Image: EAP_2778

CAMPBELLTOWN GREY-HEADED FLYING-FOX CAMP MANAGEMENT PLAN

July 2021

Campbelltown City Council

Acknowledgement of Country

We acknowledge the Traditional Custodians of the land, the Dharawal people and their unique and spiritual connections to the land. We also respectfully acknowledge Elders past, present and emerging, for the role they continue to play in guiding future generations.
We acknowledge Aboriginal and Torres Strait Islander peoples who reside in our local government area and the traditional custodial Nations.

Executive Summary

The grey-headed flying-fox (*Pteropus poliocephalus*) is listed as a threatened species under the New South Wales *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Council is currently responsible for two grey-headed flying-fox camps within the Campbelltown Local Government Area including a 'nationally important' camp at Bingara Reserve Macquarie Fields.

Council first become aware of the grey-headed flying-fox camp in Campbelltown in April 2010. The camp is located along Bow Bowing Creek, between Blaxland Road, Narellan Road and the train line, Campbelltown.

The Campbelltown Grey-headed Flying-fox Management Plan has been developed in consultation with the local community and other key stakeholders to guide appropriate management of the camp. The Plan outlines issues of concern to the local community and identifies feasible management actions that will be undertaken to reduce impacts on the community whilst managing the camp in situ.

Adopt:

- education and awareness programs
- property modification
- routine camp management
- protocols to manage heat stress
- research
- appropriate land-use planning.

Investigate further:

- nudging
- interventions to reduce impacts of HSEs such as misting sprinklers.

And disregard for Campbelltown camp:

- noise attenuation fencing
- service subsidies
- property acquisition
- buffers through vegetation removal
- active dispersal
- do nothing.

Experience at other camps has shown that attempts to disperse flying-foxes have been largely unsuccessful, expensive and often move the problem or splinter the camp into multiple locations making issues more widespread. As such, relocation of the Campbelltown grey-headed flying-

fox camp has not been identified as a feasible option.

The Plan will be implemented over a five-year period. Certain factors, such as changes to the camp extent from an influx of flying-foxes, may trigger an earlier review of the Plan to enable other management options to be considered. An adaptive, flexible approach to management has been adopted and will be informed by ongoing monitoring of the camp and the effectiveness of implemented management actions.

The Plan has been prepared in accordance with the Department of Planning, Infrastructure and Environment's Flying-fox Camp Management Policy 2015. Approval will be required in order to implement some of the identified management actions.

Acknowledgements

This Camp Management Plan was developed by Ecosure Pty Ltd (2020) and Campbelltown City Council using NSW DPIE template upon which the Camp Management Plan is based.

We would also like to acknowledge the input and thank everyone who participated in community consultation, with all comments considered in the development of the Plan and incorporated where possible.

We would also like to acknowledge the support of Council staff from City Delivery, City Growth and Economy, and City Development during the Plan development process.

Acronyms and abbreviations

ABLV	Australian bat lyssavirus
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BFF	Black flying-fox (*Pteropus alecto*)
the camp	Campbelltown flying-fox camp
CE	Critically endangered
CEEC	Critically endangered ecological community
Council	Campbelltown City Council
DEE	Department of Environment and Energy (Commonwealth)
DPIE	Department of Planning, Industry and Environment (NSW)
E	Endangered
EEC	Endangered ecological communities
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
GHFF	Grey-headed flying-fox (*Pteropus poliocephalus*)
the Guideline	Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015 (Commonwealth)
HeV	Hendra virus
HSE	Heat stress event
LEP	Local Environmental Plan
LGA	Local Government Area
LGNSW	Local Government of New South Wales
LRFF	Little red flying-fox (*Pteropus scapulatus*)
MNES	Matters of national environmental significance
NFFMP	National flying-fox monitoring program
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NPWS	National Parks and Wildlife Service (NSW)
the Plan	this Camp Management Plan

POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
the Policy	Flying-fox Camp Management Policy 2015 (NSW)
SEPPs	State Environmental Planning Policies
SIS	Species impact statement
TEC	Threatened ecological community
V	Vulnerable

Contents

List of figures

List of tables

1 Introduction

The Campbelltown Grey-headed Flying-fox Camp Management Plan (the Plan) will provide Campbelltown City Council (Council) with a framework to enhance community awareness and understanding of flying-foxes, manage issues that may be associated with the camp and balance the protection of flying-foxes with future land uses.

Three species of flying-foxes occur in New South Wales (NSW):

- grey-headed flying-fox (*Pteropus poliocephalus*) (GHFF)
- black flying-fox (*P. alecto*) (BFF)
- little red flying-fox (*P. scapulatus*) (LRFF).

Campbelltown flying-fox camp (the camp) to date has only been occupied by GHFF (Figure 1). All three species of flying-foxes, and their habitats, are protected under NSW legislation. The GHFF is also listed as Vulnerable under Commonwealth legislation, affording it additional protection.

Details of relevant legislation and policy related to flying-foxes is provided in Appendix 2. Flying-fox ecology and species profiles are provided in Appendix 3.

Figure 1 Campbelltown camp is occupied by GHFF

1.1 Flying-foxes in urban areas

Flying-foxes are highly nomadic, moving across their range between a network of camps. Camps may be occupied continuously, annually, irregularly or rarely (Roberts 2005), and numbers can fluctuate significantly on a daily/seasonal basis. Although camps may become vacant periodically, once flying-foxes have utilised a site, the habitat is permanently protected under legislation.

Flying-foxes may travel up to 100 km a night in search of food resources (nectar, pollen and fruit), and their occurrence within the region is tightly linked to flowering and fruiting of foraging trees. Typically, the abundance of resources within a 20–50 km radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments 2012). However, understanding the availability of foraging resources is difficult because flowering and fruiting are not reliable every year and vary between locations (SEQ Catchments 2012). This highlights the need for a multi-faceted approach to management that is continually adapted as situations change or further research improves our understanding of flying-foxes and their management.

Living near a flying-fox camp can be challenging for communities, with impacts associated with noise, odour, faecal drop, damage to vegetation and concern about potential health risks (Appendix 4). There are also challenges associated with management. State approval is required under legislation to manage a camp, and actions which may affect the GHFF must also adhere to Commonwealth policy. Attempts to relocate flying-foxes are extremely costly, and often splinter a camp to multiple undesirable locations in the local area that are difficult to predict (Roberts and Eby 2013). Flying-foxes will also regularly attempt to recolonise their preferred camp site when resources are available, and it is not appropriate or possible to remove all the flowering and fruiting trees that attract them to the region.

Flying-foxes appear to be roosting and foraging in urban areas more frequently. During a study of national flying-fox camp occupation, almost three quarters of the 310 active GHFF camps (72%) were located in urban areas, 22% on agricultural land and only 4% in protected areas (Timmiss 2017). Furthermore, the number of camps increased with increasing human population densities (up to ~4000 people per km^2) (Timmiss 2017).

There are many possible drivers for this urbanising trend, as summarised by Tait et al. (2014):

- loss of native habitat and urban expansion
- opportunities presented by year-round food availability from native and exotic species found in expanding urban areas
- disturbance events such as drought, fires, cyclones
- human disturbance or culling at non-urban camps or orchards
- urban effects on local climate
- refuge from predation
- movement advantages, e.g. ease of manoeuvring in flight due to the open nature of the habitat or ease of navigation due to landmarks and lighting.

These drivers mean that flying-foxes are likely to occupy the camp periodically into the future. Favourable habitat and food resources within the local government area (LGA) mean that camps may also establish in new locations. Optimal vegetation available for flying-foxes must allow movement between preferred areas of the camp and so that vegetation can recover from roosting pressure. 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 a slightly smaller patch size may still be sustainable with hardy vegetation and/or for camps that are not permanently occupied.

1.1 Plan objectives

The Plan has been prepared in accordance with the NSW Flying-fox Camp Management Policy (2015) framework, administered by the Department of Planning, Industry and Environment (DPIE). The Plan also reflect the 2019 updates in the camp management plan template and changes to state legislation around threatened species.

The objectives of the Plan are to:

- minimise impacts to the community and avoid future issues, while conserving flying-foxes and their habitat
- improve community understanding and appreciation of flying-foxes, including their critical ecological role
- provide a framework for a variety of land uses and operational works around the camp, whilst ensuring its protection and flying-fox welfare
- enable Council to appropriately manage essential drainage and landscaping works
- enable long-term conservation of flying-foxes in appropriate locations
- ensure camp management does not contribute to loss of biodiversity or increase threats to threatened species/communities
- clearly define roles and responsibilities
- clearly outline the camp management actions that have been approved and will be utilised at the camp
- implement an adaptive management approach to camp management based on evidence collected
- facilitate licence approval (where required) for actions at the camp
- augment and align with other relevant land use and community planning documentation.

2 Context

2.1 Camp description

The camp is located in an urban area and semi-industrial area along Bow Bowing Creek, between Blaxland Road, Narellan Road and the train line, in Campbelltown. The Campbelltown Mall lies to the south of the camp and the nearest residential area lies approximately 170 m to the north west.

One endangered ecological community (EEC) is mapped at the site; River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and south east corner bioregions. For further information on ecological values of the camp refer to Section 2.5. Bow Bowing Creek can be subject to flooding in heavy rains.

The maximum camp extent recorded in June 2021 is 1.74 ha (as shown on Figure 2).

Figure 2 Maximum camp extent based on previous distribution data

2.2 History of the camp

According to available records the Campbelltown camp has been occupied periodically since 2010 (Campbelltown City Council 2016, NFFMP 2019). Council's Bush Regeneration contractors (Toolijooa) notified Council about the camp in a monthly report in April 2010. It is a confirmed GHFF maternity camp with females and young first observed on 16 October 2012 and in consecutive subsequent years (Campbelltown City Council 2016).

Historic data shows that the camp has been occupied annually since 2012 (OEH 2018), and it is anticipated this seasonal occupation will continue. The maximum total number of flying-foxes ever recorded at the camp was 9,265 in August 2019 (Figure 3). This influx is likely to have been associated with a widespread food shortage in the north of the GHFF range along with extensive bushfires across other parts of NSW.

The GHFF population will generally move south within their range in spring and summer, then return to the coastal forests of north-east NSW and south-east Queensland in winter (Ratcliffe 1932; Eby 1991; Parry-Jones & Augee 1992; Roberts et al. 2012). In autumn they occupy primarily coastal lowland camps (Appendix 3).

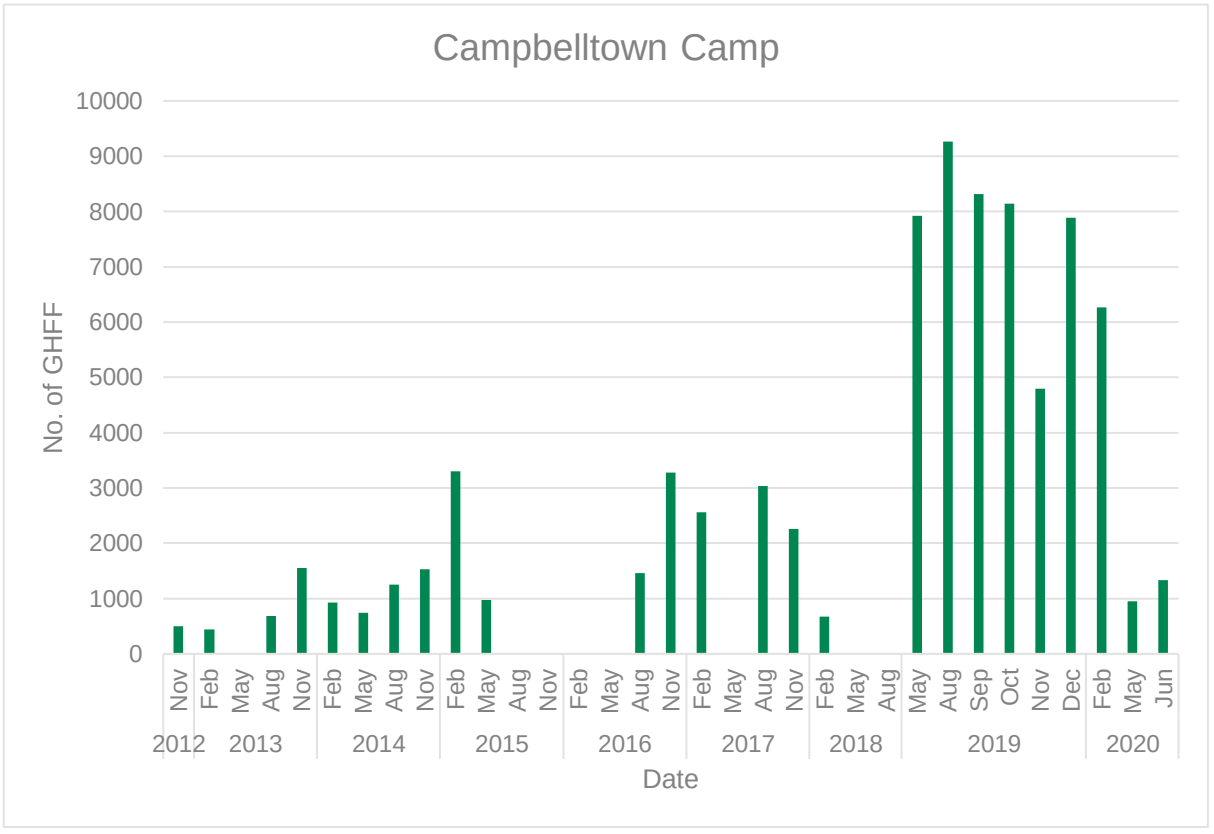


Figure 3 Numbers of GHFF at Campbelltown camp (Source NFFMP 2019, Council 2019, Ecosure 2020)

2.3 Land tenure

The camp is located on multiple land parcels which are all Council land, zoned as DM - Deferred Matter.

