



Centennial  
Parklands

**Centennial Parklands**



# **Flying-fox Camp Management Plan**

**June 2021**

**Centennial Parklands**

## Document Tracking

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## Acronyms and abbreviations

ABLV	Australian bat lyssavirus
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BFF	<i>Pteropus Alecto</i> (Black Flying-fox)
the Code of Practice / the Code	NSW Flying-fox Camp Management Code of Practice 2018
DAWE	Commonwealth Department of Agriculture, Water and the Environment, previously Department of the Environment and Energy (DEE)
the Department/ DPIE	NSW Department of Planning, Industry and Environment
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GHFF	<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)
the Guideline	Commonwealth Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015
LGA	local government area
LRFF	<i>Pteropus scapulatus</i> (Little Red Flying-fox )
MNES	matters of national environmental significance
NPWS	NSW National Parks and Wildlife Service
OEH	NSW Office on Environment & Heritage (now the Department of Planning, Industry and the Environment)
the Plan	Camp Management Plan
the Policy	NSW Flying-fox Camp Management Policy 2015
SEPPs	State Environmental Planning Policies

# 1. Overview

This Camp Management Plan (the Plan) has been prepared in accordance with the Department of Planning, Infrastructure and Environment's (the Department, formerly known as the Office of Environment and Heritage (OEH)) policy and plan template to ensure that management activities are consistent with the NSW Flying-fox Camp Management Policy 2015 (OEH 2018) under the *Biodiversity Conservation Regulation 2017*. Changes have been made to the Plan template where necessary in order to clearly and concisely reflect information relevant to the Flying-fox camp at Centennial Park.

## 1.1 Objectives

The objectives of the Plan are to:

- Protect and maintain the Centennial Park flying-fox camp in the long-term
- Manage public health and safety risks
- Ensure management is sympathetic to flying-fox behaviours and requirements, and avoids creating conflict with the community
- Enhance the amenity of the area
- Improve community understanding and appreciation of flying-foxes, including their critical ecological role
- Ensure Flying-fox welfare is a priority during all works
- Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b) and the Flying-fox Camp Management Code of Practice 2018 under the Biodiversity Conservation Regulation 2017
- Ensure that Centennial Parklands is a place where:
  - Wildlife can seek habitat and refuge and
  - Native vegetation is protected and nurtured, as listed in the Plan of Management 2018.
- Facilitate licence approval, where required, for actions at the camp under the NSW *Biodiversity Conservation Act 2016* (BC Act)
- Implement an adaptive approach to camp management
- Facilitate a coordinated approach to camp management
- Ensure camp management is consistent with broader conservation management strategies that may be developed to protect threatened species/communities.

## **2. Context**

### **2.1 Camp area and location within Centennial Parklands**

The core and potential flying fox habitat of this camp is located in an area of Centennial Park referred to as Lachlan Swamp, and supporting vegetation (Figure 1 and Figure 2). The identified camp extent as at June 2019 is shown in Figure 1. The camp (including core and seasonal overflow) currently covers 6.5 ha.

The camp is bordered by Dickens Drive in the north, Parkes Drive in the west, and Grand Drive in the south east. Areas adjoining the camp, such as Lachlan Reserve, in the west of the Camp Boundary, and Brazilian Fields, to the north of Dickens Drive, are available for public use including recreation, events and venue hire.

Centennial Parklands extends across the four local government areas (LGAs) of City of Sydney, Randwick City Council, Woollahra Municipal Council and Waverly Council. The Lachlan Swamp camp is within the Randwick City Council LGA.



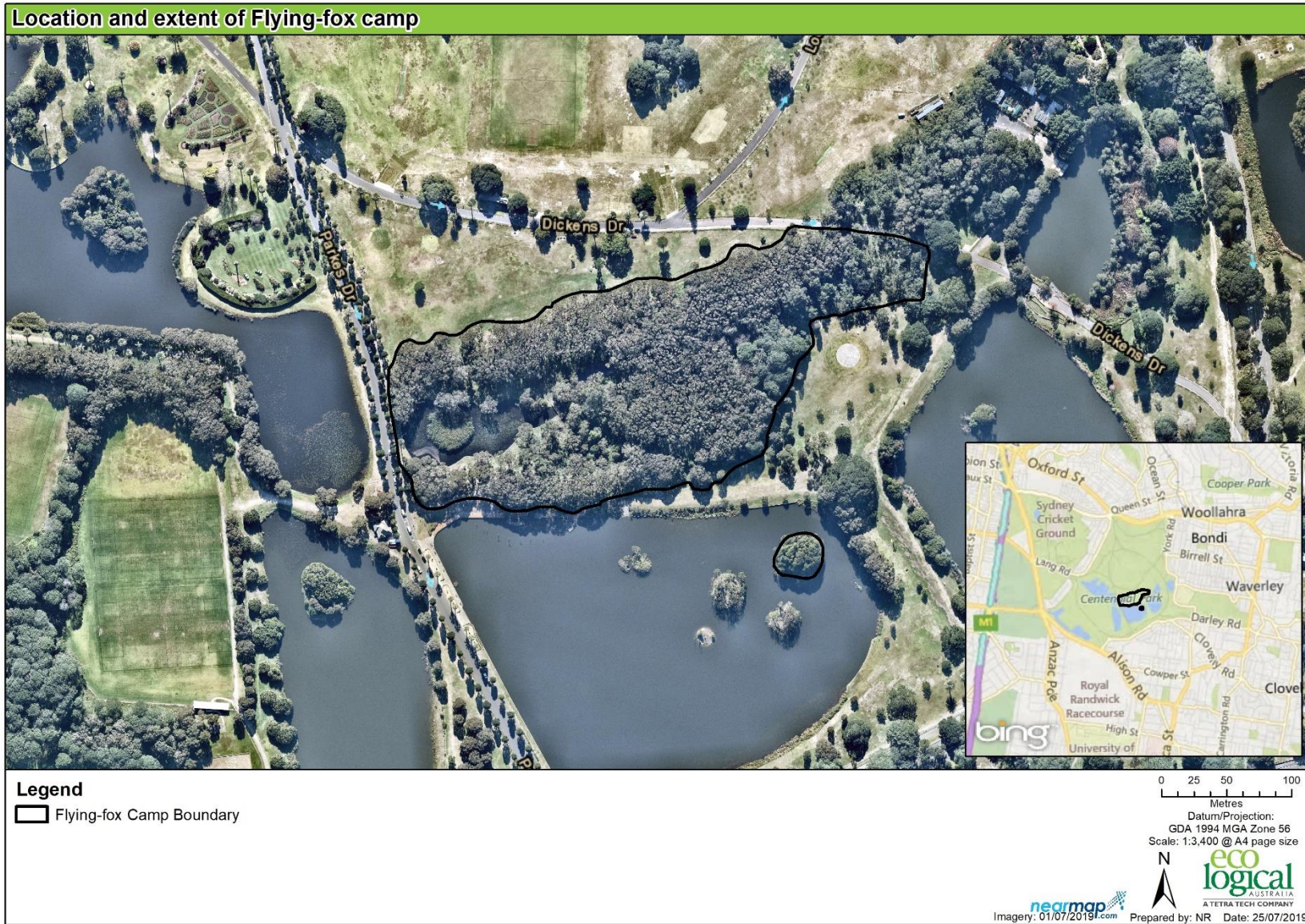


Figure 1: Location of Centennial Park Flying-fox camp



**Figure 2: Flying-fox camp area in Lachlan Swamp, Centennial Park**

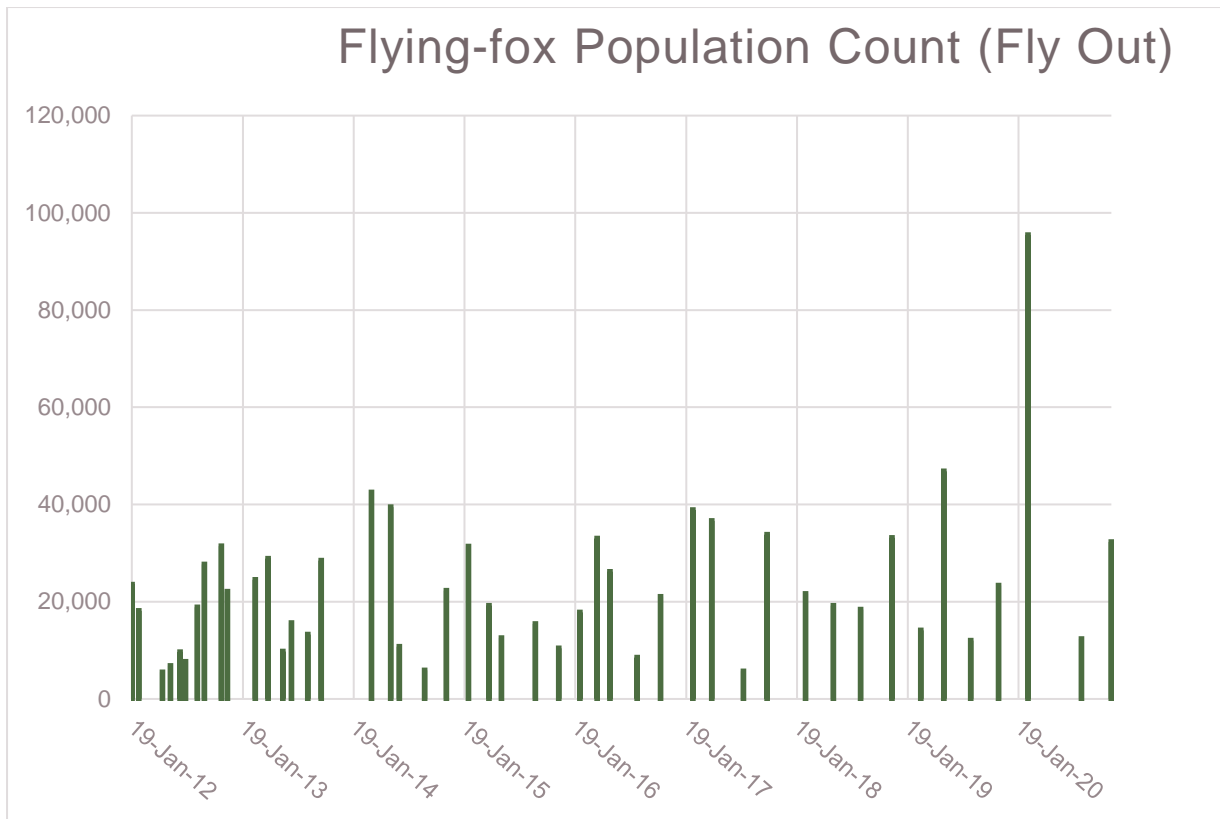
### 2.1.1 Flying-fox population

The camp established at Centennial Park in February 2010, possibly as a response to a food shortage event that affected large parts of coastal NSW between February and September. During this food shortage event, Flying-foxes were observed to establish new colonies closer to food resources. In the Sydney region, colonies also established at Oatley, Balgowlah, Gladesville and Warriewood (J. Martin pers. comm.). The number of bats using the Centennial Park camp has been observed to comprise primarily *Pteropus poliocephalus* (Grey-headed Flying-fox, GHFF), but also *P. alecto* (Black Flying-foxes, BFF).

The extent of the core roosting habitat varies seasonally as determined by the availability of food within the Sydney region. Results of quarterly population counts taken at the Centennial Park camp (Figure 3) indicate that the number of Flying-foxes using the camp fluctuates.

The camp meets the criteria for being 'nationally important' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) because it has contained more than 10,000 GHFFs in more than one year in the last ten years (Figure 3). The average population count between January 2012 and November 2020 is 21,393, with only eight of the quarterly counts since 2012 yielding less than 10,000 individuals. The largest number of Flying-foxes has been recorded over two consecutive years (May 2019 and February 2020), with the maximum number of flying foxes recorded to date being 95,442 in February 2020 (Figure 3). The camp now is an important annual maternity roost within central Sydney.

This nationally important camp stands out for its highly urban setting, where Lachlan Swamp provides vital habitat for threatened species. Deaths from heat stress have been reported widely for Flying-foxes over the last five years and there has been concern that climate change is increasing the regularity and severity of such events. Heat-related incidents have been reported at the Centennial Parklands camp in recent years, but there has been careful monitoring of the bats during heat waves and anecdotal evidence suggests that the Centennial Park camp was not as severely affected as some other camps in Sydney (A. Glynn Pers. Comm.). This may have been a result of the presence of Lachlan Swamp providing moisture from the creek, which creates a higher humidity environment, or its proximity to the coast. The swamp forest, however, has a single very uniform canopy and limited midstorey that bats could retreat in order to find denser shade.



**Figure 3: Results of Flying-fox counts at Centennial Park between 2010 and 2020 (A. Glynn per. comm.)**

## 2.1.2 Soils and landform

Information on the soils and landform of the camp location is sourced from <https://www.centennialparklands.com.au/visit/environment/geology-and-landform>.

The Parklands are located within the geological unit known as the Botany Sands. These are composed of a complex of Aeolian sand dunes of the Holocene era, of variable thickness, with an underlying layer of inter-bedded clays, peats and sands.

The topography has been significantly altered by European occupation of the area. Filling and urban development in the late 19th century resulted in the ponds system being a modified remnant of the original extensive freshwater wetlands.

Lower lying sections such as the Lachlan Swamp, have bands and lenses of Waverley Coffee Rock, a finely textured soft impermeable mudstone. The resultant podsolised soil profiles are azonal, acidic and with only weakly differentiated or non-existent horizon development. Decaying vegetation provides humus in a thin upper 'A' horizon with staining and discoloration of the prevalent white sand. Nutrient status is low, the absence of clay causing low cation exchange capacity, and particles in the fine to very fine range contributing to the drainage characteristics of the parklands.

## 2.1.3 Vegetation

Prior to European settlement, it is likely that the vegetation would have comprised an Epacris-dominated heath-swampland community (Hamilton and Penny 2015). The region is presumed to have once supported Eastern Suburbs Banksia Scrub (Benson and Howell 1990). There are remnant pockets of this community within the Parklands in six locations, including the Bird Sanctuary and York Road. This is a Critically Endangered Ecological Community listed under the BC Act and an Endangered Ecological community listed under the EPBC Act.

The 2002 Tree Masterplan for the Centennial Parklands states that the majority of trees in the Parklands were planted between the 1880s and 1920s. *Melaleuca quinquenervia* (Broad-leaved Tea-tree or paperbark) was planted extensively throughout the Parklands to create wind breaks, particularly in damp locations. According to the 2002 Tree Masterplan, the plantings on the northern side of the Lily Pond were probably planted in 1896 or 1897. The Centennial Parklands website reports that paperbarks were planted at Lachlan Swamp approximately 30 years ago, although these trees are as tall as those planted around Lily Pond because of favourable conditions.

Land surrounding the Lachlan Swamp, known as Lachlan Reserve, is maintained as mown grassland.

A comprehensive list of flora identified during a site inspection in 2015 is presented in Appendix 1: Recorded flora species.

### Canopy health and retention

The Action Plan contained within the 2002 Tree Masterplan for the Centennial Parklands identifies Lachlan Swamp as an area where planting is to be conserved or reinforced.

The dominant canopy species within the Lachlan Swamp showed minimal signs of stress related to the Flying-fox habitation. Of the 'roost' Paperbarks with crown damage, approximately 10-20% of leaf cover was directly affected or damaged. A number of trees which showed crown damage also had produced epicormic growth lower in the branch assemblage, indicating the plants' ability to recover and respond to such events.

The Lachlan Swamp displayed typical characteristics associated with densely planted monocultures with examples of 'sucker failure' due to competitive pressures amongst the larger parent specimens.

The larger and more robust *Melaleuca quinquenervia* could be found on the northern borders of the Lachlan Swamp where suitable spacing during installation provided for sufficient space for expansion and root zone development. There was no evidence of local species recruitment of *Melaleuca quinquenervia* or *Casuarina glauca* (i.e. no seedlings or saplings within or on the extremities of the area).

