land-use planning

Land-use planning instruments may be able to be used to ensure adequate distances are maintained between future residential developments and existing or historical flying-fox camps. While this management option will not assist in the resolution of existing land-use conflict, it may prevent issues for future residents.

Property acquisition

Property acquisition may be considered if negative impacts cannot be sufficiently mitigated using other measures. This option will clearly be extremely expensive, however is likely to be more effective than dispersal and in the long-term may be less costly.

Do nothing

The management option to 'do nothing' involves not undertaking any management actions in relation to the flying-fox camp and leaving the situation and site in its current state.

Level 2 actions: in-situ management

Buffers

Buffers can be created through vegetation removal and/or the installation of permanent/semi-permanent deterrents.

Creating buffers may involve planting low-growing or spiky plants between residents or other conflict areas and the flying-fox camp. Such plantings can create a visual buffer between the camp and residences or make areas of the camp inaccessible to humans.

Buffers greater than 300 metres are likely to be required to fully mitigate amenity impacts (SEQ Catchments 2012). The usefulness of a buffer to mitigate odour and noise impacts generally declines if the camp is within 50 metres of human habitation (SEQ Catchments 2012), however any buffer will assist and should be as wide as the site allows.

Buffers through vegetation removal

Vegetation removal aims to alter the area of the buffer habitat sufficiently so that it is no longer suitable as a camp. The amount required to be removed varies between sites and camps, ranging from some weed removal to removal of most of the canopy vegetation.

Any vegetation removal should be done using a staged approach, with the aim of removing as little native vegetation as possible. This is of particular importance at sites with other values (e.g. ecological or amenity), and in some instances the removal of any native vegetation will not be appropriate. Thorough site assessment (further to desktop searches, see Appendix 4) will inform whether vegetation management is suitable (e.g. can impacts to other wildlife and/or the community be avoided?).

Removing vegetation can also increase visibility into the camp and noise issues for neighbouring residents which may create further conflict.

Suitable experts (Appendix 1) should be consulted to assist selective vegetation trimming/removal to minimise vegetation loss and associated impacts.

The importance of under- and mid-storey vegetation in the buffer area for flying-foxes during heat stress events also requires consideration.

Buffers without vegetation removal

Permanent or semi-permanent deterrents can be used to make buffer areas unattractive to flying-foxes for roosting, without the need for vegetation removal. This is often an attractive option where vegetation has high ecological or amenity value.

While many deterrents have been trialled in the past with limited success, there are some options worthy of further investigation:

- Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012 and balloons (Ecosure 2016 pers. obs.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The type and placement of any visual deterrent would need to be varied regularly to avoid habituation. Standard lights and strobes have had limited success at deterring flying-foxes in the past (Ecosure pers. obs.), however new technology has been developed by researchers and lighting experts PROVolitans aimed at harmlessly interrupting flying-fox

- sight to deter them from specific trees. This new technology has been trialled at one flying-
- fox camp in Queensland with reported good results and may be investigated for CBG in consultation with DELWP.
- Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. This is also likely to be disruptive to nearby residents.
- Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and successfully used at numerous camps to deter flying-foxes from designated buffer zones. Design and use of sprinklers need to be considerate of animal welfare and features of the site. For example, misting may increase humidity and exacerbate heat stress events, and overuse may impact other environmental values of the site.

Note that any deterrent with a high risk of causing inadvertent dispersal may be considered a Level 3 action.

The use of visual deterrents, in the absence of effective maintenance, could potentially lead to an increase in rubbish in the natural environment.

Noise attenuation fencing

Noise attenuation fencing could be installed in areas where the camp is particularly close to residents. This may also assist with odour reduction, and perspex fencing could be investigated to assist fence amenity. Although expensive to install, this option could negate the need for habitat modification, maintaining the ecological values of the site, and may be more cost-effective than ongoing management.

Level 3 actions: disturbance or dispersal

Nudging

Noise and other low intensity active disturbance restricted to certain areas of the camp can be used to encourage flying-foxes away from high conflict areas. This technique aims to actively 'nudge' flying-foxes from one area to another, while allowing them to remain at the camp site.

Unless the area of the camp is very large, nudging should not be done early in the morning as this may lead to inadvertent dispersal of flying-foxes from the entire camp site. Disturbance during the day should be limited in frequency and duration (e.g. up to four times per day for up to 10 minutes each) to avoid welfare impacts. As with dispersal, it is also critical to avoid periods when dependent young are present (as identified by a flying-fox expert[20]).

Dispersal

Dispersal aims to encourage a camp to move to another location, through either disturbance or habitat modification.

There is a range of potential risks, costs and legal implications that are greatly increased with dispersal (compared with in-situ management as above). These include:

- impact on animal welfare and flying-fox conservation

- splintering the camp into other locations that are equally or more problematic
- shifting the issue to another area
- impact on habitat value
- effects on the flying-fox population, including disease status and associated public health risk
- impacts to nearby residents associated with ongoing dispersal attempts
- excessive initial and/or ongoing capacity and financial investment
- negative public perception and backlash
- increased aircraft strike risk associated with changed flying-fox movement patterns
- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

Despite these risks, there are some situations where camp dispersal may be considered. Dispersal can broadly be categorised as ‘passive’ or ‘active’ as detailed below.

Passive dispersal

Removing vegetation in a staged manner can be used to passively disperse a camp, by gradually making the habitat unattractive so that flying-foxes will disperse of their own accord over time with little stress (rather than being more forcefully moved with noise, smoke, etc.). This is less stressful to flying-foxes, and greatly reduces the risk of splinter colonies forming in other locations (as flying-foxes are more likely to move to other known sites within their camp network when not being forced to move immediately, as in active dispersal).

Generally, a significant proportion of vegetation needs to be removed in order to achieve dispersal of flying-foxes from a camp or to prevent camp re-establishment. For example, flying-foxes abandoned a camp in Bundall, Queensland once 70% of the canopy/mid-storey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important camps (defined in Section 4.1) sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

This option may be preferable in situations where the vegetation is of relatively low ecological and amenity value, and alternative known permanent camps are located nearby with capacity to absorb the additional flying-foxes. While the likelihood of splinter colonies forming is lower than with active dispersal, if they do form following vegetation modification there will no longer be an option to encourage flying-foxes back to the original site. This must be carefully considered before modifying habitat.

There is also potential to make a camp site unattractive by removing access to water sources. However at the time of writing this method had not been trialled so the likelihood of this causing a camp to be abandoned is unknown. It would also likely only be effective where there are no alternative water sources in the vicinity of the camp.

Active dispersal through disturbance

Dispersal is more effective when a wide range of tools are used on a randomised schedule with animals less likely to habituate (Ecosure pers. obs. 1997–2015). Each dispersal team member should have at least one visual and one aural tool that can be used at different locations on different days (and preferably swapped regularly for alternate tools). Exact location of these and positioning of personnel will need to be determined on a daily basis in response to flying-fox

movement and behaviour, as well as prevailing weather conditions (e.g. wind direction for smoke drums).

Active dispersal will be disruptive for nearby residents given the timing and nature of activities, and this needs to be considered during planning and community consultation.