The camp is located within Lot 248 DP 1222763. The lot has a split zoning of part 4(b) "Industry B Zone" and part 6(a) "Local Open Space Zone" under the Campbelltown (Urban Area) Local Environmental Plan 2002. The camp is within the part of the site currently zoned 6(a).

Recently a planning proposal has been prepared which seeks to repeal the Campbelltown (Urban Area) Local Environmental Plan 2002 and apply the Campbelltown Local Environmental Plan 2015 to the land. This planning proposal has been publicly exhibited and will soon be enacted which will see the land split into two land zonings. The proposed zoning under the Campbelltown Local Environmental Plan 2015 will see land lying on the upper, flatter areas zoned as IN2 Light Industrial and areas downslope, including the creekline where the camp currently exists, zoned as RE1 Public Recreation.

Further to this Council has prepared the Reimagining Campbelltown City Centre Master Plan 2020 which is currently on public exhibition. It is envisaged that once this master plan has been adopted, there will be a further review of planning rules applying to the land.

2.4 Reported issues related to the camp

A range of issues have been reported by the community in relation to flying-foxes, however these are primarily related to the Bingara Reserve camp (see Section 3 for community engagement results). No concerns regarding disease have been reported regarding this site.

Two businesses adjacent the camp have complained to Council staff regarding faecal drop on their property (pers. comm. City Growth 20 November 2019). No other community impacts have been reported.

Issues have been raised with regards to firework celebrations for community events such as New Year's Eve, Australia Day and their potential impacts on the GHFF. As a result the staging area location for fireworks was relocated to provide a larger buffer for the camp as per recommendations by DPIE (previously the Office of Environment and Heritage [OEH]).

Management actions at Campbelltown and Bingara Reserve camps cannot be considered in isolation as flying-foxes are likely to utilise and move between both camps on a seasonal basis. Future land uses both at the site and on surrounding lands must ensure appropriate considerations for suitable mitigation measures to reduce the potential for GHFF/human conflict.

2.5 Other ecological values of the site

Twelve threatened species are known to occur or have been recorded within one kilometre of Campbelltown camp (Figure 4). Migratory and marine species found within the area have been excluded from this list but are linked in Appendix 5. The EPBC Act protected matters report

returned five threatened plant communities within one kilometre of the site; Castlereagh Scribbly Gum and Agnes banks Woodlands of the Sydney basin bioregion (EEC), Cooks River/Castlereagh Ironbark Forest of the Sydney basin bioregion (Critically Endangered Ecological Community {CEEC}), Cumberland Plain Shale Woodlands and Shale-gravel Transition Forest (CEEC), Shale Sandstone Transition Forest of the Sydney basin bioregion (CEEC) and Western Sydney Dry Rainforest and Mist Woodland on Shale (CEEC) (PMST 2019). One EEC is mapped at the site; River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and south east corner bioregions (Figure 5). Table 1 provides a preliminary assessment of ecological values found around the camp; however a flora and fauna assessment must be undertaken to ground truth desktop findings before any works occur on site.

Table 1 Ecological values within 1 km of Campbelltown camp between 2010 and 2020. Note some records may pre-date development and have not been verified by Council.

Protection level	Source	Category	Values/significance	Details
Commonwealth	NFFMP (DEE 2019)	Nationally important camp	See Appendix 2	Site does not meet criteria
	Protected Matters (DEE 2019)	Threatened species	White-throated needletail (*Hirundapus caudacutus*) (V) Swift parrot (*Lathamus discolor*) (CE) Green and golden bell frog (*Litoria aurea*) (V) Koala (*Phascolarctos cinereous*) (V) Sydney plains greenhood (*Pterostylis saxicola*) (E) Golden sun moth (*Synemon plana*) (CE)	6 species (2 birds, 1 frog, 1 insect, 1 mammal, 1 plant) known to occur within the area (SPRAT data not mapped)
State	Atlas of Living Australia (ALA 2019) and Bionet (OEH 2019)	Threatened species	Gang-gang Cockatoo (*Callocephalon fimbriatum*) (V) Spotted harrier (*Circus assimilis*) (V) Little Lorikeet (*Glossopsitta pusilla*) (V) Swift parrot (*Lathamas discolor*) (E) Cumberland Plain land snail (*Meridolum corneovirens*) (E) Masked owl (*Tyto novaehollandiae*) (V)	6 species (5 birds and 1 gastropod) have been recorded within 1 km of camp (Figure 4)

Figure 4 NSW Bionet state threatened species mapping

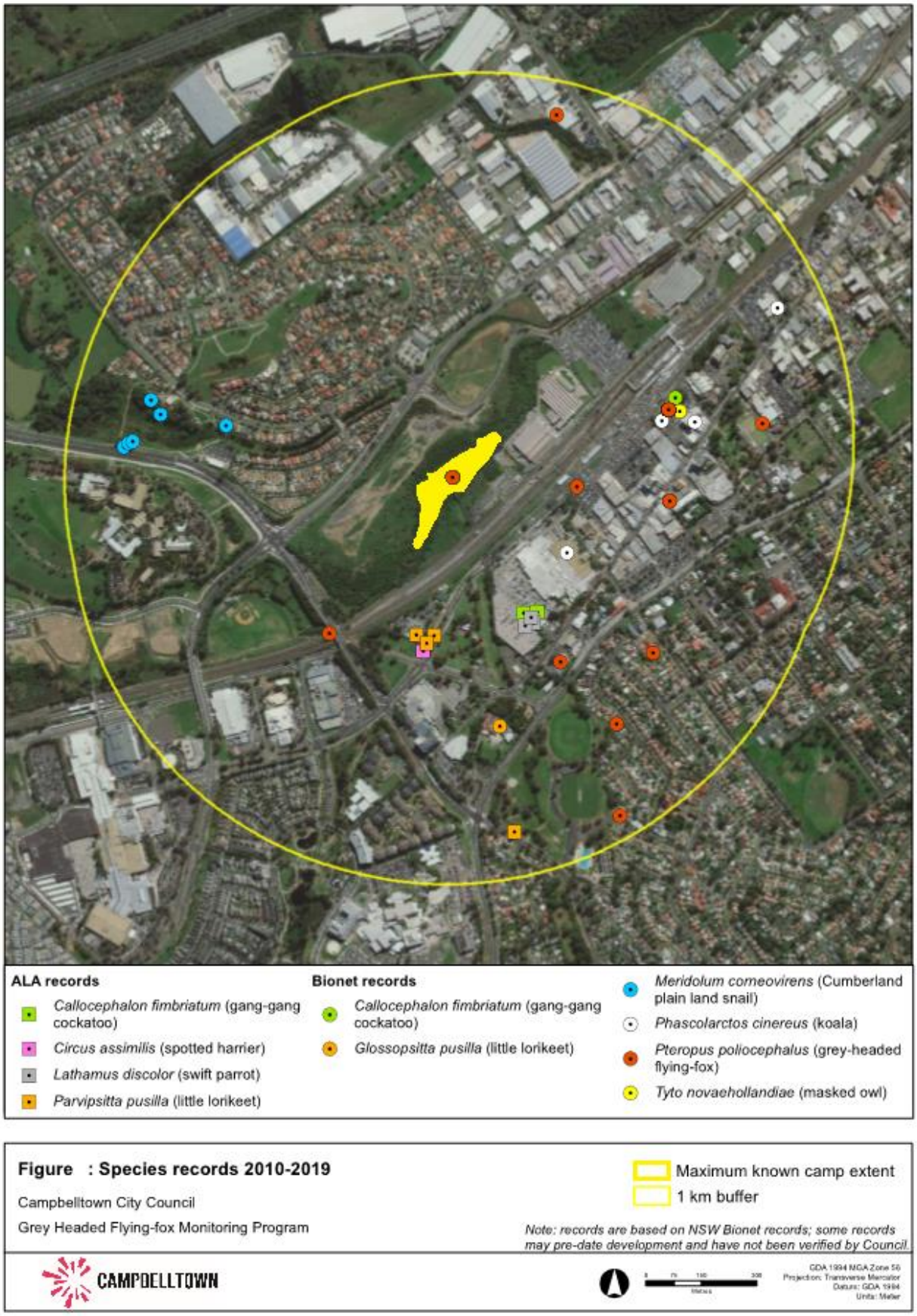
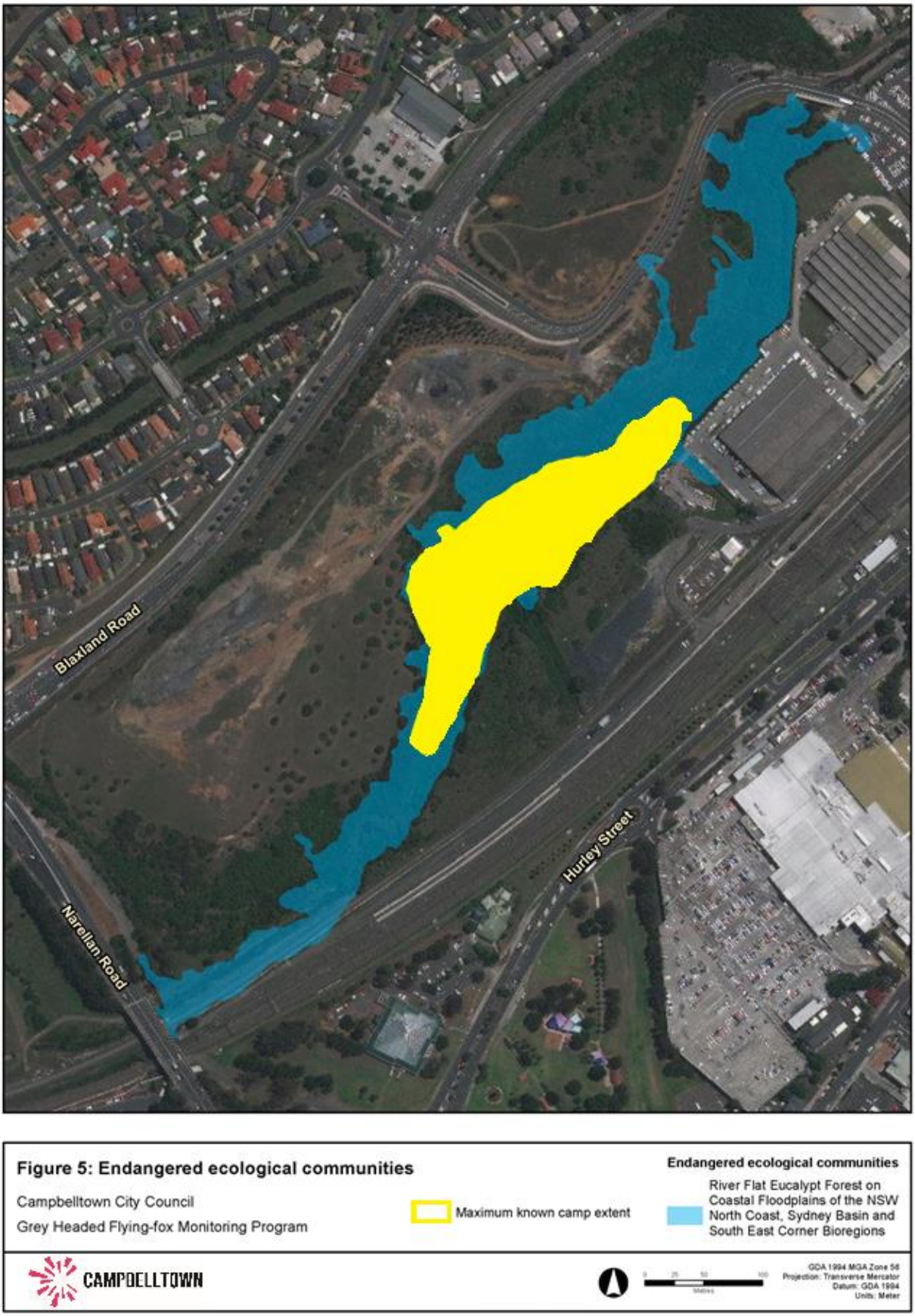