Regardless of the factors associated with natural canopy recruitment, such issues will eventually affect the vegetation and the in-situ sustainability of the camp. As an insurance measure seed has been collected and plants have been propagated from one of the paperbarks in order to raise replacement plants for use in re-plantings, as required.

At the time of an earlier inspection in 2015, there were few fallen or large dead/dying trees. This suggests an absence of soil borne pathogens that could result in tree root or collar rot. Anecdotal evidence suggests mature specimens are only uprooted during extreme rain events.

Further investigation into the presence of Phytophthora Dieback (caused by *Phytophthora cinnamomi* and other closely related plant pathogens) may be required because the site presents suitable conditions for this pathogen. No evidence has been found to date to indicate the presence of Myrtle Rust (*Puccinia psidii*) within the actual project site. However, Myrtle Rust has been detected from self-sown paperbarks on the edge of Duck Pond, Centennial Park, which is only a few hundred metres away; and paperbark seedlings planted in August 2020 have been susceptible to Myrtle Rust. Regular inspections of the residing Myrtaceae species should be conducted, as the introduction of any disease could have rapid and severe effects on the trees present, potentially rendering the site unsuitable for further use as a roost site for bats.

## 2.2 Land tenure

The camp is located on Crown Land managed by the Centennial Park and Moore Park Trust (CPMPT). It is zoned RE1 Public Recreation under the Randwick Local Environmental Plan 2012. The management of Centennial Parklands is guided principally by the *Centennial Park and Moore Park Trust Act 1983*, the *Heritage Act 1977* (NSW), Centennial Parklands Plan of Management and Centennial Parklands Conservation Management Plan.

Land use within the immediate radius of the camp is largely recreational. The Lachlan Reserve and Swamp areas are surrounded by walking paths, mown parkland used for a limited number of major events and weddings, and the Wild Play Discovery educational Centre. Parklands activities include:

- Sports at Lachlan Reserve
- Bookable picnic sites
- Nearby roads used by motorists and cyclists
- Visitor access to the Lachlan Swamp Boardwalk
- School groups undertaking tours and survey activities with Centennial Parklands Education Rangers
- Functions such as weddings held at Lachlan Reserve and Lily Pond
- Large events, such as music concerts and community festival events, held in the areas nearby to the camp (at Brazilian Fields and Loch Avenue South)
- Maintenance activities (mowing, weeding, tree works) in and around the camp
- Filming for documentaries and television programs.

## 2.3 Current licenses

A Threatened Species Licence (Licence No. C0004947) and Section 95(2) Certificate (Certificate No. C0001336) issued to Centennial Parklands expired 21 December 2020. No works have been undertaken within Lachlan Swamp since this date.

It is understood that Centennial Parklands will manage the camp and surrounds through level 1 management actions in line with the Flying-fox Camp Management Code of Practice 2018.

The Parklands will seek approval for annual tree maintenance works to remove trees within the camp that are determined to present an unacceptable level of risk to public safety.

Actions requiring a license are outlined in Section 10.1.

## 2.4 Issues raised by the community to date

Despite being in a highly urbanised area in the centre of Sydney, the nearest residence is approximately 390 m from the camp. The lack of potentially conflicting adjacent land uses has likely been a reason why there are little to no records of complaints from the community about the flying-fox camp.

### 2.4.1 Community involvement with the camp to date

A summary of community involvement events is presented in Table 1.

**Table 1: Past community involvement events**

Event	Event details provided to the community	Date
Bat surveying	Volunteers participate in population counts of the Centennial Park flying fox colony. The method used for estimating the number of bats is known as a 'fly-out count' and involves counting the number of bats exiting the roost at dusk.  <a href="https://www.centennialparklands.com.au/support-join/volunteers/bat-surveying">https://www.centennialparklands.com.au/support-join/volunteers/bat-surveying</a>	Feb 2021 Nov 2020 August 2020 Feb-20 Nov-19 Aug-19 May-19 Mar-19 Nov-18 Aug-18 May-18 Feb-18
Science in the swamp	A fun, free family festival of science displays, shows and activities to celebrate National Science Week.	August 2019 August 2018
Get Fit with Bats - The Big Bat Walk	A 2km-twilight walk around Lachlan Swamp. Our rangers will talk about our bat colony – we will observe the beautiful fly-out of the fruit bats and we'll listen for the echolocating calls of microbats.	May 2019 April 2018
Bat Fest	Experts will share their knowledge and stories of what it's like to be a wildlife carer.  Watch the flyout of Sydney's largest colony during sunset and start from there on a Spotlight Prowl through Centennial Park to find more of Australia's fascinating nocturnal wildlife and of course we have some bat-tastic fun activities for	April 2021 April 2019 April 2018

Event	Event details provided to the community	Date
	the smaller bat-fans.	
The Great CP Bat Count	Family event to join our volunteers and see how the bats are counted.	May 2019 May 2018
Bat night	Bat Count with North Sydney Council Bushcare Volunteers.	March 2021 March 2019
Theatre for Kids – What a Bat Life?	A fun-filled interactive theatre production that features flying foxes. Join the actors of the Eaton Gorge Theatre Company and get a get a bats-eye view on the park! This interactive play will lead you through the Lachlan Swamp and get you interesting insights into the world of microbats and flying foxes. For children 5-10 years old.	October 2018

## 2.5 Current management issues

Land managers have identified the main issue of concern to be the sustainability of vegetation associated with the camp. As is typically the case, vegetation in parts of the Flying-fox camp has been degraded by weeds associated with, at least in part, the faecal droppings from the bats themselves (seed propagules and nutrients), and has experienced physical damage by roosting Flying-foxes.

The Centennial Park Master Plan 2040 states that ‘there will be no reduction of green, open space within the park, tree numbers or animal habitat areas’. Relevant matters that have been raised in previous studies such as the Centennial Park Master Plan 2040, Centennial Parklands Plan of Management 2006-2016, Tree Masterplan (2002) and Conservation Management Plan (2003) include:

- Some trees and landscape elements are in a state of gradual deterioration due to water stress, age and pest problems
- There is a high level of visitor usage and there is a risk of conflicts
- The appearance of trees and ponds is highly valued
- There is a desire for conservation of ecology and landscaping of the Parklands and the interpretation and communication of its values.

More recently, Centennial Parklands have identified the detrimental impacts of natural events, such as hail, heat stress and food shortages, as matters for concern to the Flying-foxes that inhabit this camp.

### 2.5.1 Roost habitat loss and weed infestation

Flying-foxes will often defoliate and break branches while landing and flying within their roosts. Tree deaths are common in densely populated camps or during prolonged periods of camp occupation. The loss of canopy combined with increased levels of sunlight reaching the lower vegetation strata and increased nutrient loadings can lead to a proliferation of weeds unless native species are encouraged to regenerate. A camp will be sustainable if there is sufficient habitat for the GHFF to shift into new roost trees and allow old roost trees to recover or regenerate.

As discussed in Section 2.1.3, vegetation in the camp shows some signs of stress related to Flying-fox habitation, and a number of exotic species and dying trees were recorded on site.



Though weeds may offer some relief to GHFF from heat stress, their removal is necessary for the long-term sustainability of the habitat where they impact on the growth and regeneration of native species. Weed and vegetation management activities need to be conducted in a manner that minimises risks to GHFF.

### **2.5.2 Heat stress**

Stanvic et al. (2013) report that a heat stress event occurs when temperatures within the camp reaches 40° C or more. These temperatures can harm or kill GHFF. Heat stress or hyperthermia occurs when the body absorbs or produces more heat than it can dissipate. This process can be fatal as the internal body temperatures climb rapidly leading to severe dehydration and vital organ failure.

Contributing factors that might increase the likelihood of heat stress and death of GHFF include:

- Absence of adequate understorey vegetation – dense understorey vegetation provides a refuge to escape intense heat.
- High temperatures occurring during the GHFF birthing season or when juveniles are present in the camp.
- High numbers of GHFF in camp - more bats will lead to competition for cool roost locations.
- Stress from other factors (noise, low food resources, disease or a combination of these things) will mean the GHFF have lower resilience to additional stress.

One concern with the Centennial Park camp is the limited area of available roost habitat that may result in high densities of bats during heat waves when the colony has larger numbers of bats present (>30,000) and the limited area of available swamp habitat does not allow for the camp to spread out.

### **2.5.3 Food shortages**

Flying-foxes feed on the nectar and pollen of native blossoms and fruits such as figs and require multiple populations of food trees dispersed over a large area (OEH 2019). The continued loss of foraging habitat presents a primary threat to GHFF and is evident through repeated food shortages which have been observed in winter and spring. Food shortages are associated with rapid weight loss and poor reproductive success because the species is subject to recurring food shortage events during late gestation, birth and early lactation (DEE 2017).

Food shortages in 2016 resulted in a widespread abandonment of Flying-fox pups across regional NSW and some parts of Sydney and food shortages in 2017 had marked effects in Sutherland Shire's Kareela camp. There have been apparent food shortage related incidents at Centennial Park in recent years with anecdotal observations finding an increased number of abandoned and underweight pups present in the camp during food shortage events (low flower numbers and/or low nectar production). Food shortages limit a mother's ability to lactate, which often leads to underweight pups and, in severe circumstances, the mothers abandoning their young.

### **2.5.4 Unexpected weather events**

Unexpected weather events that have the potential to detrimentally affect Flying-fox camp populations include hail storms, strong winds, prolonged heavy rains and extreme cold

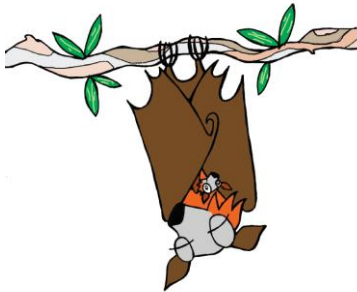


winter temperatures. These events may cause stress to Flying-foxes, potentially leading to injury, abortions by pregnant females or even death.

There have been hail storm related incidents at Centennial Park in recent years (Dec 2018) and the potential for increased severe weather events as a result of climate change may result in increasingly severe effects in the future. Again, the limited area of roosting habitat limits the choices for roost locations and local microclimates that may provide better protection against weather events.

## 2.6 Management responses to date

The management activities related to the Flying-fox camp at Centennial Park carried out to date are summarised in Table 2 below.

**Table 2: Management response to date and proposed activities**

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
2015	<p>Section 95 Certificate (C0000982):</p> <ul style="list-style-type: none"> <li>Remove 2 dead trees from Lachlan Reserve. They were used as roost trees when numbers in the camp were high.</li> <li>Maintenance of signage that informs parks users of who to contact in case of encountering a dead or injured Flying-fox (Figure 4).</li> </ul>	<ul style="list-style-type: none"> <li>Manage public health and safety risks</li> </ul>	Yes
<div style="text-align: center;"> <h3>Centennial Park's flying-fox colony</h3>  <p>There are two species of flying-fox in our colony – the Black Flying-fox (<i>Pteropus alecto</i>) and the Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>). Both are protected species in Australia.</p> <p>Flying-foxes have been visiting the Parklands to feed on the flowers and fruits of native plants for many years. Grey-headed Flying-foxes, which started roosting in Centennial Park in 2010, play an important role in the Australian environment as they are natural pollinators and seed dispersers.</p> <p><b>PLEASE DO NOT HANDLE FLYING-FOXES</b></p> <p>Flying-foxes pose no health risks unless you are bitten or scratched, so it is very important that you never handle them. The risk of disease transmission to humans is extremely low, however if you encounter a sick or injured flying-fox, do not approach or handle it. Please contact the Parklands Rangers on 0412 718 611, who are fully trained in handling the animals.</p> </div> <div style="display: flex; justify-content: space-between; align-items: center; background-color: #f4a460; padding: 5px;"> <div style="font-size: 8px;"> <p>For more information (02) 9339 6699 centennialparklands.com.au</p> </div> <div style="font-size: 12px;">  <p>Keep your dog on a leash in this area</p> </div> <div style="font-size: 12px;">  <p>Centennial Parklands</p> </div> </div> <p><b>Figure 4: Existing signage in Lachlan Swamp</b></p>			
2016	<p>Under Section 95(2) Certificate (Certificate No. C0001336):</p> <p>Weed and vegetation management activities:</p>	<ul style="list-style-type: none"> <li>Provide a reasonable level of amenity for the surrounding community</li> <li>Manage public health and safety risks</li> </ul>	Yes

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
	<ul style="list-style-type: none"> <li>• A volunteer youth group was engaged by Centennial Parklands to undertake targeted weeding and planting of native species using gardening tools such as hand trowels for digging and planting.</li> <li>• A total of 381 plantings of <i>Gahnia</i>, <i>Acacia</i> and <i>Melaleuca quinquenervia</i> were undertaken at Lachlan Swamp during September 2015 to June 2016.</li> <li>• Minor fencing repair work was undertaken by the volunteer Men's Shed during June 2016.</li> <li>• On 22 Sept 2015, a felled tree in Lachlan Reserve that had previously been left on the ground because of wet ground conditions, was cut into smaller sections. The tree sections were taken across the road away from the camp (to behind the Dickens Drive Toilet block) for chipping, to minimise noise disturbance to Flying-foxes during the sensitive birthing season (August to November).</li> <li>• There have been four trees (<i>Melaleuca quinquenervia</i> x 2, <i>Eucalyptus</i> sp., <i>Casuarina cunninghamiana</i>) removals (due to tree failure), in the Lachlan Swamp / Reserve area.</li> </ul> <p>Maintenance of paths and fences:</p> <ul style="list-style-type: none"> <li>• Small area of asphalt was laid at Lily Pond Bridge Nov 2016. Minor works, not noisy or disruptive to Flying-foxes.</li> </ul>	<ul style="list-style-type: none"> <li>• Enable long-term conservation of Flying-foxes in appropriate locations</li> <li>• Ensure management is sympathetic to Flying-fox behaviours and requirements</li> <li>• Ensure Flying-fox welfare is a priority during all works</li> <li>• Ensure camp management is consistent with broader conservation management strategies that may be developed to protect threatened species/communities</li> <li>• Ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities</li> <li>• Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b).</li> </ul>	
2017	<p>Under Section 95(2) Certificate (Certificate No. C0001336):</p> <p>Weed and vegetation management activities:</p> <ul style="list-style-type: none"> <li>• A bush regeneration contractor was engaged by Centennial Parklands for targeted woody weed removal and track vegetation clearing in Lachlan Swamp on 1/6/17, 26/6/17 and 28/6/17.</li> <li>• Regular low-impact, hand-removal of <i>Eryngium</i> by a volunteer around the edges of the swamp.</li> <li>• The trust undertook a drone survey for aerial photos of the Lachlan Swamp tree canopy, 5 June 2017.</li> <li>• Hanging branch removal of <i>Melaleuca</i> in Lachlan Swamp East, 25/10/16.</li> <li>• Installation of various nest boxes in Lachlan Reserve, 25/06/17.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide a reasonable level of amenity for the surrounding community</li> <li>• Manage public health and safety risks</li> <li>• Enable long-term conservation of Flying-foxes in appropriate locations</li> <li>• Ensure management is sympathetic to Flying-fox behaviours and requirements</li> </ul>	Yes

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
	<p>Maintenance of paths and fences:</p> <ul style="list-style-type: none"> <li>• Area of boardwalk blocked off / closed because of unstable structure, Sept 2017.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure Flying-fox welfare is a priority during all works</li> <li>• Ensure camp management is consistent with broader conservation management strategies that may be developed to protect threatened species/communities</li> <li>• Ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities</li> <li>• Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b)</li> <li>• Implement an adaptive management approach to camp management based on evidence collected.</li> </ul>	
2018	<p>Under Section 95(2) Certificate (Certificate No. C0001336): Weed and vegetation management activities:</p> <ul style="list-style-type: none"> <li>• A bush regeneration contractor was engaged by Centennial Parklands for targeted woody weed removal and track vegetation clearing in Lachlan Swamp on 11/7/18.</li> <li>• Regular low-impact, hand-removal of <i>Eryngium</i> by a volunteer around the edges of the swamp.</li> <li>• The trust undertook a drone survey for aerial photos of the Lachlan Swamp tree canopy, 8 June 2018.</li> <li>• The following tree works in the Lachlan Swamp / Reserve area in the past year: <ul style="list-style-type: none"> <li>○ Chipping of broken branch – Lachlan Swamp, 19th December 2018</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Provide a reasonable level of amenity for the surrounding community</li> <li>• Manage public health and safety risks</li> <li>• Enable long-term conservation of Flying-foxes in appropriate locations</li> <li>• Ensure management is sympathetic to Flying-fox behaviours and requirements</li> <li>• Ensure Flying-fox welfare is a priority during all works</li> </ul>	Yes