This method does not explicitly use habitat modification as a means to disperse the camp, however if dispersal is successful, some level of habitat modification should be considered. This will reduce the likelihood of flying-foxes attempting to re-establish the camp and the need for follow-up dispersal as a result. Ecological and aesthetic values will need to be considered for the site, with options for modifying habitat the same as those detailed for buffers above.

Early dispersal before a camp is established at a new location

This management option involves monitoring local vegetation for signs of flying-foxes roosting in the daylight hours and then undertaking active or passive dispersal options to discourage the animals from establishing a new camp. Even though there may only be a few animals initially using the site, this option is still treated as a dispersal activity, however it may be simpler to achieve dispersal at these new sites than it would in an established camp. It may also avoid considerable issues and management effort required should the camp be allowed to establish in an inappropriate location.

It is important that flying-foxes feeding overnight in vegetation are not mistaken for animals establishing a camp.

Maintenance dispersal

Maintenance dispersal refers to active disturbance following a successful dispersal to prevent the camp from re-establishing. It differs from initial dispersal by aiming to discourage occasional over-flying individuals from returning, rather than attempting to actively disperse animals that have been recently roosting at the site. As such, maintenance dispersal may have fewer timing restrictions than initial dispersal, provided that appropriate mitigation measures are in place (see Section 6).

Unlawful activities

Culling

Culling is addressed here as it is often raised by community members as a preferred management method; however, culling is contrary to the objects of the TSC Act and will not be permitted as a method to manage flying-fox camps.

Appendix F Flying-fox rescue protocol

Reference documents:

OEH 2012, NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes, Office of Environment and Heritage, Sydney.

OEH 2011, NSW Code of Practice for Injured, Sick and Orphaned Protected Fauna, Office of Environment and Heritage, Sydney.

Agriculture Victoria 2000, Code of Practice for the Welfare of Wildlife During Rehabilitation, Victorian Government Gazette, Victoria.

This protocol is based on the NSW plan template with minor additions from the Victorian COP. Discussion to occur with DELWP Victoria in ascertaining their requirements.

Purpose

These work instructions are intended for Australian bat lyssavirus (ABLV)-vaccinated fauna spotter catchers (FSCs) or wildlife rescue personnel on site during dispersal activities to monitor, capture or provide first aid treatment for sick or injured flying-foxes that may require human intervention for their survival. Flying-fox rescue must only be attempted by personnel trained and experienced in flying-fox rescue and handling.

This work instruction provides rescuers with information regarding capture and first aid until a flying-fox is in the specialist care of a veterinarian or person qualified in wildlife rehabilitation.

Requirements

FSC and wildlife rescue personnel involved in flying-fox rescue must:

- be trained and experienced in rescue and handling
- be vaccinated against ABLV (titre levels checked at least once every two years)
- be aware of the hazards and risks of coming into contact with all bats
- utilise appropriate PPE and equipment for capture, transport and treatment of flying-foxes
- undertake a risk assessment before carrying out a rescue – do not endanger yourself or others during a rescue
- have the contact details for a local veterinarian or bat carer who will accept the sick or injured flying-fox.

Human first aid

All bats in Australia should be viewed as potentially infected with ABLV. If bitten or scratched by a bat, immediately wash the wound with soap and water (do not scrub) and continue for at least five minutes, followed by application of an antiseptic with anti-viral action (e.g. Betadine), and immediate medical attention (post-exposure vaccinations may be required). Similarly medical attention should be immediately sought if exposed to an animal's saliva or excreta through the eyes, nose or mouth.

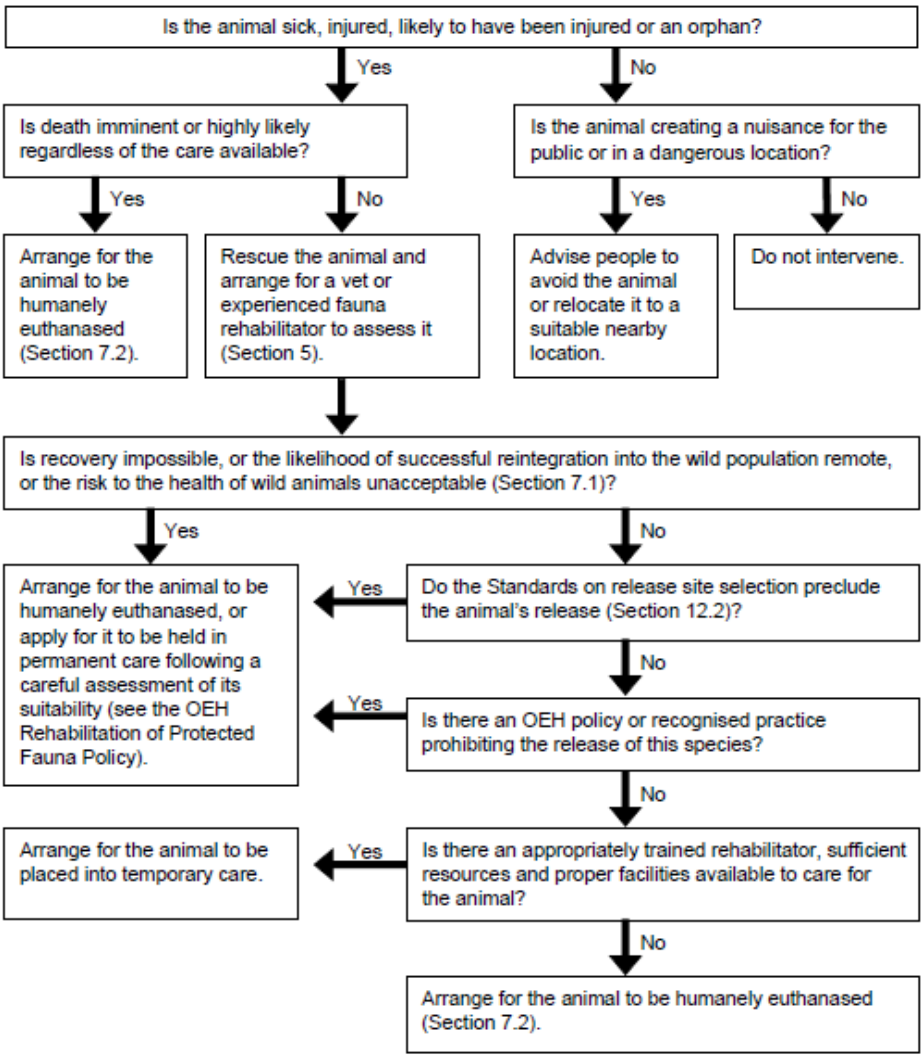
Equipment

- lidded plastic carry basket or 'pet-pack' with bedding (juveniles) / transport container with hanging perch, tall enough for bat to hang without hitting its head (in accordance with Section 5.1 of the NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes (OEH 2012) and 'Housing and enclosure design' in the Victoria Code of Practice for the Welfare of Wildlife During Rehabilitation (Agriculture Victoria 2000)
- warm water bottle / cold brick
- wraps / towels
- teats for small bottle
- extension pole or broom
- bat first aid kit – juice drink/glucose powder, syringes, cloths for wounds, Betadine/saline, dummy for baby bats. FFs only to be offered liquids under advice from a licensed wildlife carer.