Figure 5 Endangered vegetation mapping and maximum camp extent



2.6 Management response to date

Council has undertaken the following actions to educate the community on flying-foxes including:

- community engagement during the development of the Bingara Reserve Camp Management Plan in 2017
- online educational facts sheets (Living with Grey-headed Flying-foxes; Flying-foxes and health, Flying-fox NSW Fact Sheet, NSW DPI – Bats and Health Risks)
- links to state government resources on flying-foxes
- creation of Grey-headed Flying-fox Frequently Asked Questions brochure
- promoting events such as Australasian Bat Night through social media
- delivery of GHFF education walk and talks including bat nights during 2017/18
- quarterly monitoring of camp
- management of flying-foxes during heat stress events (HSEs) with wildlife carers
- collection of deceased animals following HSEs.

3 Community engagement

Early and effective community engagement and education has benefits for both communities and land managers. These benefits include increasing community understanding and awareness of flying-foxes, their critical ecological role and factors that need to be considered in developing a management approach. Engaging with the community is equally important to ensure land managers understand impacts associated with a camp to effectively manage community concerns.

Council sought to identify and consult with all stakeholders with an interest in the camp prior to and during the development of the Plan. Identified key stakeholders are outlined in Section 3.1 below and the engagement methods that were utilised are detailed in Section 3.2.

3.1 Stakeholders

There are a range of stakeholders who could be directly or indirectly affected by management of flying-foxes in Campbelltown, or who are interested in the camp (Table 2).

Table 2 Stakeholders

Stakeholder group	Stakeholder	Interest/reported impacts
Community	Residents	59 residents responded to the survey. 54.3% of residents who participated in the flying-fox survey (survey open to whole LGA) experience impacts associated with foraging flying-foxes. 44.7% of survey respondents had no concerns relating to flying-foxes.
	Business owners	Some business owners between the station and Bow Bowing Creek report issues associated with faecal drop.
	Horse owners and managers	Horse owners, equine facility managers and local vets should be aware that Hendra virus risk is associated with foraging flying-foxes (e.g. risk is present across the entire flying-fox range), and appropriate mitigation measures.
	Orchardists and fruit growers	Fruit growers may be impacted by flying-foxes and need to have access to safe-netting guidelines.
	Hospitals	Any helicopter operator associated with Campbelltown Hospital heliport must be made aware of flying-foxes in the area and follow risk mitigation measures (especially during dusk or dawn operations).
	Traditional Custodians	The Dharawal People are the traditional custodians who cared for the land now known as the Macarthur Region. This includes the land on the Woronora Plateau where Campbelltown are located. Aboriginal people have a strong connection to place that encompasses landforms, waterways, flora and fauna and have a deep understanding of the ecologic interrelationships between all of these. In addition flying foxes specifically have a notable significance in both Dharawal and broader Aboriginal history, including foraging and camp sites.

Stakeholder group	Stakeholder	Interest/reported impacts
Government	Campbelltown Council	Council is responsible for developing Camp Management Plans for Campbelltown and Bingara Reserve, and currently monitors the camps as part of the National Flying-fox Monitoring Program.
	DPIE	DPIE is responsible for administering legislation relating to (among other matters) the conservation and management of native plants and animals, including threatened species and ecological communities.
	Commonwealth Department of the Environment and Energy (DEE)	DEE is responsible for administering federal legislation relating to matters of national environmental significance, such as the grey-headed flying-fox which roosts in Campbelltown.
	Local Government NSW (LGNSW)	LGNSW is an industry association that represents the interests of councils in NSW. LGNSW also administered funds under the NSW Flying-fox Grants Program.
Non-government organisations	Wildlife carers and conservation organisations	Wildlife carers care for flying-foxes in the Campbelltown LGA and monitor colonies during HSEs. Wildlife care and conservation organisations also have an interest in flying-fox welfare and conservation of flying-foxes and their habitat.
	Researchers/universities/CSIRO	Researchers have an interest in flying-fox behaviour, biology and conservation.

3.2 Engagement methods

Extensive effort has been made to engage with the community regarding flying-foxes to:

- understand the community's awareness of and concerns regarding flying-foxes
- correct misinformation and allay fears
- share information and invite feedback about management responses to date
- seek feedback from the community to identify the most appropriate management actions at both Campbelltown and Bingara camps.

The types of engagement that have been undertaken include:

- telephone conversations to record issues and complaints
- face-to-face meetings and telephone calls with adjacent residents
- promotion of contact details of responsible officers
- online community survey
- Council workshop
- community workshop.

The community survey and workshop were advertised via social media and Council marketing. Flyers were also letterbox dropped to residents within close proximity to camps at Campbelltown and Macquarie Fields.

3.3 Community survey results

The community survey was open for five weeks between 28 October and 2 December 2019. Fifty-nine submissions were received online and one in writing. Survey questions and results are provided in Appendix 6.

In relation to flying-fox issues of concern for residents (Question 15), 29.17% of respondents had no concerns relating to flying-foxes, faecal drop was the issue of most concern (17.5%) followed by damage to vegetation (13.33%).

The overall feedback from the community favoured flying-fox camp management measures that:

- protect the welfare (Question 12) of the flying-foxes (72.8% very or extremely important)
- consider the ecological value (Question 13) and amenity of the vegetation and trees in which the flying-foxes roost (79.6% very or extremely important)
- proposed higher density development does not move the camp away from the site to other areas near residents or businesses (Question 14) (71.1% very or extremely important).

In relation to future planning of new development adjoining flying-fox camps (Question 17), the following were the top three actions voted to help people coexist with flying-fox camps:

- use appropriate buffer distances between the camp and residential dwellings or offices (26.4%)
- ensure designs for future buildings or properties reduce impacts of flying-foxes (22.9%)
- market the flying-fox camp and associated open space as an asset to future residents (18.9%).

3.4 Community workshop results

The community workshop was held at Macquarie Fields Leisure Centre on Wednesday 20 November, 6-8pm. The workshop discussion was focussed on Bingara Camp due to its size and proximity to residents. Twenty-three people attended to give feedback.

Participants were invited to share their thoughts/concerns and asked to select from available management options, tools and techniques which they believe would assist or provide some relief from flying-fox impacts.

Some of the impacts cited by residents included:

- *flying-foxes are getting closer and closer, they are in trees they've never been in before, they have moved further south down the creek*
- *vegetation is being stripped*
- *smell and faecal drop on property, driveways and cars is the main issue*

- *health of residents is at stake*
- *amenity has been reduced significantly over the last few years*
- *can't have solar panels, veggie patch, water tanks*
- *air conditioning on all summer*
- *noise at 4:30am*
- *cleanliness of creek, discharge, creek smells*
- *creek needs regular cleaning, cut bush and grass, make it presentable, not like a dumping zone.*

The condition of the Redfern Creek was of concern for many residents regarding overgrown weeds, rubbish such as trolleys in the creek, and the presence of perceived pests such as rats or snakes.

One community member presented a petition with 184 signatures from residents living in Bingara Road, Myee Road, Bunbury Road, Waratah Crescent, Alexander Crescent and Curran Avenue in order to draw Council's attention to the magnitude of the residents' problem. Residents' concerns were largely focused on number of GHFF at the site, the noise and smell generated and the condition of the creekline. Ongoing engagement by Council staff with frustrated community members has resulted in a tempering of complaints; for instance community member's request being moderated from full dispersal of the camp to investigating measures to mitigate impacts associated with flying-foxes.

Some of the preferred management options and solutions cited by workshop participants included:

- *high pressure water cleaners*
- *build a wall in front of the creek*
- *double glaze windows and doors*
- *cover for clothesline*
- *subsidise water bills*
- *shade sails for vegie patch*
- *water tank to clean bat faeces off driveway, car and house*
- *remove some trees that are near our property*
- *prioritise vegetation removal along the creek, 20m buffer, replace with low growing shrubs*
- *prioritise disturbance as often as possible to move them*
- *clean up the creek of weeds and pests*
- *Council to pay for monthly high pressure water cleaning of property.*
-

3.5 Council workshop results

Nine Council staff from six departments attended the flying-fox meeting to discuss implications for both Campbelltown and Bingara Reserve camps. The workshop revealed potential competing priorities for the Council-owned site in Campbelltown concerning proposed future land use.

Campbelltown camp lies within the Campbelltown Precinct of the Glenfield to Macarthur Urban Renewal Corridor Strategy. This strategy proposes to increase building densities around railway precints including Campbelltown.

Council's objective to protect flying-foxes and their habitat is not intended to interfere with future growth of the city, however protocols and management measures will need to be implemented to strike a balance between development and conserving the camp.

During the workshop, Council staff sought advice regarding what needs to happen during planning and development to avoid impacts to flying-foxes and humans, specifically:

- how the flying-foxes utilise the space – camp footprint, flight paths, solar access, microclimate, movement corridors
- implications for increasing residential densities around the train station
- site maintenance including flood prevention, drain management, bushfire management
- development controls such as height restrictions or set back requirements
- avoiding future HSEs.

4 Camp management options analysis

Appendix 7 provides an overview of management options commonly used across NSW and Australia which have been considered in the development of the Plan. These are categorised as Level 1, 2 or 3 in accordance with the Policy (i.e. Level 1: Routine camp management; Level 2: Creation of buffers; Level 3: Camp disturbance or dispersal). Table 3 provides a site-specific analysis of the camp management options for Campbelltown.

Level 3 intervention will generally only be considered in extreme circumstances where justified through Council's management framework, adherence to legislated management steps, and where sufficient resources are available. Dispersal is a high risk and expensive management action. If successful, it generally only provides temporary outcomes, with flying-foxes regularly attempting to return to the original site. If habitat at the current location was removed or made unavailable, flying-foxes would almost certainly relocate to an alternative location within six kilometres (Eby and Law 2013). As shown in Figure 6, much of the potential habitat within six kilometres would be equally or more problematic (and likely splinter) to a less desirable location. As such, dispersal has not been considered for this camp.