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
	<ul style="list-style-type: none"> <li>○ Chipping of broken branch – Lachlan Reserve, 20th December 2018</li> <li>○ Palm tree removal &amp; chipping &amp; stump grinding (<i>Phoenix</i> sp.) – Lachlan Reserve, 3rd March 2018</li> <li>○ Chipping of broken branch – Lachlan Swamp, 23rd April 2018</li> <li>○ Tree pruning &amp; chipping (<i>Melaleuca</i> sp.), deadwood &amp; broken branches – Lachlan Reserve, 9th May 2018</li> <li>○ Tree removal &amp; chipping (<i>Casuarina</i> sp.), dead – Lachlan Swamp, 10th May 2018</li> <li>○ Various small tree removals (approx. 10 <i>Melaleuca</i> sp.) and pruning to remove dead trees and branches in proximity to walkways – Lachlan Swamp, 21-25th May 2018</li> <li>○ Stump grinding – Lachlan Reserve, 11th July 2018</li> <li>○ Fire (vandalism) – Lachlan Reserve, 5th August 2018</li> <li>○ Chipping of broken branch – Lachlan Reserve, 6th August 2018.</li> </ul> <p>Maintenance of paths and fences:</p> <ul style="list-style-type: none"> <li>● Contractor on site at Lachlan Swamp Friday 8th June and Tuesday 12th – Friday 15th June 2018 to pressure clean the boardwalk, repair metal rope handrails and decking boards where required. Works scheduled in June to minimise disturbance to the bats</li> </ul>	<ul style="list-style-type: none"> <li>● Ensure camp management is consistent with broader conservation management strategies that may be developed to protect threatened species/communities</li> <li>● Ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities</li> <li>● Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b)</li> <li>● Implement an adaptive management approach to camp management based on evidence collected.</li> </ul>	
2019	<p>Under Threatened Species Licence, a class of biodiversity conservation licence under Part 2 of the BC Act (Licence No. C0004947):</p> <ul style="list-style-type: none"> <li>● The pruning or cutting down of tree considered a risk to public safety following an annual assessment by the senior arborist at Centennial Park ('planned maintenance works') for eight dead <i>Melaleuca quinquenervia</i>.</li> <li>● The pruning or cutting down of other trees at times where tree failure poses an unforeseen immediate risk to public safety in the opinion of the senior arborist at Centennial Park – at any time ('unplanned works').</li> </ul>	<ul style="list-style-type: none"> <li>● Provide a reasonable level of amenity for the surrounding community</li> <li>● Manage public health and safety risks</li> <li>● Enable long-term conservation of Flying-foxes in appropriate locations</li> <li>● Ensure management is sympathetic to Flying-fox behaviours and requirements</li> <li>● Ensure Flying-fox welfare is a priority during all works</li> <li>● Ensure camp management is consistent with broader</li> </ul>	Yes

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
		conservation management strategies that may be developed to protect threatened species/communities <ul style="list-style-type: none"> <li>• Ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities</li> <li>• Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b)</li> </ul>	
2020	Under Threatened Species Licence, a class of biodiversity conservation licence under Part 2 of the BC Act (Licence No. C0004947): <ul style="list-style-type: none"> <li>• The pruning or cutting down of tree considered a risk to public safety following an annual assessment by the senior arborist at Centennial Park ('planned maintenance works') for trees yet to be identified.</li> <li>• The pruning or cutting down of other trees at times where tree failure poses an unforeseen immediate risk to public safety in the opinion of the senior arborist at Centennial Park – at any time ('unplanned works').</li> </ul>	<ul style="list-style-type: none"> <li>• Provide a reasonable level of amenity for the surrounding community</li> <li>• Manage public health and safety risks</li> <li>• Enable long-term conservation of Flying-foxes in appropriate locations</li> <li>• Ensure management is sympathetic to Flying-fox behaviours and requirements</li> <li>• Ensure Flying-fox welfare is a priority during all works</li> <li>• Ensure camp management is consistent with broader conservation management strategies that may be developed to protect threatened species/communities</li> <li>• Ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities</li> </ul>	Yes

Centennial Parklands Flying-fox Camp Management Plan 2021

Year	Action(s)	Relevant plan objective(s)	Success against plan objective
		<ul style="list-style-type: none"><li>• Ensure management activities are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015b)</li></ul>	



## 3. Community engagement

### 3.1 Stakeholders

There are a range of stakeholders who are directly or indirectly affected by the flying-fox camp, or who are interested in its management. Stakeholders include those shown in Table 3 below.

**Table 3: Stakeholders in the Centennial Park Grey-headed Flying-fox Camp Plan of Management**

Stakeholder	Interest/reported impacts
The Department	The Department is responsible for administering legislation relating to (among other matters) the conservation and management of flying-foxes.
Commonwealth Department of Agriculture, Water and the Environment (DAWE)	DAWE 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. Centennial Park is included on the National Heritage List.
Land owner	The camp is on land managed by Centennial Parklands
Users of Centennial Park	Centennial Park is a popular destination for a diversity of leisure, sport, entertainment, and educational activities. It features landscaped and natural areas as well as cafes and car parking. There is a need to maintain or enhance amenity for park users by removing rubbish and controlling weeds at the camp. The camp needs to be managed and contained to minimise conflicts with recreation and Park business.
Future commercial and education infrastructure	The types and locations of future development in the area need to be planned and managed to avoid creating conflict over issues such as noise, odour and faecal drop.
Existing residents in the broader area	Flying-foxes forage at night up to 20 km from the camp. This can disturb residents and cause short-term conflict.
Wildlife carers and conservation organisations e.g., <ul style="list-style-type: none"> <li>- Sydney Metropolitan Wildlife Services (Sydney Wildlife)</li> <li>- NSW Wildlife Information, Rescue and Education Service (WIRES)</li> <li>- Royal Society for the Protection of Animals (RSPCA)</li> <li>- Australasian Bat Society</li> <li>- Parklands volunteer bat count group</li> <li>- Wildlife care volunteers</li> </ul>	Wildlife carers and conservation organisations are actively engaged in flying-fox welfare and conservation at Centennial Park. Volunteers with these groups provide valuable advice and assistance with care of sick or injured flying-foxes, including during heat stress events.
Equine facilities and vets: <ul style="list-style-type: none"> <li>- Centennial Park Equestrian Centre</li> </ul>	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.


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- Randwick Racecourse	
Airports	Airport managers have a responsibility to reduce the risk of wildlife–aircraft strike. Lachlan Swamp is within 5.5 km of Sydney airport.
Researchers/universities/CSIRO	Researchers have an interest in flying-fox behaviour, biology and conservation.

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## 3.2 Engagement methods

The draft Plan was publicly exhibited from 3 May 2021 to 7 June 2021 on the Centennial Parklands Website (<https://www.centennialparklands.com.au/about-us/parklands-projects/flying-fox-camp-management-plan>). Notification about the exhibition was also sent to key stakeholders, including the Parklands volunteer bat count group, wildlife care volunteers, and Australasian Bat Society. Social media posts were placed on Centennial Parklands Facebook site on 3 May and 31 May 2021 as a further means to reach the public (Figure 5 and Figure 6).


 **Centennial Parklands** ✓  
3 May at 09:42 · 🌐

We're seeking feedback on our draft Centennial Park Flying Fox Management Plan, which has now been placed on public exhibition for 30 days.

The Lachlan Swamp area is home to a camp of grey-headed flying foxes, which have been classified as a threatened species by the Commonwealth and State Governments.

A copy of the draft Plan can be found on our website >  
<https://bit.ly/3tav69S>

All Park visitors and interested parties are encouraged to submit their feedback by email to: inf... **See more**



👍👎 11 · 1 comment 5 related 🗨️

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 Like  Comment  Share

Figure 5: Example of social media post seeking community engagement



Figure 6: Example of social media post seeking community engagement

### 3.3 Community feedback

Four submissions were received, as detailed in Table 4, and have been incorporated into this final Management Plan.

**Table 4: Stakeholder feedback received as part of community engagement**

Stakeholder	Feedback	Section in Management Plan
Parklands volunteer	Powerful Owls are currently nesting in Centennial Park.	Section 5
Parklands volunteer	The swamp path looks well ready for refurbishment. It's an enchanting passageway for young and old alike & privileged to have insight to their habitat	Section 8.2
Parklands volunteer	Signage should include other languages, open/closed information, and information regarding fines. Vegetation management plan should cater to the possibility of the Camp expanding and should include species that are resistant to myrtle rust. The installation of a reticulated water supply and spray system should be considered as an approach to manage heat stress events. Cabbage Tree Palms should be managed as weeds.	Section 8.2 Section 8.3 Section 8.6.1
Sydney Wildlife	<ol style="list-style-type: none"> <li>1. Due to significant loss of habitat and food resources for flying-foxes following the mammoth bushfires, many more flying-foxes are seeking refuge in urban roosts. For this reason planting more native Australian trees is essential to accommodate the high number of flying-foxes especially during the Spring/Summer months. The current trees are perfect as roosting and food trees for the bats, however they are aging and there is a desperate need for more tree planting to extend the area available for the flying-foxes.</li> <li>2. It is recommended that the noxious Cocos palms are removed from the Lachlan Swamp flying-fox colony because the fruit is severely toxic to the bats causing dehydration, constipation and ill health often leading to death.</li> <li>3. It is also recommended that the palms, which produce the sharp spikes, also be removed because they could injure the very young and juvenile flying-foxes should they fall from the trees.</li> </ol>	Section 6.3 Section 8.3.1

## 4. Legislation and policy

### 4.1.1 Flying-fox Camp Management Policy 2015

The Flying-fox Camp Management Policy 2015 (the Policy) has been developed to empower land managers, principally local councils, to work with their communities to manage flying-fox camps effectively. It provides the framework within which the Department will make regulatory decisions. In particular, the Policy strongly encourages local councils and other land managers to prepare Camp Management Plans for sites where the local community is affected.

### 4.1.2 Biodiversity Conservation Act 2016

The BC Act replaced the *Threatened Species Conservation Act 1995* on 25 August 2017.

The purpose of the BC Act includes to conserve biodiversity at the bioregional and state scales. Under this Act, a person who harms or attempts to harm an animal of a threatened species, an animal that is part of a threatened ecological community, or a protected animal, is guilty of an offence.

The Grey-headed Flying-fox is listed as threatened under the BC Act (see also Why the grey-headed flying-fox is listed as threatened).

A biodiversity conservation licence under Part 2 of the BC Act may be required if the proposed action is likely to result in one or more of the following:

- a. harm to an animal that is a threatened species, or part of a threatened population
- b. the picking of a plant that is a threatened species, or part of a threatened population or ecological community
- c. damage to habitat of a threatened species, population or ecological community
- d. damage to a declared area of outstanding biodiversity conservation value.

If the Department assesses a biodiversity conservation licence application and determines that a significant impact is unlikely, a biodiversity conservation licence will be granted (the appendix to the Policy lists standard conditions for flying-fox management approvals).

The Department regulates flying-fox camp management through two options provided to land managers:

- authorisation under the Flying-fox Camp Management Code of Practice for public land managers
- licensing for public and private land managers.

The Code of Practice provides a defence under the BC Act for public land managers, as long as camp management actions are carried out in accordance with the Code of Practice.

Proposed actions that would otherwise constitute an offence under the BC Act can be authorised under another law.

### 4.1.3 Prevention of Cruelty to Animals Act 1979

It may be an offence under this Act if there is evidence of unreasonable/unnecessary torment associated with management activities. Adhering to welfare and conservation measures provided in Section 10.3 will ensure compliance with this Act.

#### **4.1.4 Environmental Planning and Assessment Act 1979**

The objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act) are to encourage proper management, development and conservation of resources, for the purpose of the social and economic welfare of the community and a better environment. It also aims to share responsibility for environmental planning between different levels of government and promote public participation in environmental planning and assessment.

The EP&A Act is administered by the Department of Planning, Industry and Environment.

Development control plans under the Act should consider flying-fox camps so that planning, design and construction of future developments is appropriate to avoid future conflict.

Development under Part 4 of the Act does not require licensing under the BC Act.

Where public authorities such as local councils undertake development under Part 5 of the EP&A Act (known as 'development without consent' or 'activity'), assessment and licensing under the BC Act may not be required; however, a full consideration of the development's potential impacts on threatened species will be required in all cases.

Where flying-fox camps occur on private land, landowners are not eligible to apply for development under Part 5 of the EP&A Act. Private landowners should contact council to explore management options for camps that occur on private land.

## **4.2 Commonwealth**

### **4.2.1 Environment Protection and Biodiversity Conservation Act 1999**

The Commonwealth's EPBC Act provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the DAWE 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. DAWE has developed the Referral guideline for management actions in GHFF and Spectacled Flying-fox (SFF) camps (DoE 2015) (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  $\geq 10,000$  GHFF in more than one year in the last 10 years
- been occupied by more than 2500 GHFF permanently or seasonally every year for the last 10 years.

Provided management at nationally important camps follows the mitigation standards below, DAWE has determined that a significant impact on the population is unlikely, and referral is not likely to be required.

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 (DoE 2013) to assist in determining whether a significant impact is likely; otherwise consultation with DAWE will be required.

### Mitigation standards

- The action must not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.
- The action must not occur during or immediately after climatic extremes (heat stress event<sup>1</sup>, cyclone event<sup>2</sup>), or during a period of significant food stress<sup>3</sup>.
- Disturbance must be carried out using non-lethal means, such as acoustic, visual and/or physical disturbance or use of smoke.
- Disturbance activities must be limited to a maximum of 2.5 hours in any 12-hour period, preferably at or before sunrise or at sunset.
- Trees are not felled, lopped or have large branches removed when flying-foxes are in or near to a tree and likely to be harmed.
- The action must be supervised by a person with knowledge and experience relevant to the management of flying-foxes and their habitat, who can identify dependent young and is aware of climatic extremes and food stress events. This person must assess the relevant conditions and advise the proponent whether the activity can go ahead consistent with these standards.
- The action must not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

These standards have been incorporated into mitigation measures detailed in Section 10.3. If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

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<sup>1</sup> A 'heat stress event' is defined for the purposes of the Australian Government's [Referral guideline for management actions in GHFF and SFF camps](#) as a day on which the maximum temperature does (or is predicted to) meet or exceed 38°C.

<sup>2</sup> A 'cyclone event' is defined as a cyclone that is identified by the Australian Bureau of Meteorology ([www.bom.gov.au/cyclone/index.shtml](http://www.bom.gov.au/cyclone/index.shtml)).

<sup>3</sup> Food stress events may be apparent if large numbers of low body weight animals are being reported by wildlife carers in the region.



## 5. Other ecological values of the site

Prior to European settlement, it is likely that the vegetation would have comprised Eastern Suburbs Banksia Scrub (Benson & Howell 1990). There are 6 remnant pockets of this community within the Parklands at York Road, York Road West, Queens Park, Bird Sanctuary, Randwick Gate to Ash Paddock Eastern Suburbs Banksia Scrub remnant (Referred to as "Lone (Lost) Xanthorrhoea", and Kensington Ponds Eastern Suburbs Banksia Scrub remnant. This is a Critically Endangered Ecological Community listed under the BC Act and an Endangered Ecological Community under the EPBC Act.