Work instructions

Initial case assessment

Observe, assess and then determine if/what intervention is required using the decision tree in the NSW Code of Practice for Injured, Sick and Orphaned Protected Fauna (OEH 2011), included below.



Personnel should approach stressed flying-foxes cautiously. If flying-foxes panic or fly this will waste energy; retreat and continue to monitor behaviour.

1. Dehydration: Eyes dull or depressed in skull, change to skin elasticity, skin stays pinched, animal cold, wing membranes dry, mouth dry.
2. Heat stress: wing fanning, shade seeking, clustering/clumping, salivating, panting, roosting at the base of trees, on the ground, falling from tree.
3. Obvious injury: bleeding, broken bones.

Rescue instructions

As per Section 4 of the NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes (OEH 2012):

i. The objective is to rescue a flying-fox while minimising further stress and injury to the animal.

ii. Before a rescue attempt, rescuers must assess the risks to the flying-fox from environmental hazards and from capture.

iii. Rescuers must employ the correct rescue equipment for the condition and location of the flying-fox, and be trained in its use.

Example scenarios

1. Bat low in tree:
   - quickly place towel around bat before it can move away
   - grab hold of feet, toes may curl over rescuers fingers
   - place in carry basket / transport container.
2. Bat high in tree:
   - place pole wrapped in towel in front of bat
   - coax bat onto towel
   - once on towel, quickly move away from branches and lower to ground
   - once on ground, cover with towel and place into carry basket / transport container.
3. A bat caught on barbed wire fence:
   - two people only – one to restrain with towel, while the other untangles
   - put towels on the wire strands under or around to avoid further entanglement
   - if the membrane has dried onto wire, syringe or spray water onto wing
   - use pliers or wire cutter if necessary.

Animal first aid

Physical assessment: Keep animal wrapped and head covered, only expose one part at a time. Examine head. Unwrap one wing and extend. Wrap and extend other wing. Check legs. Examine front and back of body.

Dehydration: Offer water/juice (low acid juice only, e.g. apple/mango) orally with syringe (under supervision/advice from licensed wildlife carer ONLY).

Heat stress: Reduce temperature in heat exhausted bats by spraying wings with tepid water.

Hypothermia: May be seen in pups separated from mother – keep head covered and warm core body temperature slowly by placing near (not on) warm water bottle covered by towel.

Bleeding: Clean wounds with room temperature saline or diluted Betadine.

Transport to veterinarian / wildlife carer

See Section 5 of the NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes (OEH 2012) summarised below.

Objective

To transport a flying-fox so as to minimise further stress and injury to the animal.

Standards

a. The transport container must be tall enough for the flying-fox to hang by its feet without hitting its head on the floor.
b. The container must be designed, set up and secured to prevent injuries to the flying-fox. The sides of the container must prevent the flying-fox from poking its head or wings out.
c. The container must be designed to prevent the flying-fox from escaping.
d. The flying-fox must be allowed to hang by its feet from the top of the container or if it is unable to hang, wrapped in material (e.g. sheet or flannel) and placed in a sling so its feet are higher than its head.
e. The container must be kept at a temperature which is appropriate for the age and condition of the flying-fox. A range of 25–27°C is appropriate for an adult. A temperature of 28°C is appropriate for an orphan. A cool or warm water bottle may be required.
f. The container must be ventilated so air can circulate around the flying-fox.
g. The container must minimise light, noise and vibrations and prevent contact with young children and pets.
h. During transport, a container holding a flying-fox must have a clearly visible warning label that says 'Warning – live bat'.
i. A flying-fox must not be transported in the back of an uncovered utility vehicle or a car boot that is separate from the main cabin.

Guidelines

- Flying-fox transport should be the sole purpose of the trip and undertaken in the shortest possible time.
- The fauna rehabilitation group's contact details should be written on the transport container in case of an emergency.

Rehabilitation case assessment

As detailed in the Victorian Code of Practice for the Welfare of Wildlife During Rehabilitation:

- Upon collection, animals must be assessed accurately and without delay by a person who is knowledgeable in the particular requirements of the species (a veterinarian if possible, or an experienced wildlife rehabilitator). At all stages of the rehabilitation process, animal welfare should be the primary objective.

- Where the animal is found to be suffering from significant pain, distress, trauma or disease that cannot be relieved, it must be promptly euthanased.
- Where the animal would not survive without extended treatment or surgery, and is unlikely to recover sufficiently to return to the wild, it should be promptly euthanased.
- Where there is uncertainty regarding the suitability of a release site (see below for details) the animal should be humanely euthanased.
- If there is a reasonable expectation that the animal can be successfully rehabilitated and released to its own environment, the wildlife rehabilitator should ensure that he/she has the capacity to provide for the captive needs of the animal. For example, experience with the particular species, suitable housing, and access to species specific social groups where relevant.
- Conditions which could preclude successful rehabilitation and release include:
    - Loss of limbs or function of limbs, including tails
    - Permanent vital sensory loss (hearing, sight, smell, feeding)
    - Untreatable infectious disease
    - Permanent damage to the nervous system
    - Inability to adjust to temporary captivity
    - Chronic ill health
    - Imprinted behaviour patterns.
- The following considerations are important when assessing a release site:
    - The release site should be suitable habitat in the general vicinity from which the animal was originally collected. For instance, if an animal were found injured on a highway, an area of bushland adjacent to the highway would be a suitable release site. Exceptions may be ocean going seabirds or migratory species.
    - There should be an available home range for the animal upon release. The sooner an animal can be rehabilitated and released back to its own environment, the more likely its place within the home range will not have been reoccupied.
    - If there are limited resources available at the release site (for example, due to large numbers of conspecifics or vegetation removal), the cost of release to the existing population must be justified in terms of competition for food and shelter.
    - The factors that lead to the original injury or condition must not pose an unacceptable risk to the animal again upon release (for example, if there are unusually high numbers of introduced predators at the site).
- Continual reassessment during the process of rehabilitation is required, to ensure it remains in the best interests of the animal and that eventual release to the wild remains likely. If it becomes evident during the rehabilitation process that successful return to the wild is unlikely, the animal should be promptly euthanased.
- Exceptional circumstances where a threatened species is involved should be discussed with an officer from DELWP.

Appendix G Arborist technical report

TREE DAMAGE FROM GREY HEADED FLYING FOX

LOCATION: COLAC BOTANIC GARDENS

COMPLETED FOR: COLAC CITY COUNCIL

DATE: 19TH JUNE 2019

ENSPEC
ENVIRONMENT AND RISK

WWW.ENSPEC.COM

ABN 92062909255

☎+613 9755-6799
+613 9755-6788
ADMIN@ENSPEC.COM

HEAD OFFICE & LABORATORY
UNIT 2 - 13 VIEWTECH PLACE
ROWVILLE. 3178

STATE OPERATIONAL OFFICES

QUEENSLAND
39 VERNON TERRACE,
TENERIFFE.