Table 3 Management options analysis

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
Level 1 options: Routine camp management						
Education and awareness programs	Fear of disease Noise Smell Faecal drop	$	Low cost. Proactive measure Increasing awareness and education will help the community coexist with flying-foxes. Council has ready-made FF resources and materials which can be used in an education program.	The camp does not generally create conflict for the community, with most complaints associated with Bingara camp. Education and advice itself will not mitigate all issues, and on its own would not be acceptable to the community.	Survey results indicate the community believes conserving flying-fox welfare and the ecological value and amenity value of the vegetation in which the flying-foxes roost is extremely important.	Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
Property modification	Noise Smell Faecal drop Health/wellbeing Lost rental return	$-$$	Property modification is one of the most effective ways to reduce amenity impacts of a camp without dispersal. Its relatively low cost, and can be included in building design and materials, will not impact on the camp and may add value to the property. Property modification, covered outdoor living areas, glazing windows or installing noise attenuating insulation, will greatly assist with noise impacts inside residences and businesses.	May be cost-prohibitive for private landholders when retrofitting existing premises	Although the community is not currently being impacted by this camp, future land uses adjacent to the camp should include property modification in designs and materials to avoid future conflict.	Adopt
Service subsidies	Noise Smell Faecal drop Health/wellbeing	$	Subsides may include car covers, clothesline covers and free hire of pressure cleaners to assist with faecal drop impacts.	Costly over a large scale which must be considered if proposed development intends to increase dwelling density around camp.	The community is not seeking subsides around the Campbelltown camp at this stage.	Disregard
Odour reducing / masking plants	Noise Smell Health/wellbeing Property devaluation	$	Planting dense screens and fragrant plants to assist with odour and noise and trim tall trees to less than 5 meters high and/or use wildlife friendly netting to prevent occupation by flying-foxes.	May take time for plants to provide the desired effect. Not suitable for areas within EEC vegetation.	Suitable for areas outside of EEC vegetation and in landscape planting.	Adopt
Routine camp management	Health/well-being	$	Weed removal has the potential to reduce roost availability and reduce numbers of roosting FFs. Can improve amenity at the site as well as impacts to biodiversity such as weeds on the site and in	Will not generally mitigate amenity impacts for nearby landholders. Flying-foxes may relocate to more problematic camps (i.e. Bingara). Removing weeds also changes the microclimate which can increase	Within the camp, any weed or bushfire management should be staged and considerate of flying-fox behaviour and habitat requirements.	Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
			downstream areas.	camp temperature and therefore susceptibility to HSEs.		
Alternative habitat creation	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$$-$$$	If successful in attracting FFs away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts and helps FF conservation. Rehabilitation of degraded habitat that is likely to be suitable for FF use could be a more practical and faster approach than habitat creation.	Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract FFs to a new site have not been known to succeed.	Flying-fox habitat mapping can be used to identify potential sites for creating alternate habitat with low conflict nearby.	Disregard
Provision of artificial roosting habitat	Noise Smell Faecal drop Health/wellbeing Property devaluation	$-$$	Artificial roosting habitat could be considered to supplement the canopy if weed removal or camp management effects available roosting space.	No guarantee that flying-foxes would use artificial habitat but collaborating with a researcher on varying design options would increase the likelihood of success.	Investment better directed towards other management options for this site.	Disregard
Protocols to manage incidents and HSEs	Health/wellbeing Fear of disease	$	Low cost, will reduce actual risk of negative human/pet–FF interactions, promotes conservation of FFs, can be undertaken quickly. In some cases, infrastructure problems such as power black-outs from flying-foxes being electrocuted on powerlines may be avoided by proactive management.	Will not mitigate amenity impacts.	Council could develop standard internal procedures as part of HSE plan for facilitate carers to respond to sick and injured wildlife in resident's backyards Safety protocols should be developed as part of any induction package for future construction activities.	Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
Research	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$	Support research that improve understanding and more effectively mitigates impacts. Develop understanding of native flowering event in area.	Generally, cannot be undertaken quickly, management trials may require cost input.	Council staff are actively involved in attending conferences and Council staff stay up to date with research and where possible look at GHFF colonies as study areas. Investigate creche for flying fox release.	Adopt (on-going)
Appropriate land-use planning	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$	Planning for future land use where possible will reduce potential for future conflict between community and flying-fox camps.	Will not generally mitigate current impacts.	Incorporate planning controls and appropriate design features for all future land uses.	Adopt
Property acquisition	All for specific property owners Nil for broader community	$$$			N/A - Council is the landholder for this site.	Disregard
Do nothing	Nil	Nil	No resource expenditure.	Will not mitigate impacts and would not be considered acceptable by impacted members of the community.	Not suitable for this site.	Disregard
Level 2 options: creation of buffers						
Buffers through vegetation removal	Noise Smell Health/wellbeing	$-$$	Any vegetation removal should be done using a staged approach, with the aim of removing as little native	Removing vegetation can also increase visibility into the camp and noise issues for the community	As the site contains an EEC, any works other than assisted regeneration could trigger an impact assessment of	Disregard

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
			vegetation as possible and only in vegetation directly affecting future land uses. Can provide a buffer between the community and flying fox camps which can reduce concerns in some instances.	which may create further conflict. Vegetation removed too quickly could cause inadvertent dispersal. and will exacerbate the impacts of HSEs.	significance (Part 5 activities under EP&A Act) and may require a Threatened species licence under *Biodiversity Conservation Act2016*.	
Buffers without vegetation removal – visual deterrents, canopy mounted sprinklers	Noise Smell Health/wellbeing Damage to vegetation	$$	Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes from designated buffer zones in Queensland. Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012) and balloons (Ecosure 2016, pers. comm.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents.	This option can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Misting may increase humidity and exacerbate HSEs, and overuse may impact other environmental values of the site. Water restrictions recently implemented in Sydney. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. May appear an eye-sore and lead to increase in rubbish in the natural environment.	Non-vegetative buffers are not likely to be incorporated into the strategic plan for this site due the vegetation being classed EEC. Planting and clever building design are better alternatives to mitigate flying-fox impacts.	Investigate further
Noise attenuation fencing	Noise Smell Health/wellbeing Property devaluation Lost rental return/income	$$	Standard noise attenuation fencing is intended to alleviate amenity issues for residents. Advice from an acoustic consultant may provide site-specific alternatives.	Noise attenuation fencing is costly and can be considered unsightly if not cleaned of faecal drop.	Noise attenuating building materials should be considered in future land use adjacent to the camp, however fencing is not appropriate at this site.	Disregard

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site	Appraisal
Level 3 options: disturbance or dispersal						
Nudging	All	$$-$$$	Can encourage flying-foxes to shift away from high conflict areas next to residential areas.	May lead to inadvertent dispersal if not done at the correct time, frequency or duration.	This management tool may be helpful when construction activities are required near the camp, however this would depend on the size of the camp and availability of roosting space. Nudging is not designed to remove a colony from its location but push the area of occupation away from area of conflict	Investigate further
Active dispersal	All. Not generally appropriate for alleviating amenity impacts only.	$$$	If successful can mitigate all impacts at that site.	Studies show that dispersal is rarely successful, especially without significant vegetation removal (not suitable for this site) or high levels of ongoing effort and significant expenditure (e.g. several years of daily works and over $1M for Sydney Botanic Gardens). Flying-foxes will almost always continue to roost in the area (generally within 600 m, Roberts and Eby 2013), and often splinter into several locations nearby while also remaining at the original site on most occasions.	Due to flying-fox fidelity with this habitat, along with the protection level afforded the vegetation, it is highly likely flying-foxes would continue to utilise this camp if dispersal was attempted. If dispersal was successful, flying-foxes will almost always stay within six kilometres of the original site (Eby and Roberts 2013). As shown in Figure 6, suitable habitat in this radius is likely to be more problematic than the current site (e.g. within existing residential areas).	Disregard

Figure 6 Potential relocation sites 6 km

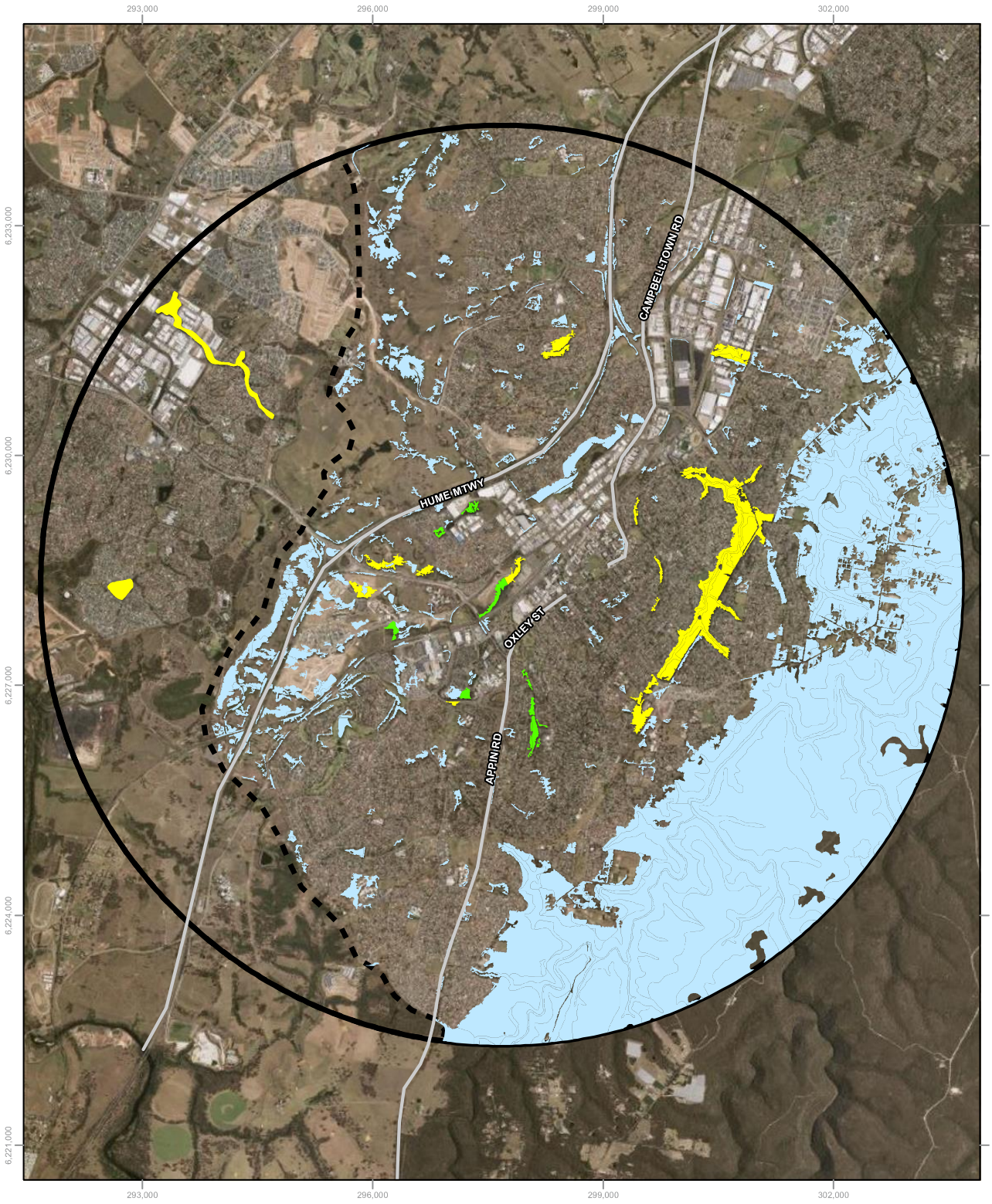


Figure 6: Likely flying-fox camp relocation sites showing 6 km buffer

Campbelltown City Council

Flying-fox Habitat Mapping

Road

No available vegetation data

6 km buffer

Potential flying-fox habitat

High

Moderate

Low

ecosure

Job number: PR3547
Revision: 0
Author: KF
Date: 7/15/2020

0 1 2 4
Kilometers

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Data Sources: © Ecosure Pty Ltd 2018; State of Queensland 2018; Image .
ECOSURE does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. ECOSURE shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

PR3547_MP1_6km_v1

5 Planned management approach

Campbelltown camp is currently neighboured by two businesses, however, is not currently bounded by residential areas, and existing conflict is low. Therefore, management approaches have been driven by the need for routine maintenance at the camp the proposed options for future land use and community opinions gathered during engagement. A site-specific analysis of the camp management options (Appendix 7) was undertaken in Section 4 and determined the most appropriate actions to utilise at Campbelltown camp (Table 4). It should be noted that any management actions implemented at Campbelltown camp could have a consequence at Bingara Reserve camp. The management approach includes actions to adopt, investigate further or disregard within the Plan:

Adopt:

- education and awareness programs
- property modification
- routine camp management
- protocols to manage heat stress
- research
- appropriate future land-use planning.

Investigate further:

- nudging
- interventions to reduce impacts of HSEs such as misting sprinklers/fans.

And disregard for Campbelltown camp:

- noise attenuation fencing
- service subsidies
- property acquisition
- buffers through vegetation removal
- active dispersal
- do nothing.

These actions will be implemented in accordance with Section 6, Assessing Impacts to Flying-Foxes.

As part of the evaluation and review process stipulated in Section **Error! Reference source not found.**, changes to legislation as well as phase two engagement has triggered a review of the Plan. **Error! Reference source not found.** provides a status of the management options (i.e. in progress, or complete or if not yet begun, the level of priority of those actions is provided – low,

medium, high).