A list of threatened species known to occur within 10 km of the site is provided in Appendix 2: Threatened species with the potential to occur within site locality including the likelihood of each occurring within the camp and its immediate vicinity (the site). The following threatened species have been observed within the site or identified as likely to occur within the site:

- *Acacia terminalis* subsp. *terminalis* (Sunshine Wattle) listed as Endangered under the BC Act and Endangered under the EPBC Act
- *Ardea ibis* (Cattle Egret), listed as Marine under the EPBC Act
- *Calidris acuminata* (Sharp-tailed Sandpiper), listed as Marine and Migratory under the EPBC Act
- *Gallinago hardwickii* (Latham's Snipe), listed as Marine and Migratory under the EPBC Act
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle), listed as Vulnerable under the BC Act
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat), listed as Vulnerable under the BC Act
- *Myiagra cyanoleuca* (Satin Flycatcher), listed as Marine and Migratory under the EPBC Act
- *Ninox strenua* (Powerful Owl), listed as Vulnerable under the BC Act
- *Pteropus poliocephalus* (Grey-headed Flying-fox), listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act
- *Rhipidura rufifrons* (Rufous Fantail), listed as Marine and Migratory under the EPBC Act
- *Sterna hirundo* (Common Tern), listed as Marine and Migratory under the EPBC Act
- *Stictonetta naevosa* (Freckled Duck). Listed as Vulnerable under the BC Act

The fauna species listed above have been identified as occasional or rare visitors to the site and are not considered to use the site with regularity, with the exception of the Grey-headed Flying-fox and the Powerful Owl.

A pair of Powerful Owls have been observed roosting and attempting to nest within Centennial Parklands over several years. The first successful rearing of a chick occurred in 2018 and at least one egg was laid in 2019 but nesting was abandoned by the pair in early August. Powerful Owl breeding in Centennial Park was again successful in 2020 with two owlets fledging. The Owls are currently nesting in the 2021 breeding season. Powerful Owls frequently roost in the Park and there is ongoing monitoring during the breeding season. This pair is known to roost near the Flying-fox camp (Figure 7) and prey on GHFF at least occasionally. Centennial Parklands has protected the known nesting tree since 2018 using signage and orange mesh safety fencing to exclude access to the area directly under the nest tree (Figure 8).

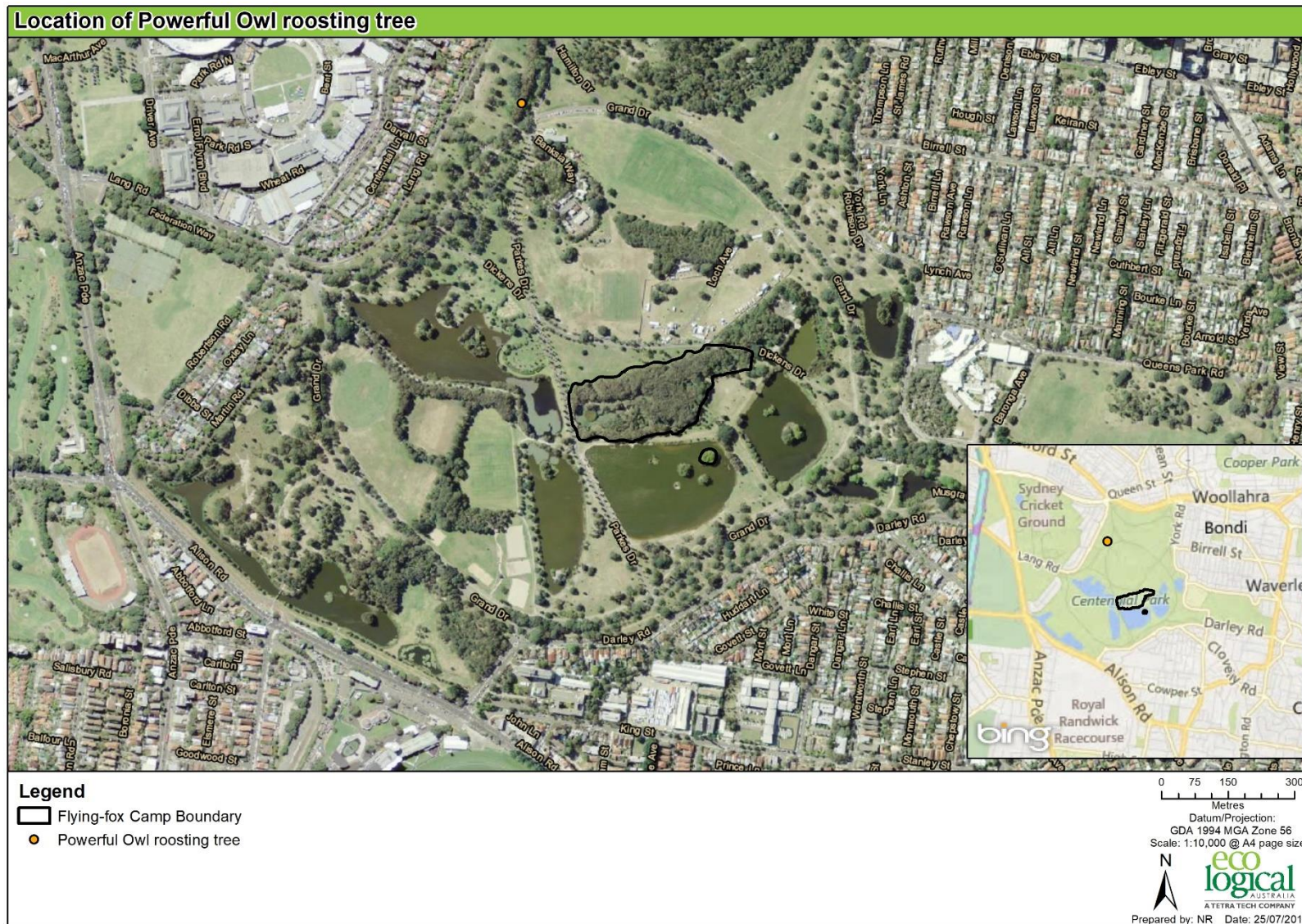


Figure 7: Location of observed Powerful Owl (*Ninox strenua*) nesting hollow



**Figure 8: Top left: Powerful Owl observed within Centennial Parklands on 15 July 2019. Top right: Roosting tree with hollow. Bottom: Signage and orange mesh safety fencing surrounding roosting tree and immediate vicinity.**

## 6. Flying-fox ecology and behaviour

### 6.1 Ecological role

Flying-foxes make a substantial contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton et al. 2004). This directly assists gene movement in native plants, improving the reproduction, regeneration and viability of forest ecosystems (DEE 2019b). 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 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012) and have been recorded travelling over 500 kilometres 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 make 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 (DES 2018). 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 (Roxburgh et al. 2006), provide habitat for other animals and plants, 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 (DES 2018).

### 6.2 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 at non-urban roosts or culling at 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.

### 6.3 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 in 2001 was listed as vulnerable by the NSW Government through the *Threatened Species Conservation Act 1995* (now BC Act).

At the time of listing, the species was considered eligible for listing as vulnerable, as counts of flying-foxes over the previous decade suggested the national population had declined by up to 30%. It was also estimated 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, culling and other threats.

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

Key threats to the survival of the GHFF, as identified by the Department, include:

- habitat loss and degradation
- conflict with humans (including culling at orchards)
- incidental deaths from entanglements in barbed-wire and fruit netting, electrocutions on powerlines, and poisoning and injuries from exotic plants such as *Syagrus romanzoffiana* (Cocos Palm) and *Phoenix canariensis* (Canary Island Date Palm) – both of which are widely planted across Centennial Parklands
- exposure to extreme natural events such as cyclones, drought and heatwaves.

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

## 6.4 Camp characteristics

All flying-foxes are nocturnal, typically 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 to 50-kilometre radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments 2012). Many flying-fox camps are 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; Eco Logical Australia 2018):

- 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), however this may not be feasible within Centennial Park given its urban setting and land use.

## 6.5 Species profiles

### 6.5.1 Black flying-fox (*Pteropus alecto*)



**Figure 9: Black flying-fox indicative species distribution (adapted from DPIE 2019a)**

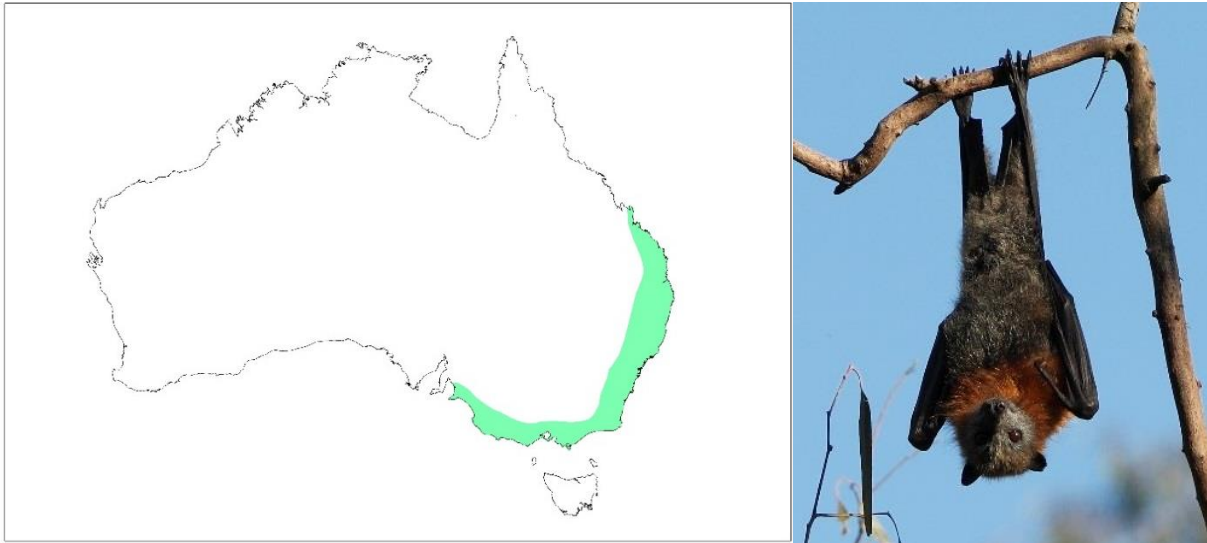
The black flying-fox (BFF) (Figure 9) has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across northern Australia, down through Queensland and into New South Wales (Churchill 2008; DPIE 2019a). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann 1995).

They forage on the fruit and blossoms of native and introduced plants (Churchill 2008; DPIE 2019a), including orchard species at times.

BFF are largely nomadic animals with movement and local distribution influenced by climatic variability and the flowering and fruiting patterns of their preferred food plants. Feeding commonly occurs within 20 kilometres of the camp site (Markus & Hall 2004).

BFF usually roost beside a creek or river in a wide range of warm and moist habitats, including lowland rainforest gullies, coastal stringybark forests and mangroves. During the breeding season, camp sizes can change significantly in response to the availability of food and the arrival of animals from other areas.

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



**Figure 10: Grey-headed flying-fox indicative species distribution (adapted from DPIE 2019a)**

The grey-headed flying-fox (GHFF) (Figure 10) is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (DPIE 2019c). This species now ranges into South Australia and individual flying-foxes have been reported on the Bass Islands and mainland Tasmania (Driessen et al. 2011). 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 feed in orchards at times, especially when other food is scarce (DPIE 2019a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb and Tidemann 1996; DoE 2015). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012). They have been recorded travelling over 500 kilometres 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 generally 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). This results in large fluctuations in the number of GHFF in New South Wales, ranging from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby 2000). They are widespread throughout their range during summer, but in spring and winter are uncommon in the south. In autumn they occupy primarily coastal lowland camps and are uncommon inland and on the south coast of New South Wales (DECCW 2009).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000; Richards 2000 cited in DPIE 2019a). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, culling in orchards, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, and power line electrocution) and competition and hybridisation with the BFF (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation (see Section 4).

### 6.5.3 Reproduction

#### Black and grey-headed flying-foxes

Males initiate contact with females in January with peak conception occurring around March to April/May; this mating season represents the period of peak camp occupancy (Markus 2002). Young (usually a single pup) are born six months later from September to November (Churchill 2008). The birth season becomes progressively earlier, albeit by a few weeks, in more northerly populations (McGuckin & Blackshaw 1991); however, out of season breeding is common, with births occurring later in the year.

Young are highly dependent on their mother for food and thermoregulation. They are suckled and carried by the mother until approximately four weeks of age (Markus & Blackshaw 2002). At this time, they are left at the camp during the night in a crèche until they begin foraging with their mother in January and February (Churchill 2008) and are usually weaned by six months of age around March. Sexual maturity is reached at two years of age with a life expectancy up to 20 years in the wild (Pierson & Rainey 1992).

As such, the critical reproductive period for GHFF and BFF is generally from August (when females are in their final trimester) to the end of peak conception around April. Dependent pups are usually present from September to March (see Figure 11).

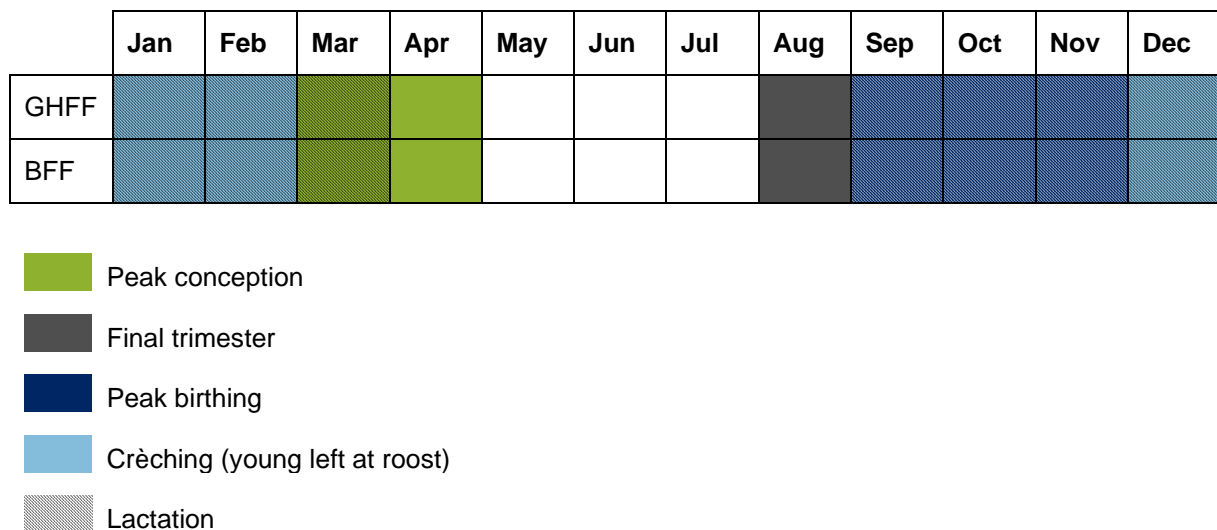


Figure 11: Indicative flying-fox reproductive cycle



## 7. Human and animal health

Flying-foxes, like all animals, carry pathogens that may pose human health risks. Many of these are viruses that cause only minor infections with no clinical signs 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), Hendra virus and Menangle virus. Specific information on these viruses is provided in Appendix 3.

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, Hendra virus 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).

### 7.1 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 Hendra virus prevalence and flying-fox disturbance; however, the consequences of chronic or ongoing disturbance and harassment and its effect on Hendra virus 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 that 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 the 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.

The risk to human health from GHFFs at the Centennial Park camp is considered to be extremely low. However, it is important that people visiting the area are aware of the risks and what they should do if they encounter a dead or injured Flying-fox. Given the high usage of parkland areas adjacent to the camp, signage should be maintained that informs parks users of who to contact in case of encountering a dead or injured Flying-fox is needed to assist with this. Existing signage in Lachlan Swamp is presented in Figure 4.

## 8. Camp management options

Three levels of actions are outlined in the NSW Flying-fox Camp Management Policy (OEH 2015). These are:

- Level 1 actions: Routine camp management
- Level 2 actions: In-situ management, including the creation of buffers or use of noise attenuation fencing
- Level 3 actions: Disturbance, nudging or dispersal.