SOUTH AUSTRALIA
UNIT 1, 6-8 MARKER AVENUE,
MARLESTON.

VICTORIA
22-24 MCCALLUM STREET,
SWAN HILL

TASMANIA
LAUNCESTON

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1. EXECUTIVE SUMMARY

ENSPEC was requested by Colac City Council to assess damage to trees at Colac Botanic Gardens from roosting Grey-headed Flying Foxes (*Pteropus poliocephalus*).

Approximately 200 protected native Grey-headed Flying Fox arrived in the Colac Botanic Gardens in late 2017, predominantly affecting a large *Quercus palustris* (Pin Oak) in the central part of the gardens. Over summer in 2019 the number of animals is estimated to have increased to more than 4000. The camp has spread to other trees since the initial colonisation, including a number of heritage trees. The camp appears to be continuing to spread towards the eastern edge of the gardens.

Transient flying fox camps are typically largely abandoned in winter, with the colony returning for spring and summer, with populations peaking for breeding over this period. In June 2019 it is estimated that 2000 flying foxes were still present, indicating that a large percentage of Grey-headed Flying have adopted the Botanical Gardens as a permanent camp.

Affected trees are mainly introduced deciduous amenity species, including two National Trust Classified Trees – *Sophora japonica* (Japanese Pagoda Tree) National Trust Tree NT 11492 and *Ulmus* X *hollandica* 'Vegeta' (Huntingdon Elm) National Trust Tree NT11495. Deciduous trees are particularly vulnerable to permanent damage and decline as the maximum defoliation occurs over the growing season of these trees in spring and summer. Evergreen trees have some chance of recovery in autumn and winter that these deciduous ornamental species do not.

If the flying fox camp remains in the gardens it is certain that some trees will be permanently damaged. At best, dieback of the upper canopy will occur with a commensurate decline in amenity and health.

Two National Trust classified heritage trees as well as up to 15 other high value amenity trees are currently affected and at significant risk of permanent damage. Given their age, the defoliation could eventually lead to tree death of the larger and older amenity trees.

ENSPEC's key recommendations –

- Disperse the Grey-headed Flying Fox camp out of the Botanic Gardens to protect the high value and vulnerable trees currently being damaged.

2. BRIEF & INSPECTION METHODOLOGY

ENSPEC was requested by Colac City Council to assess damage to trees at Colac Botanic Gardens from roosting Grey-headed Flying Foxes (*Pteropus poliocephalus*).

Site methodology involved a visual inspection of the trees' present health and growing environment. The influence of previous and proposed activities on the trees current and future condition was considered during the assessment.

3. DATE OF INSPECTION

The assessment was conducted on the 5th June 2019. The weather conditions while conducting the assessment were overcast.

4. ARBORIST CONDUCTING ASSESSMENT

Name of Arborist	**Craig Hallam**
Qualifications	Diploma Arboriculture Advanced Diploma Arboriculture Diploma Ecology Cert IV Assessment and Workplace Training
Contact phone number	+61 417 027 152
E-mail Address	craig.hallam@enspec.com

Report author

Name of Arborist	**Craig Hinton**
Qualifications	B. App. Sci. (Hort. [Env. Hort.]) Dip. Arb. Dip. App. Sci. (Hort.) Diploma Ecology Cert IV Assessment and Workplace Training
Contact phone number	+61 428 193 626
E-mail Address	craig.hinton@enspec.com

5. SITE LOCATION

The Grey-headed Flying Fox camp is located in the Colac Botanic Gardens at Fyans St, Colac.

6. DISCUSSION

Grey-headed Flying Fox (*Pteropus poliocephalus*) is a protected native mammal of the east coast of Australia. They are nocturnal animals that roost during the day in camps near a permanent water source with the camps typically comprised of thousands of animals. The flying foxes hang head down from the branches of trees. Once established, flying fox camps are typically re-visited by the colony year after year, with peak occupancy during breeding season and rearing young, which occurs in spring and summer.

The increased presence of Grey-headed Flying Foxes in urban areas is attributed to native tree clearing and habitat loss, resulting in reduced natural roosting areas. This is exacerbated by the diversity of vegetation in urban areas as this creates a varied and reliable food source, particularly when natural food sources are in limited supply.

While now more common in urban areas, habitat loss has led to a decline in the total population and the species is now listed as Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988.

Defoliation of roost trees by flying fox activity often leads to dieback of the trees, particularly in the upper canopy. Defoliation of roosting trees over several years will reduce tree health and lead to a significant reduction in amenity as the upper canopy of the tree dies. In severe cases, tree death could occur.

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E-mail Address	craig.hallam@enspec.com

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Approximately 200 Grey-headed Flying Foxes arrived in the Colac Botanic Gardens in late 2017, predominantly affecting a large *Quercus palustris* (Pin Oak). Recently the number of animals is estimated to have quadrupled to 4000 and they have spread to other trees (Colac Herald 2017; Colac Herald 2019). At the time of the tree assessment in June 2019 it is estimated that 2000 animals were still present, indicating that some of them have adopted the site as a permanent camp.

A similar issue with a flying fox camp occurred at the Royal Botanic Gardens, Melbourne (RBGM), in the early 2000s. Tree decline and death did occur at RBGM before the colony was dispersed in 2003. The majority of animals settled at Yarra Bend Park, where a flying fox camp management plan has been in place since 2005 (ARCUE 2009).

Heritage trees within the gardens are being affected, including 2 National Trust Classified Trees – *Sophora japonica* (Japanese Pagoda Tree) National Trust Tree NT 11492 and *Ulmus* X *hollandica* 'Vegeta' (Huntingdon Elm) National Trust Tree NT11495.

Other trees being impacted include –

- *Quercus palustris* (Pin Oak)
- *Quercus robur* (English Oak)
- *Ulmus* X *hollandica* (Dutch Elm)
- *Liquidambar styraciflua* (Liquidambar)
- *Populus nigra* 'Italica' (Lombardy Poplar)
- *Syzygium floribundum* (Weeping Lilly Pilly)
- *Stenocarpus sinuatus* (Firewheel Tree)
- *Phoenix canariensis* (Canary Island Date Palm)

Initially, the flying fox camp was located around the National Trust Registered *Ulmus* X *hollandica* 'Vegeta' and *Sophora japonica* as shown in orange on Figure 1. As the number of animals in the camp has grown, they are spreading east as indicated in yellow. It appears that the camp may be migrating in this direction into an area that is more protected by evergreen trees, providing better shelter during winter. It is unknown whether the camp will permanently settle in this eastern section, migrate back to the original section in warmer seasons, or spread across both. In any case, the number of trees being affected is increasing.

Photo 1 - Sophora japonica (NT 11492)

Photo 2 - Ulmus X hollandica 'Vegeta' (NT 11495)

Photo 3 - Syzygium floribundum

Most of the affected trees are introduced deciduous amenity species. As such, the maximum defoliation over spring and summer also coincides with the growing season of these trees. Where evergreen trees have some chance of recovery in autumn and winter, these deciduous ornamental species do not. They must therefore be considered particularly vulnerable to permanent damage and decline as a result of the presence of the flying fox camp.