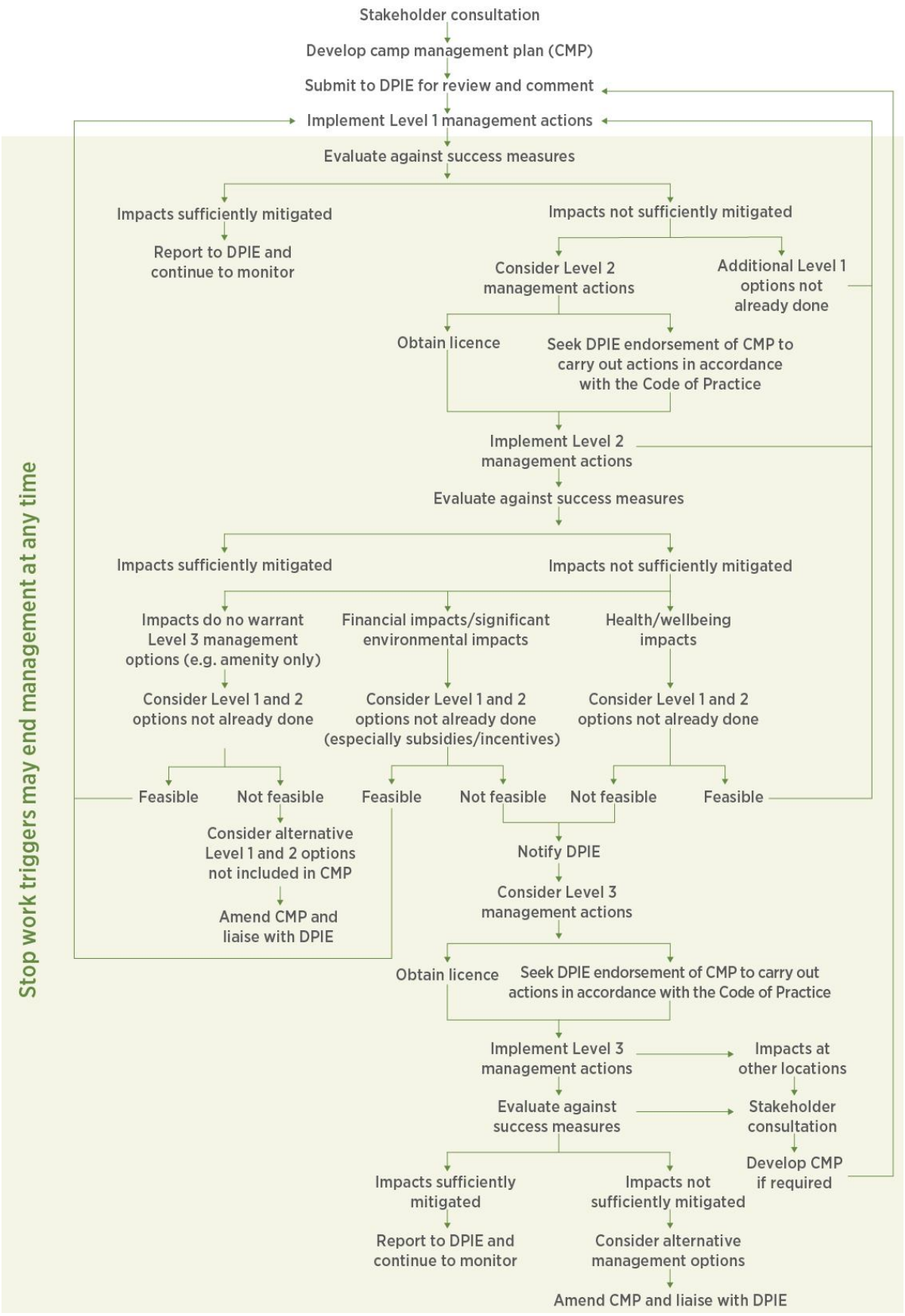
To provide long-term actions to reduce future conflict, planning instruments such as planning schemes, development control plans (DCPs) and local environment plants (LEPs) should outline adequate buffer distances, zones or overlays between future residential developments or human land uses and existing or historical flying-fox camps.

If potential future conflict can be identified and mitigated through considered planning and innovative design, then both flying-foxes and the community will benefit in the long term.

As the camp is located on the lower slope of the site and adjacent to the creekline, maintaining open space in areas immediately adjoining the camp would provide the highest ecological outcome for the camp.

Further studies will need to be undertaken in regards to future land uses to assess potential impacts to the camp with mitigations measures included where risks are identified.

In accordance with the NSW Camp Management Policy, Council will take a hierarchical approach to management, beginning with Level 1 actions and progressing to Level 2 or 3 only if required (Figure 7).



7 Flowchart that demonstrates progression through each management level

Table 4 Actions planned to be implemented by Council over the life of the plan.

Note: *Actions are categorised as Level 1, 2 or 3 in accordance with the Camp Management Policy (OEH 2015). Those actions which require assessment by DPIE via a licence application are also identified.*

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
Fears and misconceptions relating to flying-fox diseases, health and well-being, damage to vegetation and other issues affecting flying-fox health.	To maximise the effectiveness of management actions and understanding of flying-fox ecology To reduce flying-fox mortality	Level 1: Education and awareness program	1. Continue to engage directly with affected members of the community to ensure they are supported and have up-to-date information, including pro-active ways to reduce impacts at their properties and ways to protect fluing-foxes such as .wildlife friendly netting on fruit trees. https://www.wildlifefriendlyfencing.com/WFF/Netting.html	Residents kept up to date with during implementation of the Plan. Impacts of flying-foxes managed Flying-fox mortality reduced.		In progress, High
			2. Develop and maintain an annual program of community engagement (including bat events and assistance with bat counts) to support an understanding of flying-fox ecology, health and safety and management issues associated with the colony.	Program developed, bat night community events held and other relevant community programs supported.		In progress, High
			3. Ensure current flying-fox information remains readily available via Council's website and social media	Council webpage and social media kept up to date with current flying-fox information.		Complete, High
			4. Install signage at colony to build community awareness.	Signage installed at camps.		Medium

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
	To ensure staff and community not unnecessarily exposed to risk of ABLV or other diseases		5. Develop protocols for community and Council staff so everyone is aware of what to do if they encounter a dead, injured or orphaned flying-fox and ensure voluntary vaccination is available to key Council staff.	Staff and community informed with what to do if they encounter a flying-fox. Risk of disease or ABLV greatly reduced		High
Current and future impacts such as noise, smell or faecal matter and other on nearby residents or businesses Conflict between community and flying-fox camps Future land uses	To utilise innovative design features that allows flying-foxes and humans to coexist To be responsive to the future community's concerns To ensure people can better coexist with flying-foxes	Level 1: Property Modification Level 1 – Future land use planning	6. Ensure future land uses utilise innovative design and suitable building materials for reducing noise, odour and faecal drop such as the provision of covered areas or sound mitigating measures.	New developments incorporate mitigation measures to reduce impacts of flying-foxes.		High
			7. Provide information about management options and interventions for residents and nearby businesses to minimise impacts of flying-foxes.	Key impacts to residents or business are reduced.		High
			8. Undertake GIS analysis of flying-fox habitat and identify development controls (e.g. buffer distances, camp size, seasonal spatial extent, drainage, flight paths, solar access and a persistent microclimate design requirements) for areas adjacent the camp.	The inclusion of zoning or overlays and development requirements near flying-fox camps in the planning scheme.		High
			9. Develop appropriate development controls and land use planning provisions for future development adjoining flying fox camps. These provisions will seek to minimise amenity impacts through design and siting of new developments, acoustic measures, covered outdoor spaces etc, whilst also minimising the impact of proposed new development on microclimate and wellbeing of flying-foxes.	Residents/businesses can better coexist with flying-foxes Reduced concerns from community.		High

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
			10. Utilise latest habitat mapping research outcomes, which may inform additional impact mitigation measures, particularly the ability to 'attract' flying-foxes to low conflict locations.	Council makes informed with regards to options for impact mitigation		Low (research collaboration)
			11. Consult with landscape architects and flying-fox ecologists to identify plant species suitable for inclusion as narrow screen of dense vegetative buffers, in building designs and gardens of proposed development to create a visual or physical barrier between the camp and limit flying fox encroachment.	Flying-fox impacts on future development are reduced.		High
Future land use or accumulative impacts from construction processes or multiple developments impacts upon flying-foxes current area of occupation or welfare	To minimise welfare impacts on flying-foxes from construction and development	Level 1: Environmental Assessment	12. Ensure that future development and associated construction is considerate of flying-foxes and their habitat that future development and associated construction is planned, undertaken and monitored in accordance with relevant environmental legislation.	No significant change to flying-fox numbers and colony health after works.		High
Exotic weed growth and poor poor maintenance and habitat restoration	To manage, flying-fox welfare, flooding and bushfire risk in camp To protect and	Level 1: Routine camp management Level 1: Habitat Restoration	13. Undertake all works in accordance with legislation and monitor camp during and after routine management. Routine management includes minor weed management, tree removal or maintenance activities such as mowing or minor slashing that will not affect overall GHFF health. For routine management controls refer to Section 6'Assessment of impacts to flying-foxes'.	No significant change to flying-fox numbers and colony health after routine camp management. Routine management activities completed	✓ Required for working in Threatened Ecological Communities and for works that are likely	High

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
	restore the endangered ecological community in which flying-foxes roost		14. Consult with expert where impacts from operational activities, routine camp management or emergency works are significant, may be unclear or unknown.	All activities are undertaken to minimise impacts to flying-foxes.	to impact flying-foxes or their habitat.	High
			15. In consultation with a flying-fox expert, develop a restoration plan for the site in-line with long-term objectives for the site determined through above actions in line with available budgets. Any planned restoration actions must ensure suitable flying-fox habitat remains available for the maximum number of flying-foxes that have used the site (Commonwealth requirement – see Appendix 2), minimise potential for flying-foxes to be displaced (e.g. into residential properties), and that suitable vegetation is retained for protection against extreme weather (e.g. HSEs). Protocols should also be developed to ensure personnel can work safely under the camp.	Flying-fox restoration undertaken in a cost efficient and effective manner ensuring impacts to GHFF and residents and businesses are minimised.		High
			16. Undertake restoration of flying-fox habitat in accordance with the site restoration plan.			High
			17. Prioritise Council restoration efforts in natural areas with high value GHFF foraging habitat (identified in Eby and Law 2008) to limit reliance on urban areas and unnatural food sources (e.g. orchards).	Works prioritised towards key sites, improving flying-fox foraging habitat.		Medium
			18. Model habitat and land uses in the surrounds to identify other potential sites that may be improved to encourage flying-foxes to relocate on their own accord (informed by findings of ongoing research).	Other sites identified and habitat restored.		Low (research collaboration)

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
			19. Ensure appropriate habitat area is maintained at the site to support flying-foxes in the camp that restoration or revegetation activities do not encourage expansion of the colony, which may affect current or future surrounding land uses.	No net loss or gain to the habitat area required to support the maximum number of flying-foxes that utilise the camp.		High
			20. All personnel working in and around camps with or without plant to be inducted into protocols outlined in Section 6'Assessment of impacts to flying-foxes'.	Staff informed and no significant change to flying-fox numbers and colony health after routine camp management.		High
Heat Stress Events causing illness or death to numerous flying-foxes. Clean up costs associated with not mitigating Availability of vaccinated personnel to deal with HSE	To ensure impacts of heat stress on wildlife carers and flying-foxes are minimised	Other management options: Protocols to manage heat stress events	21. Allocate resources, and develop procedures, responsibilities, and community materials for heat stress events.	Resources, procedures and community materials developed and implemented.		High
			22. Investigate and support further options for technology to assist with gathering relevant data (sensors) and continue support of options to reduce heat stress including misting sprinklers such as what is underway with Western Sydney University.	Heat stress items investigated and implemented where possible.	✓ Required for installation of misting sprinklers	Medium (research collaboration)
			23. Assist wildlife carers where possible such as with data collection methods, equipment and physical assistance (including carcass collection) during and after heat stress events	Wildlife carers supported		High
Conflict between community and flying-fox camps	Understand and predict influxes of flying-foxes to the area	Level 1: Research	24. Identify foraging resources within 50 km of the Campbelltown Camp and likely flowering/fruiting times, including retrospective assessment of events likely to have contributed to previous influxes, to help predict future influxes.	Council is prepared for influxes of flying-foxes		Low (research collaboration)