Only Level 1 actions are proposed in this plan and are detailed below. Level 2 and Level 3 actions have not been detailed in this plan because the camp is stable, receives no complaints from the local residents and such options are only to be considered in future reviews of this and any other management plans, if conflict occurs.

### 8.1 Management zones

Management zones have been identified for the camp and immediate surrounds (Figure 12 and Table 5). Management responses for each of these zones conform with the 'Level 1 – routine camp management' actions in the Policy.

#### 8.1.1 Lachlan Swamp core habitat

Lachlan Swamp provides the current core roosting habitat area, as shown in Figure 12.

Historical clearing and revegetation has resulted in the creation of a dominant canopy of *Melaleuca quinquenervia* at Lachlan Swamp. This tree species comprises up to 80% of the canopy layer within Lachlan Swamp. Additional canopy species recorded included *Eucalyptus robusta* (Swamp Mahogany) and *Casuarina glauca* (Swamp She Oak), but these were limited in number and distribution.

Mid-storey plant species in Lachlan Swamp included native and horticultural specimens such as *Ficus coronata* (Sandpaper Fig), *Syzygium smithii* (Lilli Pilli), *Syzygium paniculatum* (Magenta Lilli Pilli) and *Pittosporum undulatum* (Sweet Pittosporum). Further species of note include *Acacia longifolia* (Sydney Golden Wattle) and the exotic *Solanum mauritianum* (Wild Tobacco) and *Cordyline* sp. (Cordyline).

The ground storey layer of the Lachlan Swamp was dominated by several species of native sedges and ferns including *Gleichenia dicarpa* (Coral Fern), *Hypolepis muelleri* (Harsh Ground Fern) and *Gahnia sieberiana* (Saw Sedge). These species make up to 90% of this stratum. Other plants represented in Lachlan Swamp were *Lomandra longifolia* (Spiny-headed Mat-rush), *Zantedeschia aethiopica* (Arum Lilly) and *Canna* sp. (Canna Lilly).

Due to the nature of Lachlan Swamp and its horticultural surrounds, a variety of annual and soft wooded perennials are present, predominately located adjacent to high traffic and exposed edges. Specimens recorded include *Solanum nigrum* (Blackberry Nightshade), *Bidens pilosa* (Cobblers Pegs), and *Ehrharta erecta* (Panic Veldtgrass). An exotic plant species to note was the presence of *Salpichroa origanifolia* (Pampas Lilly-of-the-valley), which was found primarily on the fringes where it was presumably distributed by local bird life or horticultural maintenance activities i.e. mowing. Other dominant exotic species include *Strelitzia* sp. (Bird of Paradise), *Ochna serrulata* (Ochna) and *Ligustrum* sp. (Privet).

An additional feature of the Lachlan Swamp area is the adjacent plantings found to the east of the main camp site. This area consisted predominately of a collection of feature specimen plants such as *Araucaria heterophylla* (Norfolk Island Pine), *Ficus benjamina* (Weeping Fig) and *Eucalyptus scoparia* (Wallangarra White Gum). There is a lack of mid or ground storey

layers within this area, having been allocated for public use and maintained regularly to support visual amenity. The dominant grass species was the native, *Microlaena stipoides* (Weeping Meadow Grass).

### 8.1.2 Lachlan Swamp supporting vegetation – Expansion Zone/ Overflow Habitat

The supporting vegetation is depicted in Figure 12 as areas of habitat expansion. This supporting vegetation is likely to be essential for the long-term sustainable presence of the Flying-fox camp and is used during those periods when the camp is at peak population (>40,000). At these times, the Flying-fox colony spills over to roost in this usually unused area; so it provides an area of expansion in times of high numbers of Flying-foxes using the camp.

The floristic diversity of the supporting vegetation is very limited with a dominant canopy of *Casuarina glauca*, no mid storey, and an understorey assemblage of exotic species (80% coverage). The main exotic species are a mixture of horticultural grasses *Pennisetum clandestinum* (Kikuyu) and *Stenotaphrum secundatum* (Buffalo Grass) with a significant portion infested with *Salpichroa origanifolia* (Pampas Lilly-of-the-valley) and a large variety of soft wooded perennial and annual horticultural weed species.

### 8.1.3 Unsuitable Habitat

Vegetation forming part of Lachlan Reserve and Lily Pond are considered unsuitable habitat for the camp to expand into because these areas are frequently used and reserved for park activities. Expansion of the camp into this management zone could result in conflict with park activities, potentially requiring disturbance actions. Future disturbance actions may require a license and/or an updated Plan endorsed by the Environment Agency Head.

**Table 5: Management zones and action**

Management Zone	Purpose	Management Actions
Core Habitat	Sustain the flying-fox population in situ by allowing natural regeneration of trees or assisting regeneration with adaptive management, revegetation and other works as required	Signage, boardwalk and fences installed to manage human disturbance. Tree work, mowing or other machine works under strict control protocols. Staged weed control. Revegetation of cleared areas with tree species and mid-storey species to offer protection. No disturbance actions allowed. Consult with the Department if management actions need to be amended.
Expansion Zone/ Overflow Habitat	Provide overflow habitat when the core camp is full. Provide a buffer between the core habitat and adjacent areas. Provide a temporary location for camp to migrate to during noisy works in the core habitat (tree pruning, mowing etc).	Maintain scattered tall trees with grass groundcover. Mowing and other landscape maintenance machinery allowed, subject to the stop work triggers and measures to avoid impacts (Section 10.2).
Unsuitable Habitat	Vegetation beyond Lachlan Swamp and Lachlan Reserve are considered unsuitable habitat due to their use for other park activities.	Sites not considered to be a desirable location for the camp to expand into and is referred to as an unsuitable habitat.

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If in future the site becomes regular roost habitat and is in conflict with park activities, disturbance actions may be considered.

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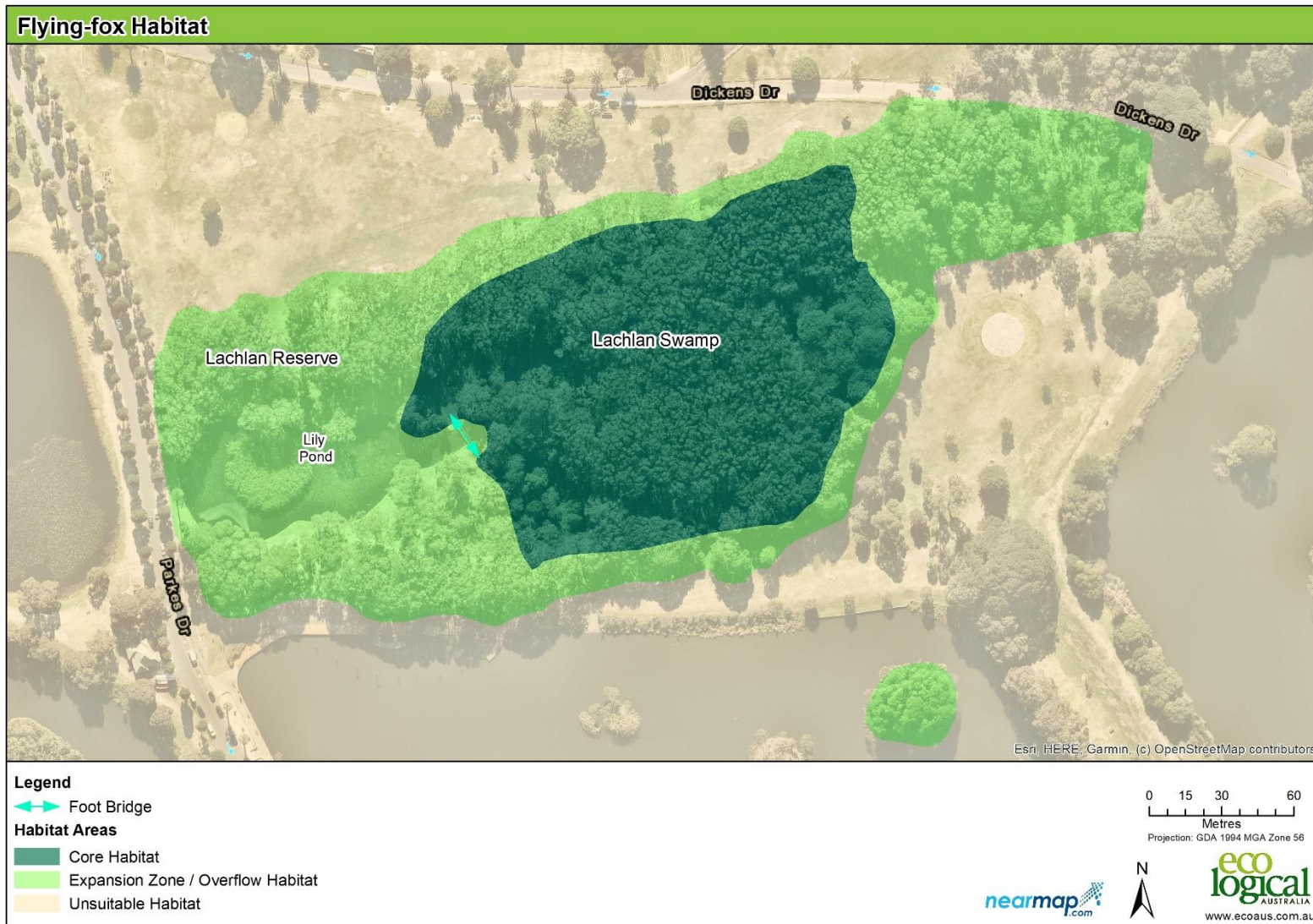


Figure 12: Flying-fox camp area

## 8.2 Signage, boardwalk and fences

Signage, boardwalk and fences are present within the core habitat area. These structures are to be maintained, reviewed and, if necessary, updated and replaced by Centennial Parklands. Installation of new signage, boardwalk or fences would require a license unless the proposed works are approved under Part 5 of *the Environmental Planning and Assessment Act 1979* (EP&A Act).

The existing wooden boardwalk is reaching 'end of life' and all timber components will soon need replacing. The Parklands are investigating options to replace the existing structure with longer-lasting design materials to maintain a walking path loop through the Lachlan Swamp area.

Following community engagement, the Parklands are investigating options to install new signs addressing the following:

- Signage in multiple languages to ensure that visitors from non-English speaking backgrounds are culturally included and informed about avoidable health risks
- Large, eye-catching signs that clearly indicate when the Camp is open or closed, specifically explaining why it is important for flying-foxes not to be disturbed when the Camp is closed
- Information to visitors that fines apply, particularly for the following:
  - Disturbing and distressing flying foxes at any time;
  - Entry of unauthorised people to the Camp when it is closed; and
  - Dogs being off leash in or near the Camp (and anywhere inside the Grand Drive).

## 8.3 Vegetation management

The following principles for future management of vegetation at the camp have been developed consistent with previous plans for the Parklands and address issues of canopy retention outlined in Section 2.1.3:

- Trees should be replaced before they substantially decline or are removed.
- Change to camp vegetation should be implemented gradually, preferably by natural attrition, so that it is incremental and subtle.
- Inform the community about any planned or expected changes in the vegetation.
- Retain aged trees where they provide habitat value.
- Prune or remove trees where there is an immediate risk to public safety.
- Ensure that tree replacement is implemented in a manner that maintains habitat for Flying-foxes.
- Yearly assessment of the health of canopy species within the Flying-fox camp.
- Periodic inspections for Phytophthora and Myrtle Rust.
- Establishment of a planting schedule to ensure the Camp is maintained and expanded to cater for increased numbers of flying-foxes.

### 8.3.1 Weed management

Techniques to be applied to reduce the prevalence of weeds are outlined in this section.

Importantly, weeds need to be controlled in a manner that does not adversely impact the microclimate conditions within the camp. Maintenance bush regeneration should be done as needed. Work will need to be scheduled to avoid sensitive periods in the GHFF/BFF life cycle (Figure 11). Any activity likely to disturb flying-foxes so that they take flight will be

avoided during the day during the sensitive GHFF/BFF birthing period (i.e. when females are in their final trimester or the majority are carrying pups, generally August – December) and avoided altogether during crèching (generally November/December to February).

### **Woody weeds**

All woody weeds will be controlled by the cut and paint or drill and fill method using a non-specific herbicide. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-specific herbicide. These methods will minimise noise and visual disturbance to roosting bats.

Exotic palms are widely planted across Centennial Parklands. Canary Island Date Palms and Cocos Palms may result in poisoning or injury to GHFF, therefore all exotic palm trees will be removed from Lachlan Swamp. Seedlings are to be removed regularly to prevent their establishment.

Native palm species, *Livistona australis* (Cabbage Fan Palm) will be retained, however, bush regeneration work will be undertaken to control the spread of palms and ensure the Melaleuca forest does not become dominated by this species.

### **Annual grasses**

Concentrations of annual grasses, pending size and densities of infestations, may be hand removed in peak growth periods. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

### **Perennial grasses**

Perennial grasses, including Paspalum and Kikuyu, require hand removal prior to seed production in spring or summer and/or, if acceptable, sprayed when it is actively growing (for better results). To limit the collateral damage associated with the application of acceptable (if any are available) non-selective herbicides, dilution rates such as 1:200 and 1:300 can be used to great effect during peak growth periods.

### **Herbaceous weeds**

Where individual plants of other herbaceous weeds, such as *Bidens pilosa*, *Plantago lanceolata* and *Coryza* sp., are found, they should be hand pulled prior to flowering. Where large swaths of these species occur, they can be sprayed using a non-specific herbicide. Regular monitoring of these species will be required to prevent seed production.

### **Scramblers and ground covers**

The only recorded invasive scrambler found within the project area was Pampas Lily-of-the-valley. Methods for the treatment and removal of this aggressive exotic plant species should be limited to hand removal supplemented by highly targeted application of a herbicide to limit its ability to spread and produce flowers/fruits. All biomass is to be removed from site and placed into general waste. Fragments of Pampas Lily-of-the-valley are not to be composted on site. There are suitable registered selective herbicides that will effectively treat infestations of *Salpichroa* sp., but due to their known residual and toxic characteristics (Picloram and 2, 4-D), use in a highly sensitive areas is not suggested. It is therefore recommended that there is further investigation into the potential use of 'off label' herbicides under the APVMA issued Off Label Permit: 9907, in order to determine if any can be considered acceptable for use.

### **8.3.2 Revegetation and regeneration to supplement existing habitat**

A staged program of supplementary and expanded planting is recommended with the following key objectives in mind:

- Strengthen and support the existing 'constructed vegetation community' located within Lachlan Swamp and its surrounds.
- Provide suitable habitat and a structurally diverse vegetation assemblage to support and retain the Flying-fox camp.
- Potentially plant sensory and educational feature plants in support of the self-guided and educational facilities within Centennial Park.

Detailed information prepared as part of a Vegetation Management Plan for the area comprising the Camp and surrounds is presented in Appendix 4.

#### **Extension of Lachlan Reserve tree plantings**

Continued planting is important to ensure that the Camp is maintained as secure and stable habitat for flying-foxes while catering for the possibility of increased numbers. Planting for increased flying-fox numbers is particularly important within the current context of fire, land clearing, climate change, and myrtle rust. Maintenance and expansion of Camp habitat is imperative given that nearby camps cannot readily accommodate the numbers of flying-foxes that the Camp regularly accommodates.

Trees that are not susceptible to myrtle rust need to be interspersed throughout the existing Camp and included in planting programs to ensure that the integrity of the Camp will not be lost to the pathogen. Smooth-barked tree species resistant to myrtle rust should be preferred over *Melaleuca* species. In addition to providing insurance against myrtle rust degrading the Camp, additional plantings could provide a shaded area around the existing Camp, helping to keep the Camp cooler on days of extreme heat. These areas will still be available for public use without any conflict with flying-foxes unless the existing Camp area is destroyed by myrtle rust.

### **8.4 Maintenance activities**

Routine camp management actions include:

- Tree work, mowing or other machine works within core habitat areas under strict control protocols.
- Mowing and use of other landscape maintenance machinery within expansion zone/ overflow habitat areas, subject to the stop work triggers and measures to avoid impacts (Section 10.2).
- Rubbish removal.
- Removal of faecal matter from adjacent pedestrian facilities, as required.