If the camp remains in the gardens it is certain that some trees will be permanently damaged. At best, dieback of the upper canopy will occur with a commensurate decline in amenity and health.

Several heritage trees are at significant risk of permanent damage, and given their age, the defoliation could eventually lead to tree death.

Figure 1 - Map of affected area

7. CONCLUSION AND RECOMMENDATIONS

Approximately 200 protected native Grey-headed Flying Fox (*Pteropus poliocephalus*) arrived in the Colac Botanic Gardens in late 2017, predominantly affecting a large *Quercus palustris* (Pin Oak). Over summer in 2019 the number of animals is estimated to have been more than 4000. The camp has spread to other trees since the initial colonisation, including a number of heritage trees. The camp appears to be continuing to spread towards the eastern edge of the gardens.

In June 2019 it is estimated that 2000 animals were still present, indicating that some of them have adopted the site as a permanent camp.

Affected trees, including the heritage trees, are mainly introduced deciduous amenity species. These trees are particularly vulnerable to permanent damage and decline as the maximum defoliation occurs over the growing season of these trees in spring and summer. Evergreen trees have some chance of recovery in autumn and winter that these deciduous ornamental species do not.

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ENSPEC's key recommendations –

- Disperse the Grey-headed Flying Fox camp out of the Botanic Gardens to protect the high value and vulnerable trees currently being damaged.

8. REFERENCES

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9. DISCLOSURE STATEMENT

ENSPEC Pty Ltd and their employees are specialists who use their knowledge, training and education (qualifications), infield learning experiences, personal experiences research, diagnostic tools, scientific equipment to examine trees, recommend measures to enhance the beauty, health and preservation of trees, to reduce the risk of living near trees.

Trees are living organisms that can be affected by pests, diseases and natural events outside of ENSPEC control. ENSPEC and their employees cannot detect every condition that affects a trees health, condition and structural integrity. Conditions are often hidden within trees and below ground where humans cannot naturally see. Unless otherwise stated, ENSPEC's employee's observations have been visually made from ground level.

In the event that ENSPEC recommends retesting or inspection of trees at stated intervals, or ENSPEC recommends the installation engineering solutions, ENSPEC must inspect the engineering solution at intervals of not greater than 12 months, unless otherwise specified in writing. It is the client's responsibility to make arrangements with ENSPEC to conduct re-inspections.

Intervention treatments of trees may involve considerations beyond the scope of ENSPEC's service, such as property boundaries and ownership, disputes between neighbours, sight lines, landlord-tenant matters and other related incidents. ENSPEC cannot take such issues into account unless complete and accurate information is given prior or at the time of the site inspection. Likewise, ENSPEC Pty Ltd cannot accept responsibility for the authorisation or non-authorisation of any recommended treatment or remedial measures undertaken.

ENSPEC Pty Ltd cannot guarantee that a tree will be healthy or safe under all circumstances or for a specified period of time after our initial inspection and recommendations.

If this written report is to be used in a court of law, or any other legal situation, or by other parties ENSPEC must be advised in writing prior to the written report being presented in any form to any other party. All written reports must be read in their entirety. At no time shall part of the written assessment be referred to unless taken in full context with the whole written report.

Clients may choose to accept or disregard the recommendations of the assessment and written report.

Notwithstanding anything in the report, express or implied, the client is not entitled to recover from ENSPEC Pty Ltd, its employees, agents and/or subcontractors any damages for business interruption or loss of actual or anticipated revenue, income or profits or any consequential, special, contingent or penal damage, whatsoever, and the client releases ENSPEC Pty Ltd from any such liability. Without limitation of the foregoing, a party shall at all times be limited (to the extent permitted by law) damages in the amount paid by the Client to ENSPEC Pty Ltd for ENSPEC Pty Ltd services. The limitation applies whether the claim is based on warranty, contract, statute, tort (including negligence) or otherwise.

Appendix H Human and animal health

Flying-foxes, like all animals, can carry pathogens that may pose human health risks. Many of these are viruses which cause only asymptomatic infections in flying-foxes themselves but may cause significant disease in other animals that are exposed. In Australia the most well-defined of these include Australian bat lyssavirus (ABLV) and Hendra virus (HeV).

Outside of an occupational cohort, including wildlife carers and vets, human exposure to these viruses is extremely rare and similarly transmission rates and incidence of human infection are very low. In addition, HeV infection in humans apparently requires transfer from an infected intermediate equine host and direct transmission from bats to humans has not been reported. Thus despite the fact that human infection with these agents can be fatal, the probability of infection is extremely low and the overall public health risk is judged to be low (Qld Health 2016).

Australian bat lyssavirus

ABLV is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been found in an insectivorous microbat and it is assumed it may be carried by any bat species. The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (DPI 2013) and transmission requiring direct contact with an infected animal that is secreting the virus. In Australia three people have died from ABLV infection since the virus was identified in 1996 (NSW Health 2013).

Domestic animals are also at risk if exposed to ABLV. In 2013, ABLV infections were identified in two horses (Shinwari et al. 2014). There have been no confirmed cases of ABLV in dogs in Australia; however, transmission is possible (McCall et al. 2005) and consultation with a veterinarian should be sought if exposure is suspected.

Transmission of the virus from bats to humans is through a bite or scratch, but may have potential to be transferred if bat saliva directly contacts the eyes, nose, mouth or broken skin. ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (NSW Health 2013).

Transmission of closely related viruses suggests that contact or exposure to bat faeces, urine or blood does not pose a risk of exposure to ABLV, nor does living, playing or walking near bat roosting areas (NSW Health 2013).

The incubation period in humans is assumed similar to rabies and variable between two weeks and several years. Similarly the disease in humans presents essentially the same clinical picture as classical rabies. Once clinical signs have developed the infection is invariably fatal. However, infection can easily be prevented by avoiding direct contact with bats (i.e. handling). Pre-exposure vaccination provides reliable protection from the disease for people who are likely to have direct contact with bats, and it is generally a mandatory workplace health and safety requirement that all persons working with bats receive pre-vaccination and have their level of protection regularly assessed. Like classical rabies, ABLV infection in humans also appears to be effectively treated using post-exposure vaccination and so any person who suspects they have been exposed should seek immediate medical treatment. Post-exposure vaccination is usually ineffective once clinical manifestations of the disease have commenced.

If a person is bitten or scratched by a bat they should:

- wash the wound with soap and water for at least five minutes (**do not scrub**)
- contact their doctor immediately to arrange for post-exposure vaccinations.

If bat saliva contacts the eyes, nose, mouth or an open wound, flush thoroughly with water and seek immediate medical advice.

Hendra virus

Flying-foxes are the natural host for Hendra virus (HeV), which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses, humans and on two occasions, dogs (DPI 2014). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (AVA 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (DPI 2015a).

Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated primarily with flying-fox urine (CDC 2014).