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
	Inform management decisions regarding influxes					
Staff knowledge and experience and research	Inform staff latest knowledge and information related to flying-fox management.	Level 1: Staff knowledge and capacity	25. Council staff to attend conferences or training relating to flying-fox management to ensure best practiced knowledge is applied to flying-fox management.	Staff are up to date on latest flying-fox management information		High
	Investigate opportunities to enhance research relating to flying foxes	Level 1: Research	26. Investigate creche for flying-fox release site in collaboration with researchers.	Research opportunities and benefits to flying-foxes enhanced.		
Number and distribution of flying-foxes	Undertake monitoring activities	Level 1: Monitoring	27. Council staff to complete National Flying-fox Monitoring Program census and data collection on a minimum of a quarterly basis. Information should include a count, mapped camp extent, condition of individuals in the camp (e.g. presence of pregnant females and young) and flying-fox behaviour. These data can be compared against weather and other variables to identify trends.	Council and government agencies informed with up to date data		High

Issue	Management aim	Management theme	Management action	Success measure	Licence Required	Priority
			28. Support establishment of a local group to research and monitor the site outside regular National Flying-fox Monitoring Program census times. Information, ideally be collected on a monthly basis. 29. Ensure all management actions and results are recorded to inform future planning.	Community engaged in monitoring process. Council learns from its management successes and potential failures		High
Lack of continuous suitable canopy in roosting habitat for bats to find refuge Location of flying-foxes in relation to essential works	To enable flying-foxes to remain on site in a lower conflict location whilst allowing Council to undertake maintenance operations	Level 3: Nudging	30. Ensure consultation with flying-fox experts to understand likely disruption to flying-foxes behaviour and habitat use, ensure appropriate habitat area is maintained at the site to support flying-foxes in the camp 31. Ensure all activities that may involve nudging the flying-fox colony adhere to relevant environmental legislation and licence conditions. 32. All personnel working in and around camps with or without plant to be inducted into protocols outlined in Section 6'Assessment of impacts to flying-foxes'.	All activities are undertaken to minimise impacts to flying-foxes wherever possible. Activities undertaken to relevant environmental legislation and licence conditions. Flying-fox expert engaged during planning and operational works to monitor disturbance to flying-foxes	✓ Required for working in Threatened Ecological Communities and for works that are likely to impact GHFF or their habitat.	High

6 Assessing impacts to flying-foxes

6.1 Impacts on flying-foxes

Actions outlined in the Plan do not include dispersal. Any on ground works will be undertaken in accordance with Section 6.2 and standard measures to avoid impacts as outlined in Section 6.3. This will ensure the welfare of flying-foxes during proposed minor works, and the safety of personnel working in the camp. As such, impacts on the GHFF are expected to be minimal.

As proposed actions over the life of the Plan do not aim to disperse any individuals from the site and so potential habitat has not been modelled.

6.2 Assessment of impacts to ecological community

Twelve threatened species are known to occur or have been recorded within one kilometre of Campbelltown camp. One EEC is mapped at the site; River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and south east corner bioregions

Management over the five year life of the Plan is restricted to weed removal, routine maintenance, and potentially canopy-sprinklers for HSEs. Such works will be undertaken by appropriately qualified bush regeneration contractors who have been trained in identifying stress in flying-foxes. These activities are not considered likely to negatively impact on this EEC or any fauna or flora on the site.

6.3 Standard measures to avoid impacts

The following mitigation measures will be complied with at all times during implementation of any activities (e.g. maintenance, flood works or bushfire management) within or immediately adjacent the camp.

Preparation and planning

- All personnel will be appropriately experienced, trained and inducted. Induction will include each person's responsibilities under the Plan.
- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and DPIE consulted in accordance with the 'stop work triggers' section of the Plan.
- Large crews will be avoided where possible.
- 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 direct contact with flying-foxes will be vaccinated against Australian bat lyssavirus 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 the nearest hospital or doctor who can provide post-exposure prophylaxis will be kept on site.

Work methods

- Incorporate planning controls and appropriate design features for all future land uses.
- The use of loud machinery and equipment that produces sudden impacts/noise will be limited where possible around the camp. 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.).
- DPIE will be contacted immediately if 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 in periods of adverse weather including strong winds, sustained heavy rains, extreme heat, cold temperatures or during periods of likely population stress (e.g. food shortages). Wildlife carers will be consulted to determine whether the population appears to be under stress.
- Works will be postponed on days predicted to exceed 35°C (or ideally 30°C), and for one day following a day that reached ≥35°C. If an actual HSE has been recorded at the camp or at nearby camps, a rest period of several weeks will be scheduled to allow affected

flying-foxes to fully recover. See the webpage about Responding to heat stress in flying-fox camps.

- 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 DPIE's opinion, to be a result of management actions under the 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 DPIE.
- Any proposed variations to works detailed in the Plan must be approved, in writing, by DPIE before any new works occur.
- DPIE may require changes to methods or cessation of management activities at any time.

Monitoring

- A flying-fox expert (as detailed in the DPIE Camp Management Plan Template 2019) will undertake an on-site population assessment prior to, during and after works, including:
  - number of each species
  - ratio of females in final trimester
  - approximate age of any pups present including whether they are attached or likely to be crèched
  - visual health assessment
  - any evidence of morbidity/mortality.
- Counts will be done at least:
  - once immediately prior to works
  - daily during works
  - immediately following completion
  - one month following completion
  - 12 months following completion.

During works

- A flying-fox expert will attend the site as often as DPIE considers necessary to monitor flying-fox behaviour and ensure compliance with the Plan and the Policy. They must also be able to identify pregnant females, flightless young, individuals in poor health and be aware of climatic extremes and food stress events. This person will make an

assessment of the relevant conditions and advise the supervisor/proponent whether the activity can go ahead.

- The potential to use canopy mounted sprinklers for HSEs will be assessed by a flying-fox expert.
- At least one flying-fox rest day with no active management will be scheduled fortnightly, preferably weekly. Static deterrents (e.g. canopy-mounted sprinklers) may still be used on rest days.

Post-works

Reports for Level 1 actions will be provided to the Department annually. Reports for Level 2 and 3 actions will be submitted to the Department one month after commencement of works and then quarterly for the life of the Plan (up to five years) (for all Level 3 actions and in periods where works have occurred for Level 2 actions). 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[1] 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 12).

Vegetation trimming/removal (if required)

- 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 m).

Canopy vegetation trimming/removal (if required)

- 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.

[1] A similar approach should be taken to pre-management engagement (see Section 3) to allow direct comparison, and responses should be assessed against success measures (Section 9) to evaluate success.

- 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. Works may continue in trees adjacent to roost trees only where a person experienced in flying-fox behaviour assesses that no flying-foxes are at risk of being harmed. 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 DPIE for approval at least two months prior to commencing works.

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 and 2 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 will be undertaken using hand tools only (or in the evening after fly-out while crèching young are not present). If core habitat area is identified in the site restoration plan other options for work outside of this may be investigated.
- 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.

Stop work triggers

Management activities in or near Campbelltown camp will cease and will not recommence without consulting DPIE if any :

- any of the animal welfare triggers occur on more than two days during the program, such as unacceptable levels of stress (see Table 5)

- there is a flying-fox injury or death
- a new camp/camps appear to be establishing
- impacts are created or exacerbated at other locations
- there appears to be potential for conservation impacts (e.g. reduction in breeding success identified through independent monitoring)
- standard measures to avoid impacts cannot be met.

Management may also be terminated at any time if:

- unintended impacts are created for the community around the camp
- allocated resources are exhausted.

A person with experience in flying-fox behaviour will monitor for welfare triggers and direct works in accordance with the criteria in Table 5.

Table 5 Planned action for potential impacts during management

A person with experience in flying-fox behaviour (as per Appendix 2) will monitor for welfare triggers and direct works in accordance with the criteria below.

Welfare trigger	Signs	Action
Unacceptable levels of stress	If any individual is observed: • panting • saliva spreading • located on or within two metres of the ground	• Works to cease for the day
Fatigue	In situ management • more than 30% of the camp takes flight • individuals are in flight for more than five minutes • flying-foxes appear to be leaving the camp	• In situ management • Works to cease and recommence only when flying-foxes have settled* / move to alternative locations at least 50 metres from roosting animals
	Dispersal • low flying • laboured flight • settling despite dispersal efforts	• Dispersal • Works to cease for the day
Injury/death	• a flying-fox appears to have been injured/killed on-site (including aborted foetuses) • any flying-fox death is reported within one kilometre of the dispersal site that appears to be related to the dispersal • loss of condition evident	• Works to cease immediately and the Department notified • Rescheduled • Adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by an independent expert (see Appendix 1) • Stopped indefinitely and alternative management options investigated.

Welfare trigger	Signs	Action
Reproductive condition	• females in final trimester • dependent/crèching young present	• Works to cease immediately and the Department notified • Rescheduled • Stopped indefinitely and alternative management options investigated.

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

7 Evaluation and review

The Plan will be in operation for five years with annual review of management actions set out in Section 5.

The following will trigger a reactive internal review 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.

8 Plan administration

8.1 Monitoring and reporting

Monitoring of the camp will be undertaken on a quarterly basis (in accordance with NFFMP) by Campbelltown City Council staff in order to determine the extent of the camp as well as its composition. This will include counts as part of the National Flying-fox Monitoring Program Census.

Monitoring of the camps management actions (and where relevant the camp's response) to these actions will be undertaken in accordance with DPIE's Monitoring, evaluating and reporting on management actions at flying-fox camps fact sheet (prepared in association with DPIE's Flying-fox Camp Management Policy).

Council staff are to ensure management actions and results are recorded to inform future planning. See DPIE webpage for datasheets for levels 1-3 Monitoring, evaluating and reporting on flying-fox camp management actions.

8.2 Responsibilities

Council is responsible for implementation of the Plan once it has been endorsed by DPIE, licences have been obtained where necessary and resources have been allocated for implementation. Council will seek advice from DPIE and other flying-fox experts as required during implementation.

If there is a sudden influx of flying-foxes to the camp, other councils and agencies should be consulted to determine if it is related to a dispersal. If this is the case, assistance will be sought from the council dispersing to manage any issues that arise.

8.3 Funding commitment

Council will commit available funds on an annual basis over the life of the Plan to implement actions in Table 4. Allocation of Council funding will be dependent on resources available and annual priorities. Council will also seek opportunities for funding through relevant grant programs, and will seek contribution from other stakeholders where appropriate.

8.4 Management structure

Council is responsible for coordinating the implementation of the Plan. In addition to the role that Council staff will play in the Plan's implementation a flying-fox expert and a range of other contractors will also be required to guide its implementation and undertake actions as detailed in Table 6 below.