### **8.5 Education and awareness events**

The camp's accessible location provides an opportunity for flying-fox education and awareness events to provide accurate information to the community about flying-foxes. Centennial Parklands has previously held community involvement events (Table 1). Ongoing community events could be held during Australasian bat month and could include 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.



## 8.6 Protocols to manage incidents

The camp is subject to detrimental impacts from incidents including heat stress, food shortages and unexpected weather events. The following protocols to manage incidents have been developed by Centennial Parklands:

- Heat Stress Protocol – Centennial Parklands (September 2019)
- Flying-fox Rescue Procedure – Centennial Parklands (June 2019).

The Lachlan Swamp Nature Trail that runs through the camp should be closed to the public during periods when mitigating stress to Flying-foxes is necessary, e.g., during heat stress events.

If a sick, dead or injured GHFF is found, Centennial Parklands should be notified as soon as is possible. If a member of the Centennial Parklands is not able to be contacted, or at their advice, the sick, injured or dead bat should be reported to NSW Wildlife Information, Rescue and Education Service (WIRES), or the Sydney Metropolitan Wildlife Services. The public should not handle sick, dead or injured GHFF and clearly visible signage should be provided to inform people of the process to manage sick, dead or injured flying-foxes.

### 8.6.1 Heat stress management

The need to handle injured or dead GHFF is likely to increase during heatwaves, so suitable staff and volunteers should be identified in advance to minimise risk and ensure a timely response. Managers of Flying-fox camps should monitor the [Flying-fox Heat Stress Forecaster](#) and the Australian Bat Society webpage to help prepare for heat stress incidents.

If current studies into the effect of misting and sprinklers on ambient air temps in flying-fox camps show benefits in reducing heat stress, the Camp should consider the installation of a spray system. A reticulated water supply for use during heat stress events could be provided on the south side of the camp near the footbridge on the west of the Lily Pond (Figure 1).

### 8.6.2 Food shortage management

The Department, in collaboration with land managers and Flying-fox experts are responsible for determining food shortage periods and should be contacted during drought years. Food shortage incidents resulting in high mortality would result in closing the camp to visitors and monitoring of the camp by wildlife carers.

### 8.6.3 Unexpected weather events

Works will not take place in periods of adverse weather including strong winds, sustained heavy rains, in very cold or hot temperatures or during periods of likely population stress (e.g. food shortages). Wildlife carers or other Flying-fox experts will be consulted to determine whether the population appears to be under stress.”

### 8.6.4 Event management

Consideration must be given to how Flying-foxes respond to any loud or large events that take place near the camp and have the potential to affect the camp. A decision-making tool is provided in Table 6 for such events and should be used in conjunction with decisions on the undertaking of activities listed in Section 10.2.

Guidelines for use of drones are also provided in this subsection.

**Table 6: Decision-making key for events with the potential to affect the camp**

<p>1. Will the event be taking place within 100 m of the core habitat of the camp as displayed in <b>Figure 12</b> or within 100 m of where flying-foxes can be observed roosting?</p>	
<p>Yes, proceed to question 2.</p>	<p>No. The event is considered <b>low risk</b> and does not require additional mitigation measures in addition to those in Section 10.</p>
<p>2. Will the event produce loud noise through the use of amplified music, loud crowd noises, fireworks, heavy machinery or similar?</p>	
<p>Yes. The event is considered <b>high risk</b>. A person experienced in flying-fox behaviour should monitor the camp prior to the event starting and during the event. A vaccinated person should be on site to rescue individuals as required during the event. Persons monitoring during the event are to determine if additional carer support is required during the event. Recommendations, if any, on changes needed for similar events in the future should be made immediately following the event.</p>	<p>No, proceed to question 3.</p>
<p>3. Is the event scheduled to take place at a time during which the camp is likely to contain females that are in the late stages of pregnancy or have dependent young that cannot fly on their own (generally August to February)?</p>	
<p>Yes. The event is considered <b>moderate risk</b>. The camp should be monitored, and a vaccinated person should be on site to rescue individuals as required during the event.</p>	<p>No. The event is considered <b>low risk</b> and does not require additional mitigation measures beyond those listed in Section 10.</p>

### Filming and photography – Use of drones

The following two guidelines are to be applied when flying drones near the Camp:

1. A minimum flying height of 50 m must be maintained when flying above canopy trees occupied by flying-foxes.
2. A maximum flying speed of 2 m per second must be adhered to when flying above the Camp.

## 8.7 Analysis of actions

An analysis of the recommended actions is presented in Table 7 below. All actions are Level 1 and are considered low cost when compared to Level 2 or 3 actions.

**Table 7: Analysis of Level 1 actions**

Management action	Cost	Advantages	Disadvantages
Maintenance of management zones	\$\$	Camp sustainability	May require future disturbance actions Ongoing costs
Signage, boardwalk and fences	\$\$	Improve amenity and awareness	
Vegetation management	\$\$	Camp sustainability and improved amenity	Ongoing costs
Maintenance activities	\$\$	Improve public perception and manage safety risk	Ongoing costs
Education and awareness events	\$	Improve environmental awareness and enjoyment	Ongoing costs
Heat stress management	\$	Animal welfare and conservation	Reliance on volunteers
Food shortage management	\$	Animal welfare and conservation	Reliance on volunteers
Unexpected weather event management	\$	Animal welfare and conservation	Reliance on volunteers
Event management	\$	Animal welfare and conservation	

## 9. Planned management approach

This section outlines actions to be implemented to assist with protection of the GHFF, BFF and their camp habitat at Centennial Park (Table 8). The actions are consistent with Level 1 – Routine Camp Management Actions, as defined by the Department, and the camp management options described in Section 8.

Where possible, the actions are presented so that they are specific but not prescriptive, to allow flexibility with implementation as circumstances change. Example success measures are included where relevant.

**Table 8: Management approach overview**

Issue	Management aim	Management actions	Example success measures
Maintenance of management zones	Sustain the flying-fox population in situ while providing overflow habitat when the core area is full.	See Table 5.	-
Weed infestation and habitat loss	Mitigate impacts to vegetation to ensure sustainability of Flying-fox habitat.	<p>Yearly assessment of the health of canopy species within the Flying-fox camp.</p> <p>Investigate the health of all trees in the subject area annually to determine which individual trees should be pruned, removed or retained dead in situ as habitat.</p> <p>For trees that have been removed or are retained dead, determine if species that are regenerating are suitable to provide replacements or if replanting is needed.</p> <p>Source plants for revegetation from reputable wholesale supply nurseries. Where applicable, canopy tree stock should be sourced from a variety of parent material to strengthen the genetic diversity within Centennial Park.</p> <p>Periodic inspections for Phytophthora and Myrtle Rust.</p>	<p>15-30% annual reduction in target weed species in accordance with timings and techniques indicated in this plan.</p> <p>At least 60-80% of all planted specimens surviving per year.</p> <p>Increase in the amount of natural recruitment of canopy species.</p>
Education and awareness programs	Improve the education and awareness of Flying-foxes amongst park visitors.	Community events to be held during Australasian bat month.	-
Heat stress	Mitigate impacts of heat stress events on camp population.	Monitor weather conditions and prepare teams to respond to heat stress – Refer to Centennial Parklands Heat Stress Management Plan	-

Issue	Management aim	Management actions	Example success measures
		(2019).	
Food shortages	Mitigate impacts of food shortage events on camp population.	Close access to camp by visitors. Monitoring of the camp by wildlife carers.	-
Unexpected weather events	Mitigate impacts of unexpected events on camp population.	Monitor weather conditions and prepare teams to respond to conditions – Refer to Centennial Parklands Flying-fox Rescue Procedure (2019).	-
Effects of events held in Centennial Parklands on Flying-foxes	Reduce potential for disturbance of Flying-foxes as result of large events	Event management plans to include consideration of the GHFF to ensure no harm to the Flying-foxes.	-

## 9.1 Stop work triggers

The management program will cease and will not recommence or progress to subsequent levels without consulting the Department if:

- Any of the animal welfare triggers occur on more than two days during the program, such as unacceptable levels of stress (see Table 9)
- There is a flying-fox injury or death
- A new camp/camps appear to be establishing
- There appears to be potential for conservation impacts (e.g. reduction in breeding success identified through independent monitoring)
- Standard measures to avoid impacts (detailed in Section 10.3) cannot be met.

**Table 9: Planned action for potential impacts during management**

Welfare trigger	Signs	Action
Unacceptable levels of stress	If any individual is observed: <ul style="list-style-type: none"> <li>• panting</li> <li>• saliva spreading</li> <li>• located on or within two metres of the ground</li> </ul>	<ul style="list-style-type: none"> <li>• Works to cease for the day</li> </ul>
Fatigue	In situ management <ul style="list-style-type: none"> <li>• more than 30% of the camp takes flight</li> <li>• individuals are in flight for more than five minutes</li> <li>• flying-foxes appear to be leaving the camp</li> </ul>	<ul style="list-style-type: none"> <li>• In situ management</li> <li>• Works to cease and recommence only when flying-foxes have settled* / move to alternative locations at least 50 metres from roosting animals</li> </ul>
	Dispersal <ul style="list-style-type: none"> <li>• low flying</li> <li>• laboured flight</li> <li>• settling despite dispersal efforts</li> </ul>	<ul style="list-style-type: none"> <li>• Dispersal</li> <li>• Works to cease for the day</li> </ul>
Injury/death	<ul style="list-style-type: none"> <li>• a flying-fox appears to have been injured/killed on-site (including aborted foetuses)</li> <li>• any flying-fox death is reported within one kilometre of the dispersal site that appears to be related to the dispersal</li> <li>• loss of condition evident</li> </ul>	<ul style="list-style-type: none"> <li>• Works to cease immediately and the Department notified</li> <li>• Rescheduled</li> <li>• Adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by an independent expert (see Appendix 1)</li> <li>• Stopped indefinitely and alternative management options investigated</li> </ul>
Reproductive condition	<ul style="list-style-type: none"> <li>• females in final trimester</li> <li>• dependent/crèching young present</li> </ul>	<ul style="list-style-type: none"> <li>• Works to cease immediately and the Department notified</li> <li>• Rescheduled</li> <li>• Stopped indefinitely and alternative management options investigated</li> </ul>

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

## **10. Assessment of impacts to flying-foxes**

No significant removal of flying-fox habitat or active dispersal of the camp is recommended in the Plan, and as such there are not expected to be any impacts upon other camps in the region. Impacts to other threatened species and ecological communities are not expected.

Management actions recommended in this Plan are intended to minimise disturbance to the flying-fox camp. However, some disturbance is possible during vegetation management, maintenance activities and events within Centennial Park. Measures to avoid impacts are provided in Section 10.2.

This plan does not replace the need for ecological impact assessment of any proposed development or major activity near the camp. However, it provides guidance on how adverse impacts can be avoided.

### **10.1 Licensing and approvals**

It is understood that Centennial Parklands will manage the camp and surrounds through level 1 management actions in line with the Flying-fox Camp Management Code of Practice 2018. Therefore, no license would be required.

Centennial Parklands will submit a Biodiversity Conservation Licence to the Department to undertake actions in accordance with this Plan that fall outside the code. The following actions would need to be undertaken under licence:

- Disturbance of GHFF in unsuitable habitat
- Installing signage, boardwalk and fences to manage human disturbance
- Removal of roost trees, or any other actions, that cannot be done in accordance with the Code.

Due to the location of the camp within Centennial Parklands, it is expected that a multi-year license aligned to the actions under this Management Plan would be appropriate.

### **10.2 Standard measures to avoid impacts**

The following mitigation measures will be complied with at all times during Plan implementation.

#### **10.2.1 All management activities**

- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and the Department consulted in accordance with the 'stop work triggers' section of the Plan.
- Large crews (>4 people) will be avoided where possible. The use of large crews will only occur with the approval of the Centennial Parklands.
- Works will only take place when at least 20% of suitable roost vegetation within the camp has been designated as a rest area, in which no works are carried out.
- The use of loud machinery and equipment that produces sudden impacts/noise will be limited. Where loud equipment (e.g. chainsaws) is required they will be started away from the camp and allowed to run for a short time to allow flying-foxes to adjust.

- Activities that may disturb flying-foxes at any time during the year will begin as far from the camp as possible, working towards the camp gradually to allow flying-foxes to habituate.
- Any activity likely to disturb flying-foxes so that they take flight will be avoided during the day during the sensitive GHFF/BFF birthing period (i.e. when females are in their final trimester or the majority are carrying pups, generally August – December) and avoided altogether during crèching (generally November/December to February).
- Where works cannot be done at night after fly-out during these periods, it is preferable they are undertaken in the late afternoon close to or at fly-out. If this is also not possible, a person experienced in flying-fox behaviour will monitor the camp for at least the first two scheduled actions (or as otherwise deemed to be required by that person) to ensure impacts are not excessive and advise on the most appropriate methods (e.g. required buffer distances, approach, etc.).
- The Department will be contacted immediately if *Pteropus scapulatus* (Little Red Flying-fox, LRFF) are present between March and October or are identified as being in their final trimester/with dependent young.
- Non-critical maintenance activities will ideally be scheduled when the camp is naturally empty. Where this is not possible (e.g. at permanently occupied camps) 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 July).
- Works will not take place during or within five days after severe weather events, which includes storms and cold snaps, or periods of significant food stress. Wildlife carers or other flying-fox experts will be consulted to determine whether the population appears to be under stress.
- Works will not take place during or within 21 days of the end of a heat stress event, which is a day or period of days where the maximum temperature is, or is predicted to exceed, 38°C. A heat stress event ends when the maximum temperature remains below 38°C for 48 consecutive hours. See the webpage about [Responding to heat stress in flying-fox camps](#).
- On days which aren't a heat stress event but are predicted to be between 35-38°C (or ideally 30-38°C), works will be postponed for that day, and for one day following a day that reached  $\geq 35^{\circ}\text{C}$ .
- Evening works may commence after fly-out. Noise generated by the works should create a first stage disturbance, with any remaining flying-foxes taking flight. Works should be paused at this stage to monitor for any remaining flying-foxes (including crèching young, although December – February should be avoided for this reason) and ensure they will not be impacted. All Level 1 and 2 works (including pack-up) will cease by 0100 to ensure flying-foxes returning early in the morning are not inadvertently dispersed. Works associated with Level 3 actions may continue provided flying-foxes are not at risk of being harmed.
- If impacts at other sites are considered, in the Department's opinion, to be a result of management actions under this Plan, assistance will be provided by the proponent to the relevant land manager to ameliorate impacts. Details of this assistance are to be developed in consultation with the Department.
- Any proposed variations to works detailed in the Plan must be approved, in writing, by the Department before any new works occur.
- The Department may require changes to methods or cessation of management activities at any time.



- Ensure management actions and results are recorded to inform future planning. See the webpage about [Monitoring, evaluating and reporting on flying-fox camp management actions](#).

### **Human safety**

- All personnel to wear protective clothing including long sleeves and pants; additional items such as eye protection and a hat are also recommended. People working under the camp should wash their clothes daily. Appropriate hygiene practices will be adopted such as washing hands with soap and water before eating/smoking.
- All personnel who may come into contact with flying-foxes will be vaccinated against ABLV with current titre.
- A wash station will be available on-site during works along with an anti-viral antiseptic (e.g. Betadine) should someone be bitten or scratched.
- Details of Randwick Hospital will be kept on-site to facilitate access to post-exposure prophylaxis.

### **Post-works**

- Reports for Level 1 actions will be provided to the Department annually. Each report is to include:
  - Results of pre- and post-work population monitoring
  - Any information on new camps that have formed in the area
  - Impacts at other locations that may have resulted from management, and suggested amelioration measures
  - An assessment of how the flying-foxes reacted to the works, with particular detail on the most extreme response and average response, outlining any recommendations for what aspects of the works went well and what aspects did not work well
  - Further management actions planned, including a schedule of works
  - An assessment of how the community responded to the works, including details on the number and nature of complaints before and after the works
  - Detail on any compensatory plantings undertaken or required
  - Expenditure (financial and in-kind costs)
  - Plan evaluation and review (see Section 11).