Humans may contract the disease after close contact with an infected horse. HeV infection in humans presents as a serious and often fatal respiratory and/or neurological disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate in horses is greater than 70% (DPI 2014). Since 1994, 81 horses have died and four of the seven people infected with HeV have lost their lives (DPI 2014).

The Hunter Valley in NSW is the furthest south in Australia that HeV has been detected, and spillover events are thought to be associated with foraging BFF and SFF. Findings to date suggest that GHFF may not excrete the virus (Edson et. al. 2019), however the precautionary principle should be applied and all horse owners should implement appropriate protective measures.

Vaccination of horses can protect horses and subsequently humans from infection (DPI 2014), as can appropriate horse husbandry (e.g. covering food and water troughs, fencing flying-fox foraging trees in paddocks, etc.).

Although all human cases of HeV to date have been contracted from infected horses and direct transmission from bats to humans has not yet been reported, particular care should be taken by select occupational groups that could be uniquely exposed. For example, persons who may be exposed to high levels of HeV via aerosol of heavily contaminated substrate should consider additional PPE (e.g. respiratory filters), and potentially dampening down dry dusty substrate.

General health considerations

Flying-foxes, like all animals, carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species. Direct contact with faecal material should be avoided and general hygiene measures taken to reduce the low risk of gastrointestinal and other disease.

Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses a health risk to humans. Household tanks should be designed to minimise potential contamination, such as using first flush diverters to divert contaminants before they enter water tanks. Trimming vegetation overhanging the catchment area (e.g. the roof of a house) will also reduce wildlife activity and associated potential contamination. Tanks should also be appropriately maintained and flushed, and catchment areas regularly cleaned to remove potential contaminants.

Public water supplies are regularly monitored for harmful microorganisms, and are filtered and disinfected before being distributed. Management plans for community supplies should consider whether any large congregation of animals, including flying-foxes, occurs near the supply or

catchment area. Where they do occur, increased frequency of monitoring should be considered to ensure early detection and management of contaminants.

Disease and flying-fox management

A recent study at several camps before, during and after disturbance (Edson et al. 2015) showed no statistical association between HeV prevalence and flying-fox disturbance. However the consequences of chronic or ongoing disturbance and harassment and its effect on HeV infection were not within the scope of the study and are therefore unknown.

The effects of stress are linked to increased susceptibility and expression of disease in both humans (AIHW 2012) and animals (Henry & Stephens-Larson 1985; Aich et. al. 2009), including reduced immunity to disease.

Therefore it can be assumed that management actions which may cause stress (e.g. dispersal), particularly over a prolonged period or at times where other stressors are increased (e.g. food shortages, habitat fragmentation, etc.), are likely to increase the susceptibility and prevalence of disease within the flying-fox population, and consequently the risk of transfer to humans.

Furthermore, management actions or natural environmental changes may increase disease risk by:

- forcing flying-foxes into closer proximity to one another, increasing the probability of disease transfer between individuals and within the population
- resulting in abortions and/or dropped young if inappropriate methods are used during critical periods of the breeding cycle. This will increase the likelihood of direct interaction between flying-foxes and the public, and potential for disease exposure
- adoption of inhumane methods with potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying flying-foxes.

The potential to increase disease risk should be carefully considered as part of a full risk assessment when determining the appropriate level of management and the associated mitigation measures required.

Appendix I Dispersal results summary

Roberts and Eby (2013) summarised 17 known flying-fox dispersals between 1990 and 2013, and made the following conclusions:

1. In all cases, dispersed animals did not abandon the local area[26].
2. In 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in the local area.
3. Dispersed animals did not move far (in approx. 63% of cases the animals only moved <600 m from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.
4. In all cases, it was not possible to predict where replacement camps would form.
5. Conflict was often not resolved. In 71% of cases conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.
6. Repeat dispersal actions were generally required (all cases except where extensive vegetation removal occurred).
7. The financial costs of all dispersal attempts were high, ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke, etc.).

Ecosure, in collaboration with a Griffith University Industry Affiliates Program student, researched outcomes of management in Queensland between November 2013 and November 2014 (the first year since the current Queensland state flying-fox management framework was adopted on 29 November 2013). An overview of findings[27] is summarised below.

- Dispersal methods included fog[28], birdfrite, lights, noise, physical deterrents, smoke, extensive vegetation modification, water (including cannons), paintball guns and helicopters.
- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.
- In nine of the 24 camps dispersed, dispersal actions did not reduce the number of flying-foxes in the LGA.
- In all cases it was not possible to predict where new camps would form.
- When flying-foxes were dispersed, they did not move further than 6 km away.
- As at November 2014 repeat actions had already been required in 18 cases.
- Conflict for the council and community was resolved in 60% of cases, but with many councils stating that they feel this resolution is only temporary.

[26] Local area is defined as the area within a 20 km radius of the original site = typical feeding area of a flying-fox.

[27] This was based on responses to questionnaires sent to councils; some did not respond and some omitted responses to some questions.

[28] Fog refers to artificial smoke or vapours generated by smoke/fog machines. Many chemical substances used to generate smoke/fog in these machines are considered toxic.

- The financial costs of all dispersal attempts, regardless of methods used were considerable, ranging from $7500 to more than $400,000 (with costs ongoing).

Appendix J Dispersal tools

Assessment of management methods. Only those marked as suitable for use in Colac will be used in the dispersal program without further consultation with DELWP.

Type	Examples	Level of historic success	Advantages	Disadvantages	Suitable for use in Colac
Aural	Stock whips, starter pistols, distress callers, heavy music, air horns, banging metal objects, gas cannons, megaphones	High (but requires ongoing effort)	Cost effective tools that are easily varied.	High operational costs (human resources). Flying-foxes may habituate quickly to some visual deterrents.	✓
	Bird scare cartridges (e.g. Bird Frite)	Effective at moving flying-foxes but high stress tool which prevents a strategic approach		High stress to flying-foxes Potential to damage flying-fox hearing Prevents strategic dispersal approach	X
Visual	Lighting - hand-held spotlights, light towers, strobe lights	Moderate (but requires ongoing effort).	Cost effective tools that are easily varied. Most effective in combination with audio tools.	Costly operational costs (human resources). Flying-foxes quickly habituate.	✓
	~~Laser pointers~~	~~Moderate (but requires ongoing effort).~~	~~Cost effective tools.~~ ~~Most effective in combination with audio tools.~~	~~Risk of damaging flying-fox vision – laser power should be low range and should not be pointed at flying-foxes (but rather habitat). Care required where aircraft are operating nearby – see requirements of Civil Aviation Safety Authority.~~	~~✓*~~
	General - dancing men, kites, balloons, plastic bags/reflective objects hung from branches	Moderate – localised only (i.e. single tree or less).	Can remain in place for periods of time without human operation so no operational costs.	Installing to cover large enough areas can be logistically difficult and resource intensive. Flying-foxes may habituate quickly to some visual deterrents.	✓*
Physical	Water - hoses[29], sprinklers (including canopy-mounted)	Unknown (but likely to be moderate-high).	Can be automated so minimal operational costs (water only).	Initial installation costly. Potential welfare implications associated with use of hoses.	✓*
	Trip wires	Low (flying-foxes have been known to utilise trip wires as heavy duty roosting space)	Alternative wires to those used in the unsuccessful trial referenced may improve efficiency	Risk of wildlife entanglement - requires proper installation, monitoring and maintenance to avoid	X

[29] Hoses should not be directed at flying-foxes for obvious welfare reasons, but can be used to deter flying-foxes from landing in a tree or re-establishing a camp.