Table 6 Roles and responsibilities

Role	Position	Required experience/approvals	Responsibilities/authority	Communication lines
Program Coordinator	Coordinator Natural Areas Campbelltown City Council	Project management Human resource management Community engagement Reporting Recommended ABLV-vaccinated	Inform and consult with stakeholders and interested parties Community engagement Evaluate program Submit reports to DPIE/DEE Ensure all landowners have been provided consent prior to works Supervise and where appropriate implement actions identified in the Plan.	Reports to: Executive Manager Open Space and Director City Delivery Direct reports: Supervisor
Project Manager	Bushcare Officer Campbelltown City Council	Project management Team leadership and coordination Data management Recommended ABLV-vaccinated Trained in the identifying signs of stress in flying-foxes	Coordinate field teams and ensure all personnel are appropriately experienced and trained for their roles Induct all personnel to the program Collect and collate data Liaise with DPIE and DEE Liaise with wildlife carers/veterinarians (for orphaned/injured wildlife only)	Reports to: Program Coordinator Direct reports: Supervisor, Contractors
Supervisor/Flying-fox expert	Yet to be determined -	Knowledgeable in flying-fox biology, behaviour and camp management ABLV-vaccinated and trained in flying-fox rescue Team training, leadership and supervision	Pre- and post-management monitoring Surrounding camp monitoring Coordinate daily site briefings Coordinate daily activities Monitor flying-fox behaviour Rescue flying-foxes if required (and no carer/vet on site) Determine daily works end point Participate in management activities On-site population assessment and ensure compliance with the Plan.	Reports to: Project Manager Direct reports: Team members, Observers/support
Team member	Yet to be determined -	Recommended ABLV-vaccinated (employer to assess risk) Knowledgeable in flying-fox biology, behaviour and camp management	Attend daily site briefings Participate in relevant management activities Assist Supervisor with their tasks relating to monitoring flying-fox behaviour and monitoring onsite population	Reports to: Supervisor Direct reports: Nil

Role	Position	Required experience/approvals	Responsibilities/authority	Communication lines
			assessment	
Contractor Bush regeneration	Yet to be determined	Relevant Biodiversity Conservation licences and experience in field Trained in the identifying signs of stress in flying-foxes	Undertake Weed Removal in buffer areas Develop and implement Restoration Plan for camp site Adhere to all directions given by Supervisor (when implementing relevant onsite actions)	Reports to: Project Manager Direct reports: Nil
Contractors (Various) Property Modifications	Yet to be Determined	Relevant experience in area of property modification	Undertake property modifications and various other actions as required	Reports to: Project Manager/relevant resident
Observer/support	WIRES and/or Sydney Metropolitan Wildlife Carers	Approval to access site Experience in Flying-fox rescue and rehabilitation Trained in identifying signs of stress in flying-foxes	Provide care of injured/orphaned wildlife (under licence) if required	Reports to: Supervisor Direct reports: Nil
Campbelltown City Council Operational Staff	Multiple	Trained in identifying signs of stress in flying-foxes	Undertake operational works as per developed guidelines Report any identified issues through to project manager	Direct reports: Nil

References and further resources

Aich, P, Potter, AA and Griebel, PJ 2009, 'Modern approaches to understanding stress and disease susceptibility: A review with special emphasis on respiratory disease', *International Journal of General Medicine*, vol. 2, pp. 19–32..

ALA 2017, Pet Dander, American Lung Association, available: https://www.lung.org/our-initiatives/healthy-air/indoor/indoor-air-pollutants/pet-dander.html

Atlas of Living Australia 2019, occurrence download, viewed 19 November 2019, *https://biocache.ala.org.au/occurrences/search?q=*%3A*&fq=geospatial_kosher%3Atrue&fq=occurrence_decade_i%3A%222010%22&fq=(data_resource_uid%3A%22dr2009%22%20OR%20data_resource_uid%3A%22dr1010%22%20OR%20data_resource_uid%3A%22dr359%22%20OR%20data_resource_uid%3A%22dr340%22)&lat=-34.0666&lon=150.8079&radius=1.0*.

Australasian Bat Society 2013, viewed 12 January 2016, ausbats.org.au/.

Australian Museum 2010, *Little Red Flying-fox*, viewed 12 January 2016, australianmuseum.net.au/little-red-flying-fox.

AVA 2015, *Hendra virus*, Australian Veterinary Association, viewed 12 January 2016, www.ava.com.au/hendra-virus.

Birt, P 2000, 'Summary information on the status of the Grey-headed (Pteropus poliocephalus) and Black (*P. alecto*) Flying-Fox in New South Wales,' Proceedings of workshop to assess the status of the grey-headed flying-fox in New South Wales. University of Sydney, Sydney, New South Wales, Australia, pp. 78-86.

Bishop T, 2015, The Management, Treatment and Physiology of Heat Stroke in Flying-foxes, presentation

Churchill, S 2008, *Australian Bats*, Allen & Unwin, Crows Nest, NSW.

Campbelltown City Council 2016, *Flying Fox Census Counts Summary Campbelltown*, Flying Fox Counts Farrow Road Campbelltown, Campbelltown City Council, viewed 21/11/2019

Campbelltown City Council 2017, Macquarie Fields Masterplan Concept Development

DECC 2007, *Threatened species assessment guidelines: the assessment of significance*, Department of Environment and Climate Change NSW, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf.

DECC 2008, *Best practice guidelines for the grey-headed flying-fox*, Department of Environment and Climate Change NSW, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/threatenedspecies/08540tsdsflyingfoxbpg.pdf.

DECCW 2009, *Draft National Recovery Plan for the Grey-headed Flying-fox* Pteropus

poliocephalus, prepared by Dr Peggy Eby for Department of Environment, Climate Change and Water NSW, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf.

DoE 2013, *Matters of National Environmental Significance: Significant Impact Guidelines 1.1*, Environment Protection and Biodiversity Conservation Act 1999, Australian Government Department of the Environment, www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf.

DoE 2014, *How can flying-foxes be managed in accordance with national environmental law*? Australian Government Department of the Environment, Canberra, viewed 12 January 2016, www.environment.gov.au/biodiversity/threatened/species/flying-fox-law.

DoE 2015, *Referral guideline for management actions in grey-headed and spectacled flying-fox camps*, Australian Government Department of the Environment, Canberra, viewed 12 January 2016, www.environment.gov.au/system/files/resources/6d4f8ebc-f6a0-49e6-a6b6-82e9c8d55768/files/referral-guideline-flying-fox-camps.pdf.

DoE 2016a, *Pteropus poliocephalus in Species Profile and Threats Database*, Australian Government Department of the Environment, Canberra, viewed 12 January 2016, www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186.

DoE 2016b, *Monitoring Flying-fox Populations*, Australian Government Department of the Environment, Canberra, viewed 12 January, www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring.

DPI 2013, *Australian bat lyssavirus*, June 2013 Primefact 1291 2nd edition, Department of Primary Industries, NSW, viewed 12 January 2016, www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/461873/Australian-Bat-lyssavirus.pdf.

DPI 2014, *Hendra virus*, June 2014 Primefact 970 9th edition, Department of Primary Industries, NSW, viewed 12 January 2016, www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/310492/hendra_virus_primefact_970.pdf.

DPI 2015a, *Hendra virus*, Department of Primary Industries, NSW, viewed 19 November 2019, https://www.dpi.nsw.gov.au/animals-and-livestock/horses/health-and-disease/hendra-virus.

DPI 2015b, *Lyssavirus and other bat health risks*, Department of Primary Industries, Primary Industry Biosecurity, NSW, viewed 12 January 2016, www.dpi.nsw.gov.au/biosecurity/animal/humans/bat-health-risks.

DSDIP 2014, *Queensland State Planning Policy July 2014*, Department of State Development, Infrastructure and Planning, Brisbane.

DPIE 2019, Flying-fox Camp Management Plan Template 2019, Department of Planning, Industry and Environment, Sydney.

Eby, P 1991, 'Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus*

(Chiroptera: Pteropodidae) from two maternity roosts in northern New South Wales', *Wildlife Research*, vol. 18, pp. 547–59.

Eby, P 1995, *The biology and management of flying-foxes in NSW*, Species management report number 18, Llewellyn, L. (ed.), National Parks and Wildlife Service, Hurstville.

Eby, P 2000, 'The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox *Pteropus poliocephalus*', Proceedings from workshop to assess the status of the Grey-headed Flying-fox in New South Wales, pp. 66–77.

Eby, P 2006, 'Site Management Plan for the Grey-headed Flying-fox camp at the Sydney Desalination Plant Site', report to Sydney Water Corporation, Sydney.

Eby, P and Lunney, D 2002, *Managing the Grey-headed Flying–fox as a threatened species in NSW*, Royal Society of New South Wales, Darlington, NSW.

Ecosure 2011, 'Hendra Virus Risk Assessment for the Gold Coast Equine Precinct: Residual Risk Report', unpublished report to City of Gold Coast.

Edson, D, Field, H, McMichael, L, Jordan, D, Kung, N, Mayer, D and Smith, C 2015, 'Flying-fox Roost Disturbance and Hendra Virus Spillover Risk', *PLoS ONE,* vol. 10, no. 5, viewed 12 January 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4446312/pdf/pone.0125881.pdf.

EHP 2012, *Living with Wildlife – Flying-foxes*, Department of Environment and Heritage Protection, Queensland, updated 14 May 2012, viewed 12 January 2016, www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/importance.html.

EHP 2013a, *Code of Practice – Ecologically sustainable management of flying-fox roosts*, Department of Environment and Heritage Protection, Queensland, viewed 12 January 2016, www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/roost-management.html.

EHP 2013b, *Code of Practice – Low impact activities affecting flying-fox roosts*, Department of Environment and Heritage Protection, Queensland, viewed 12 January 2016, www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/roost-management.html.

EHP 2013c, *Flying-fox roost management guideline*, Department of Environment and Heritage Protection, Queensland, viewed 12 January 2016, www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/roost-management.html.

ELW&P 2015, *Flying-foxes*, Department of Environment, Land, Water and Planning, State of Victoria.

EPA 2013, *Noise Guide for Local Government*, Environment Protection Authority, Sydney.

Fujita, MS 1991, 'Flying-fox (*Chiroptera: Pteropodidae*) pollination, seed dispersal, and economic importance: a tabular summary of current knowledge', *Resource Publication No. 2*, Bat Conservation International.

GeoLINK 2010, *Maclean Flying-fox Management Strategy*, report prepared for Clarence Valley

Council on behalf of the Maclean Flying-Fox Working Group.

GeoLINK 2012, *Lorn Flying-fox management strategy*, report prepared for Maitland City Council.

Hall, L and Richards, G 2000, *Flying foxes: fruit and blossom bats of Australia*, UNSW Press, Sydney.

Henry, JP and Stephens-Larson, P 1985, 'Specific effects of stress on disease processes' in Moberg, GP (ed.), *Animal Stress*, American Physiological Society, pp.161–175.

IUCN 2015, *Little red flying-fox*, International Union for the Conservation of Nature, www.iucnredlist.org.

Ku-ring-gai Council 2013, *Ku-ring-gai Flying-fox Reserve Management Plan*, Ku-ring-gai Council, Gordon, NSW.

Markus, N 2002, 'Behaviour of the Black Flying-fox *Pteropus alecto*: 2. Territoriality and courtship', *Acta Chiropterologica*, vol. 4, no. 2, pp.153–166.

Markus, N and Blackshaw, JK 2002, 'Behaviour of the Black Flying-fox *Pteropus alecto*: 1. An ethogram of behaviour, and preliminary characterisation of mother-infant interactions', *Acta Chiropterologica*, vol. 4, no. 2, pp. 137–152.

Markus, N and Hall, L 2004, 'Foraging behaviour of the black flying-fox (*Pteropus alecto*) in the urban landscape of Brisbane, Queensland', *Wildlife Research*, vol. 31, no. 3, pp. 345-355.

McCall, BJ, Field, H, Smith, GA, Storie, GJ and Harrower, BJ 2005, 'Defining the risk of human exposure to Australian bat lyssavirus through potential non-bat animal infection', *CDI*, vol. 29, no. 2, pp. 200–203, www.health.gov.au/internet/main/publishing.nsf/content/cda-cdi2902-pdf-cnt.htm/$FILE/cdi2902k.pdf.

McConkey, KR, Prasad, S, Corlett, RT, Campos-Arceiz, A, Brodie, JF, Rogers, H and Santamaria, L 2012, 'Seed dispersal in changing landscapes', *Biological Conservation*, vol. 146, pp. 1–13, doi:10.1016/j.biocon.2011.09.018.

McGuckin, MA and Blackshaw, AW 1991, 'Seasonal changes in testicular size, plasma testosterone concentration and body weight in captive flying-foxes (*Pteropus poliocephalus* and *P. scapulatus*)', *Journal of Reproduction and Fertility*, vol. 92, pp. 339–346.

McIlwee, AP and Martin, IL 2002, 'On the intrinsic capacity for increase of Australian flying-foxes', *Australian Zoologist*, vol. 32, no. 1.

Milne, DJ and Pavey, CR 2011, 'The status and conservation of bats in the Northern Territory', in Law, B, Eby, P, Lunney, D and Lumsden, L (eds), *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of NSW, Mosman, NSW, pp. 208–225.

NFFMP 2018, National Flying-fox Monitoring Program, Department of Environment and Energy, Australian Government, available: http://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

viewed 12 February 2018.

NSW Health 2012, *Flying foxes and health*, NSW Health, North Sydney, viewed 12 January 2016, www.health.nsw.gov.au/environment/factsheets/Pages/flying-foxes.aspx.