## **10.2.2      Vegetation trimming/removal**

- Deadwood and hollows will be retained on-site where possible as habitat.
- Vegetation chipping is to be undertaken as far away from roosting flying-foxes as possible (at least 100 metres).
- The clearing and trimming of vegetation will not result in the removal of more than 10% of the vegetated area historically occupied by flying-foxes.
- Vegetation removal should not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp.

### 10.2.3 Canopy vegetation trimming/removal

#### Prior to works

- Trees to be removed or lopped will be clearly marked (e.g. with flagging tape) prior to works commencing, to avoid unintentionally impacting trees to be retained.

#### During works

- Any tree lopping, trimming or removal is undertaken under the supervision of a suitably qualified arborist (minimum qualification of Certificate III in Horticulture (Arboriculture) who is a member of an appropriate professional body such as [Arboriculture Australia](#)).
- 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. The removal of tree limbs or whole trees will not occur when flying-foxes are within 30 metres of the tree. A person experienced in flying-fox behaviour is to remain on-site to monitor when canopy trimming/removal is required within 50 metres of roosting flying-foxes.
- While most females are likely to be carrying young (generally September – 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.
- Tree removal as part of management will be offset at a ratio of at least 2:1. Where threatened vegetation removal is required, the land manager will prepare an Offset Strategy to outline a program of restoration works in other locations (in addition to existing programs). The strategy will be submitted to the Department for approval at least two months prior to commencing works.

### 10.2.4 Bush regeneration

- All works will be carried out by suitably qualified and experienced bush regenerators, with at least one supervisor knowledgeable about flying-fox habitat requirements (and how to retain them for Level 1 actions) and trained in working under a camp.
- Vegetation modification, including weed removal, will not alter the conditions of the site such that it becomes unsuitable flying-fox habitat.
- Weed removal should follow a mosaic pattern, maintaining refuges in the mid- and lower storeys at all times.
- Weed control in the core habitat area will be undertaken using hand tools only (or in the evening after fly-out while crèching young are not present).
- Species selected for revegetation will be consistent with the habitat on-site, and in buffer areas or conflict areas should be restricted to small shrubs/understorey species to reduce the need for further roost tree management in the future.

### 10.2.5 Additional mitigation measures for any activity at a nationally important grey-headed flying fox camp

- The action will not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own (generally August to February).

- Disturbance activities will be limited to a maximum of 2.5 hours in any 12-hour period, preferably at or before sunrise or at sunset. Disturbance activities can be defined as any activity, other than routine activities, that disturbs the camp and therefore this may apply to both Level 2 and 3 activities.
- The action will not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation will be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

## 11. Evaluation and review

The Plan will have a scheduled review annually, which will include evaluation of management actions against measures shown in Section 8.

The following will trigger additional reviews of the Plan:

- Completion of a management activity
- Progression to a higher level of management
- Changes to relevant policy/legislation
- New management techniques becoming available
- Outcomes of research that may influence the Plan
- Incidents associated with the camp
- Any activities or infrastructure development in the vicinity of the camp not identified in this plan.

Results of each review will be included in reports to the Department.

If the Plan is to remain current, a full review including stakeholder consultation and expert input will be undertaken in the final year of the Plan's life (2024) prior to being resubmitted to the Department.

## 12. Plan administration

### 12.1 Monitoring of the camp

Regular fly-out counts of the camp should be continued and recorded to determine trends.

Quarterly monitoring of the Centennial Parkland camp is currently being undertaken by staff and volunteers of the Centennial Park bat count group. This is being undertaken in line with the National Flying-fox Monitoring Programme counts (February, May, August and November each year). This should continue regardless of whether or not the National Flying-fox Monitoring Programme continues.

The population size, composition and extent of the camp is also to be monitored four times per year, once per each season, in order to capture information on what areas the camp is occupying. Monitoring of camp extent would provide information about changes to the core habitat and expansion zone/ overflow habitat areas as well as alerting when management actions for the unsuitable habitat zone are necessary.

Additionally, more frequent monitoring may be required as a condition of consent for proposed activities or development in the area

### 12.2 Reporting

Annual reports addressing management actions set out in Sections 8 and 9 will be submitted to the Department to satisfy relevant certificate and license conditions and inform future planning. It is recommended that reporting includes the following:

- Annual reports for level 1 actions. See the webpage about [Monitoring, evaluating and reporting on flying-fox camp management actions](#).
- Results of the quarterly monitoring (in accordance with the NFFMP methodology) for size and composition of the camp.
- The results of monitoring the area of the camp (a map showing different habitat areas so changes can be tracked through time).
- The results of vegetation monitoring (e.g. weed cover, natural tree/shrub recruitment, survival of planted trees/shrubs).
- Details of the actions carried out, including timing, methods, location etc. (this should include details of when and how unsafe trees were removed, as well as any revegetation details).
- An assessment of how the flying-foxes reacted to the works, with particular detail on the most extreme response and average response, outlining any recommendations for what aspects of the works went well and what aspects did not work well.
- The reporting requirements of any applicable licences.
- Any information on new camps that have formed in the area.
- Impacts at other locations that may have resulted from management, and suggested amelioration measures.
- Further management actions planned, including a schedule of works.
- An assessment of how the community responded to the works, including details on the number and nature of complaints before and after the works.
- Plan evaluation and review.

## **12.3 Management structure and responsibilities**

Centennial Parklands are responsible for implementation of this plan. Ideally, a Camp Management Coordinator should be identified as the first point of contact and coordination for matters relevant to the camp.

All proposed works associated with this plan must be conducted by contractors who have the required qualifications for their activity and can clearly demonstrate training suitable to carry out the task. Workers must be vaccinated against Australian bat lyssavirus where there is any potential to come into contact with Flying-foxes. Workers, other than qualified wildlife carers, are not to have deliberate contact with Flying-foxes. All contractors will be given clear instruction in their requirements and responsibilities as part of the induction to the site.

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## Appendix 1: Recorded flora species

Scientific Name	Common Name	Native/ Exotic
<i>Acacia longifolia</i>	-	Native
<i>Acacia longifolia</i> subsp. <i>Sophorae</i>	Coastal Wattle	Native
<i>Acacia saligna</i>	Golden Wreath Wattle	Native
<i>Acer negundo</i>	Box-elder Maple	Exotic (PW)
<i>Acmena smithii</i>	Lilly Pilly	Native
<i>Ageratina adenophora</i>	Crofton Weed	Exotic (PW)
<i>Ananas bracteatus</i>	Wild Pineapple	Exotic
<i>Araucaria heterophylla</i>	Norfolk Island Pine	Exotic
<i>Bidens pilosa</i>	Cobblers Pegs	Exotic
<i>Brachychiton acerifolius</i>	Illawarra Flame Tree	Native
<i>Calochlaena dubia</i>	Rainbow Fern	Native
<i>Canna</i> sp. (horticultural species)	Canna Lily	Exotic
<i>Casuarina glauca</i>	Swamp Oak	Native
<i>Cenchrus clandestinus</i>	Kikuyu Grass	Exotic
<i>Centella asiatica</i>	Indian Pennywort	Exotic
<i>Cinnamomum camphora</i>	Camphor Laurel	Exotic (PW)
<i>Commelina cyanea</i>	Scurvy Weed	Native
<i>Coprosma repens</i>	Taupata	Exotic (PW)
<i>Cordyline stricta</i>	Narrow-leaved Palm Lily	Native
<i>Cupaniopsis anacardioides</i>	Tuckeroo	Native
<i>Cyathea cooperi</i>	Straw Treefern	Native
<i>Davallia solida</i>	Hare's-foot Fern	Native
<i>Dianella caerulea</i> var. <i>caerulea</i>	Blue Flax Lily	Native
<i>Dicksonia antarctica</i>	Soft Tree-fern	Native
<i>Ehrharta erecta</i>	Panic Veldtgrass	Exotic
<i>Eucalyptus robusta</i>	Swamp Mahogany	Native
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	Native
<i>Ficus benjamina</i>	Weeping Fig	Exotic

<i>Ficus coronata</i>	Sandpaper Fig	Native
<i>Ficus macrophylla</i>	Moreton Bay Fig	Native
<i>Ficus rubiginosa</i>	Port Jackson Fig	Native
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	Native
<i>Gleichenia dicarpa</i>	Pouched Coral Fern	Native
<i>Glochidion ferdinandi</i>	Cheese Tree	Native
<i>Grevillea robusta</i>	Silky Oak	Native
<i>Howea forsteriana</i>	Kentia Palm	Exotic
<i>Hydrocotyle bonariensis</i>	Largeleaf Pennywort	Exotic
<i>Hypolepis muelleri</i>	Harsh Ground Fern	Native
<i>Lantana camara</i>	Lantana	Exotic (PW, WONS)
<i>Ligustrum lucidum</i>	Large-leaved Privet	Exotic (PW)
<i>Livistona australis</i>	Cabbage Fan Palm	Native
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Native
<i>Melaleuca ericifolia</i>	Swamp Paperbark	Native
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	Native
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Native
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	Native
<i>Microlaena stipoides</i>	Weeping Grass	Native
<i>Monotoca elliptica</i>	Tree Broom-heath	Native
<i>Morus</i> sp.	Mulberry Tree	Exotic
<i>Oplismenus aemulus</i>	Basket Grass	Native
<i>Paspalum dilatatum</i>	Paspalum	Exotic
<i>Phoenix canariensis</i>	Canary Island Date Palm	Exotic (PW)
<i>Pinus radiata</i>	Radiata Pine	Exotic (PW)
<i>Pittosporum undulatum</i>	Native Daphne	Native
<i>Plantago lanceolata</i>	Lamb's Tongues	Exotic
<i>Pteridium esculentum</i>	Common Bracken	Native
<i>Salpichroa origanifolia</i>	Pampas Lily-of-the-valley	Exotic (PW)
<i>Schefflera actinophylla</i>	Umbrella Tree	Exotic (PW)
<i>Senna pendula</i>	-	Exotic (PW)
<i>Solanum mauritianum</i>	Wild Tobacco	Exotic (PW)
<i>Strelitzia nicolai</i>	Bird of Paradise Tree	Exotic

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<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	Native (Planted)
<i>Tradescantia fluminensis</i>	Trad	Exotic (PW)
<i>Triadica sebifera</i>	Chinese Tallowood	Exotic (PW)
<i>Zantedeschia aethiopica</i>	Arum Lily	Exotic (PW)

Legend: PW = Priority Weed, WONS = Weed of National Significance

## Appendix 2: Threatened species with the potential to occur within site locality

The terms for likelihood of occurrence are defined below:

- “Known” = the species was or has been observed on the site
- “Likely” = a medium to high probability that a species uses the site
- “Potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- “Unlikely” = a very low to low probability that a species uses the site
- “No” = habitat on site and in the vicinity is unsuitable for the species.

Species name	Common name	BC Act Status	EPBC Act Status	Likelihood of occurring
<b>Fauna</b>				
<i>Actitis hypoleucos</i>	Common Sandpiper		Migratory	Unlikely
<i>Apus pacificus</i>	Fork-tailed Swift		Migratory	Unlikely
<b><i>Ardea ibis</i></b>	<b>Cattle Egret</b>		<b>Migratory</b>	<b>Known - Occasional visitor</b>
<i>Arenaria interpres</i>	Ruddy Turnstone		Migratory	Unlikely
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Endangered	Unlikely
<i>Burhinus grallarius</i>	Bush Stone-curlew	Endangered		Unlikely
<b><i>Calidris acuminata</i></b>	<b>Sharp-tailed Sandpiper</b>		<b>Migratory</b>	<b>Known - Rare visitor</b>
<i>Calidris alba</i>	Sanderling	Vulnerable	Migratory	Unlikely
<i>Calidris canutus</i>	Red Knot		Endangered, Migratory	Unlikely
<i>Calidris ferruginea</i>	Curlew Sandpiper	Endangered	Critically Endangered, Migratory	Unlikely
<i>Calidris melanotos</i>	Pectoral Sandpiper		Migratory	Unlikely
<i>Calidris ruficollis</i>	Red-necked Stint		Migratory	Unlikely
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Vulnerable		Unlikely
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	Vulnerable		Unlikely
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Vulnerable		Unlikely
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Vulnerable	Vulnerable	Unlikely
<i>Charadrius mongolus</i>	Lesser Sand-plover	Vulnerable	Endangered, Migratory	Unlikely
<i>Charadrius veredus</i>	Oriental Plover		Migratory	Unlikely
<i>Dasyornis</i>	Eastern	Endangered	Endangered	Unlikely

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Species name	Common name	BC Act Status	EPBC Act Status	Likelihood of occurring
<i>brachypterus</i>	Bristlebird			
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Vulnerable	Endangered	Unlikely
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Vulnerable		Unlikely
<b><i>Gallinago hardwickii</i></b>	<b>Latham's Snipe</b>		<b>Migratory</b>	<b>Known - Rare visitor</b>
<i>Glossopsitta pusilla</i>	Little Lorikeet	Vulnerable		Unlikely
<i>Grantiella picta</i>	Painted Honeyeater	Vulnerable	Vulnerable	Unlikely
<b><i>Haliaeetus leucogaster</i></b>	<b>White-bellied Sea-Eagle</b>	<b>Vulnerable</b>		<b>Known - Rare visitor</b>
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Vulnerable	Vulnerable	Unlikely
<i>Hirundapus caudacutus</i>	White-throated Needletail		Migratory	Unlikely
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Endangered	Vulnerable	Unlikely
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	Endangered	Endangered	Unlikely
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Critically Endangered	Unlikely
<i>Limosa lapponica</i>	Bar-tailed Godwit		Migratory	Unlikely
<i>Limosa limosa</i>	Black-tailed Godwit	Vulnerable	Migratory	Unlikely
<i>Litoria aurea</i>	Green and Golden Bell Frog	Endangered	Vulnerable	Unlikely
<i>Lophoictinia isura</i>	Square-tailed Kite	Vulnerable		Unlikely
<i>Merops ornatus</i>	Rainbow Bee-eater			Unlikely
<i>Micronomus norfolkensis</i>	Eastern Freetail-bat	Vulnerable		Unlikely
<b><i>Miniopterus orianae oceanensis</i></b>	<b>Large Bent-winged Bat</b>	<b>Vulnerable</b>		<b>Likely</b>
<i>Mixophyes balbus</i>	Stuttering Frog	Endangered	Vulnerable	Unlikely
<i>Monarcha melanopsis</i>	Black-faced Monarch		Migratory	Unlikely
<i>Monarcha trivirgatus</i>	Spectacled Monarch		Migratory	Unlikely
<i>Motacilla flava</i>	Yellow Wagtail		Migratory	Unlikely
<b><i>Myiagra cyanoleuca</i></b>	<b>Satin Flycatcher</b>		<b>Migratory</b>	<b>Known - Rare visitor</b>
<i>Myotis macropus</i>	Southern Myotis	Vulnerable		Unlikely
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Critically Endangered	Critically Endangered	Unlikely