	Netting	Unknown (never trialled due to prohibitive cost and logistical issues)	Likely to be effective (physical exclusion)	Risk of wildlife entanglement - requires proper installation, monitoring and maintenance to avoid Costly installation and maintenance Reduced amenity Logistically difficult to install in large areas Reduced habitat value for other fauna	X
	Habitat modification	High.	Effective Can be substituted for active dispersal/harassment techniques as a more passive method of dispersal e.g. vegetation management while flying-foxes are absent to a point that it is no longer attractive to roosting flying-foxes so that they voluntarily abandon the site	Not suited to CBG Initially resource intensive Reduced habitat value for other fauna Potential for reduced amenity	✓
	Culling	Low (and ongoing effort required)	N/A	Not appropriate or permitted under legislation Ineffective due to transient nature of flying-foxes Welfare implications for target individuals (often inhumane death) and dependent young Conservation implications with potential to impact flying-foxes at a population/species level Would require euthanasia of injured (and potentially orphaned) animals Increased disease risk with higher likelihood of humans coming in contact with dead, injured or orphaned flying-foxes	X
Oflactory	D-Ter (manufactured by Heiniger), python excrement and the odour of paradichlorobenzene (found in toilet deoderiser blocks).	Moderate – localised only (i.e. single tree or less)	Can remain in place for periods of time without human operation so no operational costs.	Difficult and resource intensive to apply in large areas Regular maintenance required.	X

Smoke	Smoke machine or fires contained in pits/drums.	High (but ongoing)	Effective	Requires careful use[30] and monitoring to avoid welfare impacts. Heavily affected by weather conditions (rain, wind). Potential risk of bush fire. Potentially unsuitable during fire bans.	✓
General	Fogging	High (but not appropriate)	Not appropriate	Use of oils (i.e. white oil) has potential for serious health impacts to flying-foxes.	X
	Aircraft e.g. helicopters	Unknown (but not appropriate)	Not appropriate	Significant potential for strike resulting in human or wildlife injury/death.	X
	Paint ball guns	Unknown (but not appropriate)	Not appropriate	Significant potential for wildlife injury/ death.	X
	Fireworks	Unknown (but not appropriate)	Not appropriate	Significant potential for human or wildlife injury/death.	X

[30] Care should be taken when using smoke to ensure: fire must be extinguished should flying-foxes land in the area to avoid health impacts associated with smoke inhalation, and; materials that may produce harmful smoke or fumes when burnt are removed/not used (i.e. paint on drums, wood from toxic plants, petrol, etc.).

*May be suitable in some situations and/or if available resources allow.

Appendix K Flying-fox ecology and behaviour

Ecological role

Flying-foxes, along with some birds, make a unique contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton et al. 2004). This contributes directly to the reproduction, regeneration and viability of forest ecosystems (DoE 2016a).

It is estimated that a single flying-fox can disperse up to 60,000 seeds in one night (ELW&P 2015). Some plants, particularly Corymbia spp., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton et al. 2004).

Grey-headed flying-foxes may travel 100 km in a single night with a foraging radius of up to 50 km from their camp (McConkey et al. 2012), and have been recorded travelling over 500 km in two days between camps (Roberts et al. 2012). In comparison bees, another important pollinator, move much shorter foraging distances of generally less than one kilometre (Zurbuchen et al. 2010).

Long-distance seed dispersal and pollination makes flying-foxes critical to the long-term persistence of many plant communities (Westcott et al. 2008; McConkey et al. 2012), including eucalypt forests, rainforests, woodlands and wetlands (Roberts et al. 2006). Seeds that are able to germinate away from their parent plant have a greater chance of growing into a mature plant (EHP 2012). Long-distance dispersal also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones & Augee 1992; Eby 1991; Roberts 2006). This genetic diversity allows species to adapt to environmental change and respond to disease pathogens. Transfer of genetic material between forest patches is particularly important in the context of contemporary fragmented landscapes.

Flying-foxes are considered ‘keystone’ species given their contribution to the health, longevity and diversity among and between vegetation communities. These ecological services ultimately protect the long-term health and biodiversity of Australia’s bushland and wetlands. In turn, native forests act as carbon sinks, provide habitat for other fauna and flora, stabilise river systems and catchments, add value to production of hardwood timber, honey and fruit (e.g. bananas and mangoes; Fujita 1991), and provide recreational and tourism opportunities worth millions of dollars each year (EHP 2012; ELW&P 2015).

Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. There are many possible drivers for this, as summarised by Tait et al. (2014):

- loss of native habitat and urban expansion
- opportunities presented by year-round food availability from native and exotic species found in expanding urban areas
- disturbance events such as drought, fires, cyclones
- human disturbance or culling at non-urban camps or orchards
- urban effects on local climate
- refuge from predation

- movement advantages, e.g. ease of manoeuvring in flight due to the open nature of the habitat or ease of navigation due to landmarks and lighting.

Under threat

Flying-foxes roosting and foraging in urban areas more frequently can give the impression that their populations are increasing; however, the grey-headed flying-fox is in decline across its range and is listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988.

At the time of listing, the species was considered eligible for listing as vulnerable as counts of flying-foxes over the previous decade suggested that the national population may have declined by up to 30%. It was also estimated that the population would continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling.

The main threat to grey-headed flying-foxes in Victoria is clearing or modification of native vegetation. This threatening process removes appropriate roosting and breeding sites and limits the availability of natural food resources, particularly winter–spring feeding habitat. The urbanisation of the coastal plains of south-eastern Queensland and northern NSW has seen the removal of annually-reliable winter feeding sites, and this threatening process continues.

There is a wide range of ongoing threats to the survival of the GHFF, including:

- habitat loss and degradation
- conflict with humans (including culling at orchards)
- infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.)
- predation by native and introduced animals
- exposure to extreme natural events such as cyclones, drought and heat waves.

Flying-foxes have limited capacity to respond to these threats and recover from large population losses due to their slow sexual maturation, small litter size, long gestation and extended maternal dependence (McIlwee & Martin 2002).

Roosting characteristics

All flying-foxes are nocturnal, roosting during the day in communal camps. These camps may range in number from a few to hundreds of thousands, with individual animals frequently moving between camps within their range. Typically, the abundance of resources within a 20–50 kilometre radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments 2012). Therefore, flying-fox camps are generally temporary and seasonal, tightly tied to the flowering of their preferred food trees. However, understanding the availability of feeding resources is difficult because flowering and fruiting are not reliable every year, and can vary between localities (SEQ Catchments 2012). These are important aspects of camp preference and movement between camps, and have implications for long-term management strategies.

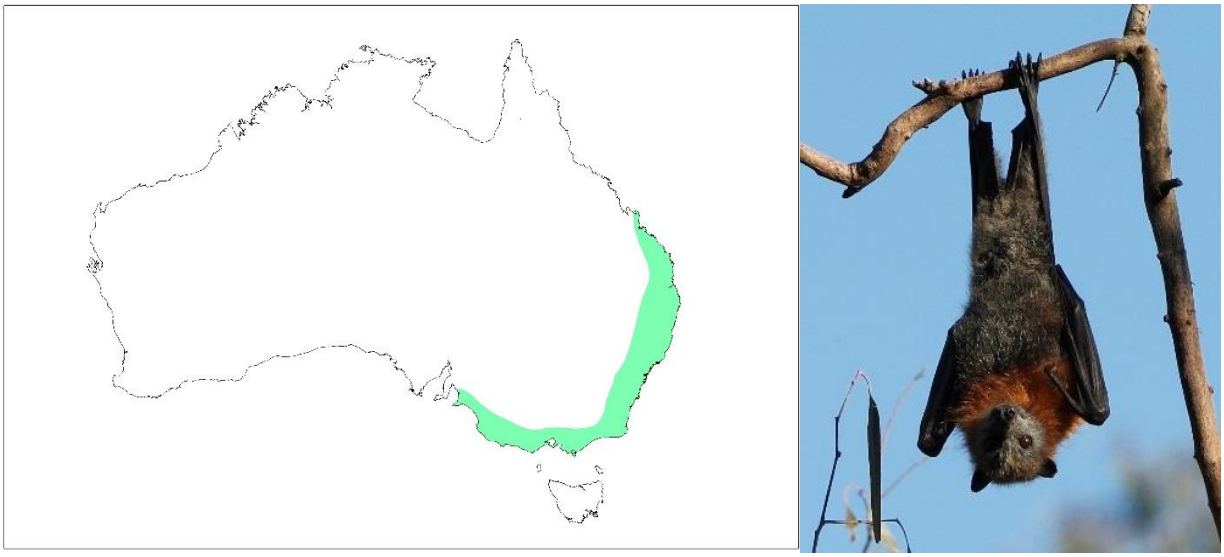
Little is known about flying-fox camp preferences; however, research indicates that apart from being in close proximity to food sources, flying-foxes choose to roost in vegetation with at least some of the following general characteristics (SEQ Catchments 2012):

- closed canopy >5 metres high

- dense vegetation with complex structure (upper, mid- and understorey layers)
- within 500 metres of permanent water source
- within 50 kilometres of the coastline or at an elevation <65 metres above sea level
- level topography (<5° incline)
- greater than one hectare to accommodate and sustain large numbers of flying-foxes.

Optimal vegetation available for flying-foxes must allow movement between preferred areas of the camp. Specifically, it is recommended that the size of a patch be approximately three times the area occupied by flying-foxes at any one time (SEQ Catchments 2012).

Grey-headed flying-fox (*Pteropus poliocephalus*)



Grey-headed flying-fox indicative species distribution, adapted from OEH 2015a

The grey-headed flying-fox (GHFF) is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (OEH 2015d). This species now ranges into South Australia and has been observed in Tasmania (DoE 2016a). It requires foraging resources and camp sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will raid orchards at times, especially when other food is scarce (OEH 2015a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb & Tidemann 1996; DoE 2015). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 km from their camp (Roberts et al. 2012). They have been recorded travelling over 500 km over 48 hours when moving from one camp to another (Roberts et al. 2012). GHFF generally show a high level of fidelity to camp sites, returning year after year to the same site, and have been recorded returning to the same branch of a particular tree (SEQ Catchments 2012). This may be one of the reasons flying-foxes continue to return to small urban bushland blocks that may be remnants of historically-used larger tracts of vegetation.

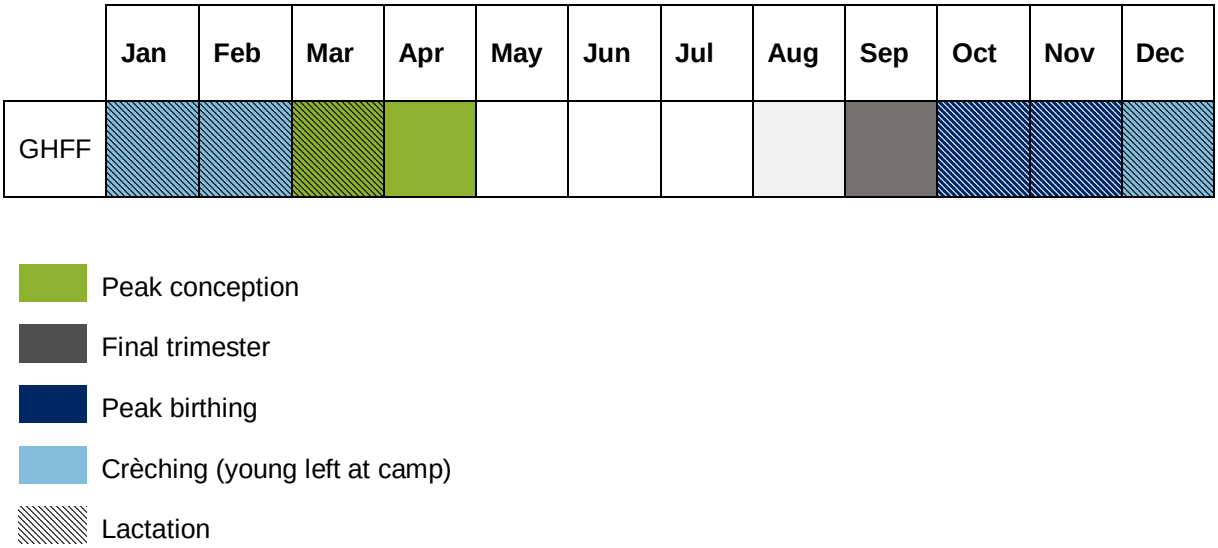
The GHFF population has a general annual southerly movement in spring and summer, with their return to the coastal forests of north-east NSW and south-east Queensland in winter (Ratcliffe 1932; Eby 1991; Parry-Jones & Augee 1992; Roberts et al. 2012). In summer they

are distributed across Queensland, NSW, ACT, Victoria, Tasmania and South Australia (DoEE

2017), but in spring and winter are uncommon in southern states. The total number of GHFF at Victorian camps monitored in the NFFMP between 2013 and 2018 generally comprise between 2% (November 2018) and 14% (May 2014) of the national population across approximately 24 camps (total camps as at November 2018) (NFFMP 2013-2019). Colac is towards the western extent of the GHFF range with only three known camps further west (Lower Gellibrand and Warrnambool, Victoria and Adelaide, South Australia) (NFFMP 2019).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000; Richards 2000 cited in OEH 2011a). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, deliberate destruction associated with the commercial horticulture industry, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.) and competition and hybridisation with the BFF (DECCW 2009).

Indicative grey-headed flying-fox reproductive cycle for Victoria is shown in the figure below.



Indicative grey-headed flying-fox reproductive cycle.