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Species name	Common name	BC Act Status	EPBC Act Status	Likelihood of occurring
<b><i>Ninox strenua</i></b>	<b>Powerful Owl</b>	<b>Vulnerable</b>		<b>Known</b>
<i>Numenius madagascariensis</i>	Eastern Curlew		Critically Endangered, Migratory	Unlikely
<i>Numenius minutus</i>	Little Curlew		Migratory	Unlikely
<i>Numenius phaeopus</i>	Whimbrel		Migratory	Unlikely
<i>Pandion cristatus</i>	Eastern Osprey	Vulnerable		Unlikely
<i>Petauroides volans</i>	Greater Glider	Endangered Population	Vulnerable	Unlikely
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Endangered	Vulnerable	Unlikely
<i>Petroica boodang</i>	Scarlet Robin	Vulnerable		Unlikely
<i>Phascolarctos cinereus</i>	Koala	Vulnerable	Vulnerable	Unlikely
<i>Philomachus pugnax</i>	Ruff		Migratory	Unlikely
<i>Pluvialis fulva</i>	Pacific Golden Plover		Migratory	Unlikely
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		Vulnerable	Unlikely
<i>Pseudophryne australis</i>	Red-crowned Toadlet	Vulnerable		Unlikely
<b><i>Pteropus poliocephalus</i></b>	<b>Grey-headed Flying-fox</b>	<b>Vulnerable</b>	<b>Vulnerable</b>	<b>Known</b>
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	Vulnerable		Unlikely
<b><i>Rhipidura rufifrons</i></b>	<b>Rufous Fantail</b>		<b>Migratory</b>	<b>Known - Rare visitor</b>
<i>Rostratula australis</i>	Australian Painted Snipe	Endangered	Endangered	Unlikely
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vulnerable		Unlikely
<b><i>Sterna hirundo</i></b>	<b>Common Tern</b>		<b>Migratory</b>	<b>Known - Rare visitor</b>
<b><i>Stictonetta naevosa</i></b>	<b>Freckled Duck</b>	<b>Vulnerable</b>		<b>Known - Occasional visitor</b>
<i>Synemon plana</i>	Golden Sun Moth	Endangered	Critically Endangered	Unlikely
<i>Tringa nebularia</i>	Common Greenshank		Migratory	Unlikely
<i>Tringa stagnatilis</i>	Marsh Sandpiper		Migratory	Unlikely
<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable		Unlikely
<b>Flora</b>				
<i>Acacia bynoeana</i>	Bynoe's Wattle	Endangered	Vulnerable	Unlikely
<i>Acacia pubescens</i>	Downy Wattle	Vulnerable	Vulnerable	Unlikely

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Species name	Common name	BC Act Status	EPBC Act Status	Likelihood of occurring
<i>Acacia terminalis</i> subsp. <i>terminalis</i>	Sunshine Wattle	Endangered	Endangered	Known
<i>Allocasuarina glareicola</i>	-	Endangered	Endangered	Unlikely
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	Endangered	Endangered	Unlikely
<i>Asterolasia elegans</i>	-	Endangered	Endangered	Unlikely
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	Endangered	Vulnerable	Unlikely
<i>Callistemon linearifolius</i>	Netted Bottle Brush	Vulnerable	-	Unlikely
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	Vulnerable	Vulnerable	Unlikely
<i>Darwinia biflora</i>	-	Vulnerable	Vulnerable	Unlikely
<i>Diuris arenaria</i>	Sand Doubletail	Endangered	-	Unlikely
<i>Doryanthes palmeri</i>	Giant Spear Lily	Vulnerable	-	Unlikely
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	Vulnerable	Vulnerable	Unlikely
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	Vulnerable	Vulnerable	Unlikely
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	Endangered	Vulnerable	Unlikely
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	Endangered	Endangered	Unlikely
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	Vulnerable	Vulnerable	Unlikely
<i>Persicaria elatior</i>	Tall Knotweed	Vulnerable	Vulnerable	Unlikely
<i>Persoonia hirsuta</i>	Hairy Geebung	Endangered	Endangered	Unlikely
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	Vulnerable	Vulnerable	Unlikely
<i>Pimelea spicata</i>	Spiked Rice-flower	Endangered	Endangered	Unlikely
<i>Prostanthera junonis</i>	Somersby Mintbush	Endangered	Endangered	Unlikely
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	Endangered	Vulnerable	Unlikely
<i>Thesium australe</i>	Austral Toadflax	Vulnerable	Vulnerable	Unlikely
<b>Threatened ecological communities</b>				
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion		Critically Endangered	Endangered	Unlikely
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community		Endangered	Endangered	Unlikely
Coastal Upland Swamps in the Sydney		Endangered	Endangered	Unlikely

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Species name	Common name	BC Act Status	EPBC Act Status	Likelihood of occurring
Basin Bioregion				
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion		Endangered	Critically Endangered	Unlikely
<b>Eastern Suburbs Banksia Scrub of the Sydney Region</b>		<b>Critically Endangered</b>	<b>Endangered</b>	<b>Known</b>
Swamp Sclerophyll Forest on Coastal Floodplains		Endangered		Unlikely
Western Sydney Dry Rainforest and Moist Woodland on Shale		Endangered	Critically Endangered	Unlikely

## Appendix 3: Additional human and animal health information

Flying-fox camps in public places, such as parks, school grounds and residential areas can sometimes raise concerns for community members about possible health risks. Human infections with viruses borne by flying-foxes are very rare. There is no risk of being infected with these viruses as long as people do not come into physical contact with flying-foxes.

### Australian bat lyssavirus

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 2017) 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 2015).

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 2015).

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 2015).

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 classic 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-exposure vaccination and have their level of protection regularly assessed. Like classic 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, 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 2018). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (Halim et al. 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (DPI 2018).

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 with urine from an infected flying-fox (CDC 2014).

Humans may contract the disease after close contact with an infected horse. Hendra virus 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 2018). Since 1994, more than 100 horses have died (Degeling et al. 2018) and four of the seven infections in humans were fatal (Goldspink et al. 2015).

Previous studies have shown that infections of horses have been associated with foraging flying-foxes rather than camp locations. Therefore, risks are considered similar at any location within the range of flying-fox species and all horse owners should be vigilant. Vaccination of horses can protect horses and subsequently humans from infection (DPI 2018), 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 Hendra virus 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 Hendra virus via aerosol of heavily contaminated substrate should consider additional personal protective equipment (PPE), e.g. respiratory filters, and potentially dampening down dry dusty substrate.

## Menangle virus

Menangle virus (also known as bat paramyxovirus no. 2) was first isolated from stillborn piglets from a NSW piggery in 1997. Little is known about the epidemiology of this virus, except that it has been recorded in flying-foxes, pigs and humans (Field 2002; Kirkland 2017). The virus caused reproductive failure in pigs and severe febrile (flu-like) illness in two piggery workers employed at the same Menangle piggery where the virus (Field 2002). The virus is thought to have been transmitted to the pigs from flying-foxes via an oral-faecal matter route (Kirkland 2017). Flying-foxes had been recorded flying over the pig yards prior to the occurrence of disease symptoms. The two infected piggery workers made a full recovery, and this has been the only case of Menangle virus recorded in Australia.

## General health considerations

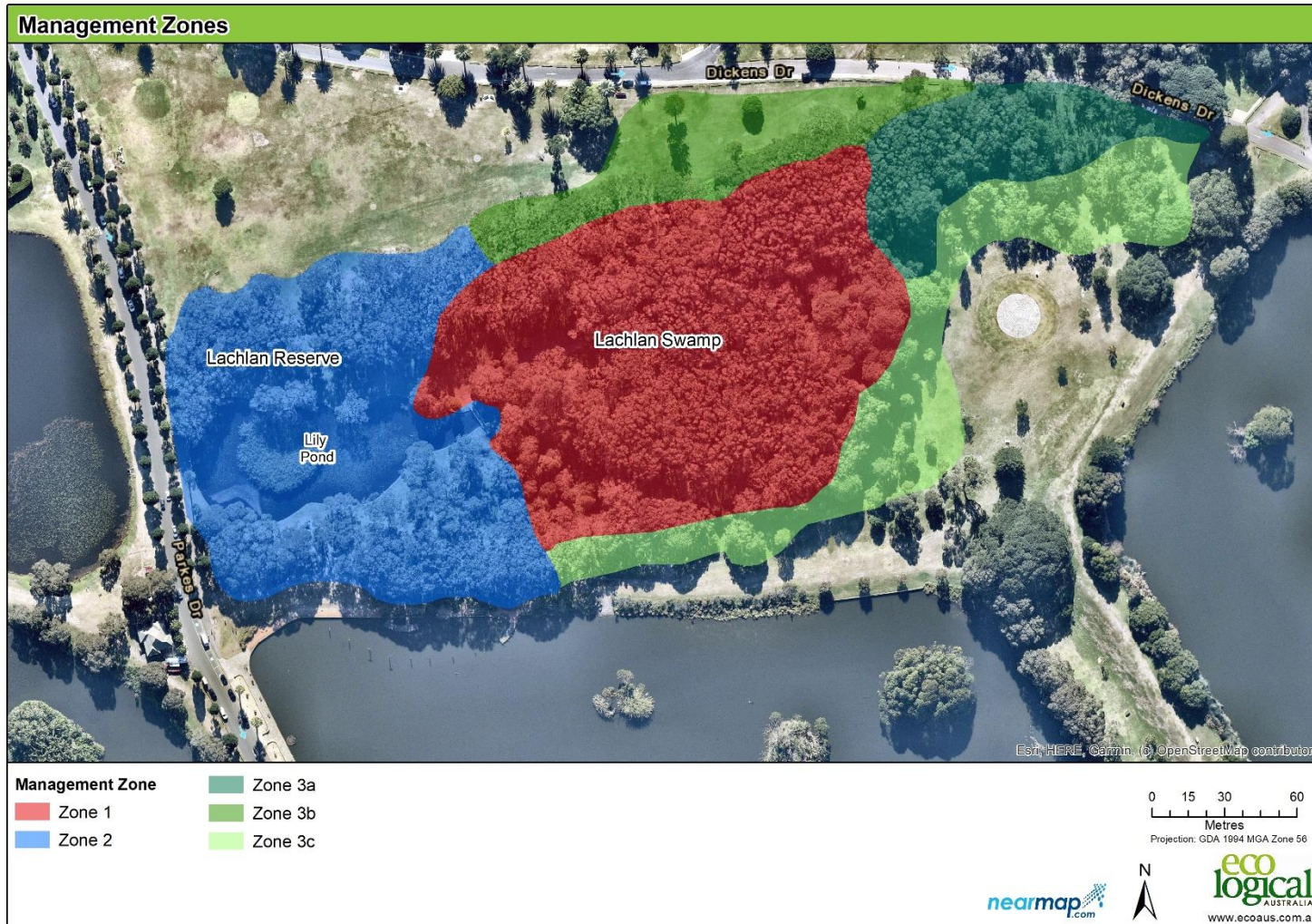
Flying-foxes, like all animals, carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species. Direct contact with faecal material should be avoided and general hygiene measures taken to reduce the low risk of gastrointestinal and other diseases.

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.

# Appendix 4: Revegetation and regeneration program



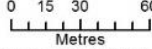
Management Zone 1					
Management Zone 1 : Approx. : 2.2 ha					
	Activity	Density	Numbers	Suggested species	Additional actions
Year 1	Installation of canopy species southern and south western sections of the MZ	1 plant per 10m <sup>2</sup>	150	<i>Melaleuca quinquenervia</i> , <i>Casuarina glauca</i> , <i>Melaleuca linearifolia</i> .	None
Year 1	Supplementary installation of canopy species throughout MZ to make provision for the next generation canopy species.	1 plant per 10 m <sup>2</sup>	10 plants per annum	<i>Melaleuca quinquenervia</i> , <i>Casuarina glauca</i> , <i>Melaleuca linearifolia</i> .	In fill planting throughout the MZ. 100 m <sup>2</sup> per annum.
Years 1 - 5	Supplementary revegetation of mid storey species improving microclimatic conditions in core flying-fox habitat at 100 m <sup>2</sup> per annum.	1 plant per 4 m <sup>2</sup>	25 plants per annum	<i>Melaleuca ericifolia</i> , <i>Banksia robur</i> , <i>Banksia paludosa</i> , <i>Xylomelum pyriform</i> , <i>Elaeocarpus reticulatus</i> , <i>Callistemon citrus</i>	Area increased at 100 m <sup>2</sup> per annum.







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Zone 1







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Management Zone 2					
Management Zone 2 Approx. : 1.7 ha					
	Activity	Density	Numbers	Suggested species	Additional Actions
<b>Year 1</b>	Supplementary installation of canopy species throughout MZ to make provision for the next generation of canopy species	1 plant per 10 m <sup>2</sup>	43 plants per annum.	<i>Melaleuca quinquenervia</i> , <i>Casuarina glauca</i> , <i>Melaleuca lineariifolia</i> .	Infill planting where applicable over 4300 m <sup>2</sup>
<b>Years 1 - 5</b>	Supplementary revegetation of mid storey species.	1 plant per 10m <sup>2</sup>	25 plants per annum.	<i>Melaleuca ericifolia</i> , <i>Banksia robur</i> , <i>Banksia paludosa</i> , <i>Xylomelum pyriform</i> , <i>Elaeocarpus reticulatus</i>	Initial planting area 100m <sup>2</sup> Area increased at 100 square metres per annum.



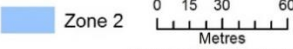


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Zone 2



Metres

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Management Zone 3a					
Management Zone 3a Area approx: 0.5 ha					
	Activity	Density	Numbers	Suggested species	Additional Actions
Year 1 - 5	Supplementary installation of canopy species throughout MZ to make provision for the next generation canopy species	1 plant per 10m <sup>2</sup>	10 plants per annum.	<i>Melaleuca quinquenervia</i> , <i>Casuarina glauca</i> , <i>Melaleuca lineariifolia</i> .	Planting area increased at 100m <sup>2</sup> per annum.
	Supplementary revegetation of mid storey species improving microclimatic conditions in core bat habitat.	1 plant per 4 m <sup>2</sup>	25 plants per annum.	<i>Melaleuca quinquenervia</i> , <i>Casuarina glauca</i> , <i>Melaleuca lineariifolia</i> .	Planting area increased at 100m <sup>2</sup> per annum.


  


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Zone 3a


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Management Zone 3b					
Management Zone 3b Area approx: 0.5 ha					
	Activity	Density	Numbers	Suggested species	Additional Actions
Year 1 - 5	Installation of supporting canopy species in sections of the MZ. Incremental encroachments onto selected turfed assets increasing the area of Bat Colony and Lachlan Swamp.	1 plant per 5 m <sup>2</sup>	20 plants per annum.	<i>Melaleuca quinquenervia</i>	Area increased at 100m <sup>2</sup> per annum. Turf lawn to be removed/ chemically treated and 75 mm of mulch installed.
	Supplementary revegetation of mid storey species improving microclimatic conditions in core bat habitat.	1 plant per 4 m <sup>2</sup>	25 plants per annum.	<i>Melaleuca ericifolia</i> , <i>Banksia robur</i> , <i>Banksia paludosa</i> , <i>Xylomelum pyriform</i> , <i>Elaeocarpus reticulatus</i> , <i>Doryanthes excelsaexcels</i>	Planting area increased at 100m <sup>2</sup> per annum.
	Encouragement of ground layer	No planting required.	No planting required	Encouragement of residing fern species.	Progression of reclamation 2 m from the existing edge, then 2 m from the constructed edge per annum. Area to be mulched to a 75mm depth to suppress weeds. Possible division of residing fern layer or allow to naturally encroach into mulched areas

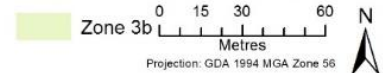




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Management Zone 3c					
Management Zone 3c Area approx: 0.9 ha					
	Activity	Density	Numbers	Suggested species	Additional Actions
Year 1- 5	Installation of supporting canopy species sections of the MZ. Incremental encroachments onto selected turfed assets increasing the area of Bat Colony and Lachlan Swamp.	1 plant per 5 m <sup>2</sup>	20 plants per annum.	<i>Melaleuca quinquenervia</i>	Area increased at 100m <sup>2</sup> per annum. Turf lawn to be removed/ chemically treated and 75 mm of mulch installed.
	Supplementary revegetation of mid storey species improving microclimatic conditions in core bat habitat at 100 square metres per annum.	1 plant per 4m <sup>2</sup>	25 plants per annum.	<i>Melaleuca ericifolia</i> , <i>Banksia robur</i> , <i>Banksia paludosa</i> , <i>Xylomelum pyriform</i> , <i>Elaeocarpus reticulatus</i>	
	Encouragement of ground layer	No planting required.	No planting required	Encouragement of residing fern species.	Progression of reclamation 2 m from the existing edge, then 2 m from the constructed edge per annum. Area to be mulched with to a 75mm depth to suppress weeds. Possible division of residing fern layer or allow to naturally encroach into mulched areas








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Zone 3c 0 20 40 80 Metres

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