NSW Health 2013, *Rabies and Australian Bat Lyssavirus Infection*, NSW Health, North Sydney, viewed 12 January 2016, www.health.nsw.gov.au/Infectious/factsheets/Pages/Rabies-Australian-Bat-Lyssavirus-Infection.aspx.

NSW Planning and Environment 2017, Campbelltown Precinct, www.planning.nsw.gov.au

OEH 2011a, *Grey-headed Flying-fox vulnerable species listing: NSW Scientific Committee final determination*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/determinations/GreyheadedFlyingFoxVulSpListing.htm.

OEH 2011b, *NSW Code of Practice for Injured, Sick and Orphaned Protected Fauna*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/wildlifelicences/110004FaunaRehab.pdf.

OEH 2012, *NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/wildlifelicences/120026flyingfoxcode.pdf.

OEH 2014, *BioBanking Assessment Methodology 2014*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/biobanking/140661BBAM.pdf.

OEH 2015a, *Flying-foxes* (including fact sheets), Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/animals/flyingfoxes.htm.

OEH 2015b, *Flying-fox Camp Management Policy 2015*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/threatenedspecies/150070-flyingfoxcamp-policy.pdf.

OEH 2015c, *Flying-fox Camp Management Plan Template 2015*, Office of Environment & Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/threatenedspecies/150102-flyingfoxcamp-template.pdf.

OEH 2015d, *GHFF threatened species profile*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10697

OEH 2015e, *Policy and procedural guidelines for the mitigation of commercial crop damage by flying-foxes*, Office of Environment and Heritage, Sydney, viewed 12 January 2016, www.environment.nsw.gov.au/resources/wildlifelicences/140480FlyfoxPol.pdf

OEH 2018, Master Data – NSW NFFMP to Nov 2017 unpublished data.

Parry-Jones, KA and Augee, ML 1992, 'Movements of the Grey-headed Flying Foxes (*Pteropus poliocephalus*) to and from a colony site on the central coast of New South Wales', *Wildlife Research,* vol. 19, pp. 331–40.

Parry-Jones, K and Augee, M 2001 'Factors affecting the occupation of a colony site in Sydney, New South Wales by the Grey-headed Flying-fox *Pteropus poliocephalus* (Pteropodidae)', *Austral Ecology*, vol. 26, pp. 47–55.

Pierson, ED and Rainey, WE 1992, 'The biology of flying foxes of the genus Pteropus: A Review', in: Wilson, DE and GL Graham (eds), *Pacific Island Flying Foxes*: *Proceedings of an International Conservation Conference*, US Department of the Interior – Biological Report no. 90, pp. 1–17.

Qld Health 2016, *Bats and Human Health*, Queensland Health, viewed 12 January 2016, www.health.qld.gov.au/communicablediseases/hendra.asp

Ratcliffe, F 1932, 'Notes on the Fruit Bats (Pteropus spp.) of Australia', *Journal of Animal Ecology*, vol. 1, no. 1, pp. 32–57.

Roberts, B 2005, 'Habitat characteristics of flying-fox camps in south-east Queensland', BSc. Honours Thesis, Griffith University, Brisbane.

Roberts, BJ 2006, *Management of Urban Flying-fox Roosts: Issues of Relevance to Roosts in the Lower Clarence, NSW*, Valley Watch Inc, Maclean.

Roberts, B and Eby, P 2013, Review of past flying-fox dispersal actions between 1990–2013, publisher unknown, viewed 12 January 2016, www.environment.nsw.gov.au/resources/animals/flying-fox-2014-subs/flyingfoxsub-jenny-beatson-part2.pdf.

Roberts, BJ, Catterall, CP, Eby, P and Kanowski, J 2012, 'Long-Distance and Frequent Movements of the Flying-Fox *Pteropus poliocephalus*: Implications for Management', *PLoS ONE*, vol. 7, no. 8, e42532.

Roberts, BJ, Eby, P, Catterall, CP, Kanowski, J and Bennett, G 2011, 'The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia', in Law, B, Eby, P, Lunney, D and Lumsden, L (eds), *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of NSW, Mosman, NSW, viewed 12 January 2016, www.griffith.edu.au/__data/assets/pdf_file/0006/358440/Roberts-et-al.pdf.

Roberts, B, Kanowski, J and Catterall, C 2006, *Ecology and Management of Flying-fox Camps in an Urbanising Region*, Rainforest CRC Tropical Forest Landscapes, Issue 5, viewed 12 January 2016, www.rainforest-crc.jcu.edu.au/issues/ITFL_flyingfox.pdf.

SEQ Catchments 2012, *Management and Restoration of flying-fox Roosts: Guidelines and Recommendations*, SEQ Catchments Ltd funded by the Australian Government's Caring for Our Country, viewed 12 January 2016, www.environment.nsw.gov.au/resources/animals/flying-fox-2014-subs/flyingfoxsub-jenny-beatson-part3.pdf.

Shinwari, MW, Annand, EJ, Driver, L, Warrilow, D, Harrower, B, Allcock, RJN, Pukallus, D, Harper J, Bingham, J, Kung, N and Diallo, IS 2014, 'Australian bat lyssavirus infection in two horses', *Veterinary Microbiology*, vol. 173, pp. 224–231.

Snoyman S, Jasmina M & Brown C 2012, 'Nursing females are more prone to heat stress: Demography matters when managing flying-foxes for climate change', Applied Animal Behaviour Science, vol 142, pp. 90-97.

Southerton, SG, Birt, P, Porter, J and Ford, HA 2004, 'Review of gene movement by bats and birds and its potential significance for eucalypt plantation forestry', *Australian Forestry*, vol. 67, no. 1, pp. 45–54.

Stanvic, S, McDonald, V and Collins, L 2013, *Managing heat stress in flying-foxes colonies*, viewed 12 January 2016, www.fourthcrossingwildlife.com/HeatStress-StanvicMcDonaldCollins.pdf.

Tait, J, Perotto-Baldivieso, HL, McKeown, A and Westcott, DA 2014, 'Are Flying-Foxes Coming to Town? Urbanisation of the Spectacled Flying-Fox (*Pteropus conspicillatus*) in Australia', *PLoS ONE*, vol. 9, no. 10, e109810, doi:10.1371/journal.pone.0109810.

Tidemann, C, Eby, P, Parry-Jones, K and Vardon, M 1999, *The Action Plan for Australian Bats: Grey-headed Flying-fox*, Environment Australia, www.environment.gov.au/node/14622.

Tolga Bat Hospital, *Wildlife Friendly Fencing Project*, Tolga Bat Hospital partly funded by grants from WWF and Australian Government Caring for Our Country, viewed 12 January, 2016, www.wildlifefriendlyfencing.com/WFF/Home.html.

Vardon, MJ and Tidemann, CR 1999, 'Flying-foxes (*Pteropus alecto* and *P. scapulatus*) in the Darwin region, north Australia: patterns in camp size and structure', *Australian Journal of Zoology*, vol. 47, pp. 411–423.

Vardon, MJ, Brocklehurst, PS, Woinarski, JCZ, Cunningham, RB, Donnelly, CF and Tidemann, CR 2001, 'Seasonal habitat use by flying-foxes, *Pteropus alecto* and *P. Scapulatus* (Megachiroptera), in monsoonal Australia', *Journal of Zoology* London, vol. 253, pp. 523–535.

Webb, N and Tidemann, C 1995, 'Hybridisation between black (*Pteropus alecto*) and grey-headed (*P. poliocephalus*) flying-foxes (Megachiroptera: Pteropodidae)', *Australian Mammalogy*, vol. 18, pp. 19–26.

Webb, NJ and Tidemann, CR 1996, 'Mobility of Australian flying-foxes, *Pteropus* spp. (Megachiroptera): evidence from genetic variation', *Proceedings of the Royal Society London Series B*, vol. 263, pp. 497–502.

Welbergen, JA 2014, 'Canaries in the coalmine: flying-foxes and extreme heat events in a warming climate', presentation at the Griffith Climate Change Seminar, July 2014, www.griffith.edu.au/research/research-excellence/griffith-climate-change-response-program/program/?a=628188.

Welbergen, JA, Klose, SM, Markus, N and Eby, P 2008, 'Climate change and the effects of temperature extremes on Australian flying-foxes', *Proceedings of the Royal Society of London B: Biological Sciences*, vol. 275, no. 1633, pp.419–425, viewed 12 January 2016, rspb.royalsocietypublishing.org/content/275/1633/419.short.

Westcott, DA, Dennis, AJ, Bradford, MG, McKeown, A and Harrington, GN 2008, 'Seed dispersal processes in Australia's Wet Tropics rainforests', in Stork, N and Turton, S, *Living in a dynamic tropical forest landscape*, Blackwells Publishing, Malden, pp. 210–223.

Westcott, DA, McKeown, A, Murphy, HT and Fletcher, CS 2011, *A monitoring method for the Grey-headed Flying-fox,* Pteropus poliocephalus, CSIRO, Queensland, viewed 12 January 2016, www.environment.gov.au/biodiversity/threatened/species/pubs/310112-monitoring-methodology.pdf.

Zurbuchen, A, Landert, L, Klaiber, J, Muller, A, Hein, S and Dorn, S 2010, 'Maximum foraging ranges in solitary bees: only few individuals have the capability to cover long-foraging distances', *Biological Conservation,* vol. 142, no. 3, pp. 669–676.

Appendix 1: Expert assessment requirements

The Plan template identifies where expert input is required. The following are the minimum required skills and experience which must be demonstrated by each expert.

Flying-fox expert

Essential

- Knowledge of flying-fox habitat requirements.
- Knowledge and experience in flying-fox camp management.
- Knowledge of flying-fox behaviour, including ability to identify signs of flying-fox stress.
- Ability to differentiate between breeding and non-breeding females.
- Ability to identify females in final trimester.
- Ability to estimate age of juveniles.
- Experienced in flying-fox population monitoring including static and fly-out counts, demographics and visual health assessments.

Desirable

- It is strongly recommended that the expert is independent of the Plan owner to ensure transparency and objectivity. The Department may be able to help with finding flying-fox experts.
- ABLV-vaccinated (N.B. This is often an essential requirement during management implementation as detailed within the template).
- Trained in flying-fox rescue (N.B. This is often an essential requirement during management implementation as detailed within the template).
- Local knowledge and experience.

Ecologist

Essential

- At least five years demonstrated experience in ecological surveys, including identifying fauna and flora to species level, fauna habitat and ecological communities.
- The ability to identify flora and fauna, including ground-truthing of vegetation mapping.
- Formal training in ecology or similar, specifically flora and fauna identification.

Desirable

- Tertiary qualification in ecology or similar.
- Local knowledge and experience.
- Accredited Biodiversity Assessment Method assessor under the *Biodiversity Conservation Act 2016*.
- Practising member of the Ecological Consultants Association of NSW.

Depending on the site, for example, when vegetation management is proposed for an endangered ecological community or an area with a high likelihood of containing other threatened flora and fauna species, a specialist in that field (e.g. specialist botanist) may be required.

Appendix 2 Legislation

State

Flying-fox Camp Management Policy 2015

The Flying-fox Camp Management Policy 2015 (the Policy) has been developed to empower land managers, primarily local councils, to work with their communities to manage flying-fox camps effectively. It provides the framework within which DPIE 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.

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (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 DPIE 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).

DPIE 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.

Local Government Act 1993

The primary purpose of this Act is to provide the legal framework for an effective, efficient and environmentally responsible, open system of local government. Most relevant to flying-fox management is that it also provides encouragement for the effective participation of local communities in the affairs of local government and sets out guidance on the use and management of community land which may be applicable to land which requires management of flying-foxes.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the conservation of nature, objects, places or features of cultural value and the management of land reserved under this Act. The Act protects Aboriginal objects and declared Aboriginal Places. An Aboriginal Heritage Impact Permit may be required under this Act to authorise camp management actions that may harm Aboriginal objects a declared Aboriginal Places.

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.

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 purposes 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 NSW Department of Planning, Industry and Environment.

Development control plans under the EP&A Act should consider flying-fox camps so that planning, design and construction of future land uses 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.

State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017

This policy aims to protect the biodiversity, and amenity values of trees, and other vegetation in non-rural areas of the State. A person must not cut down, fell, up root, kill, poison, ringbark, burn or otherwise destroy the vegetation, or lop or otherwise remove a substantial part of the vegetation to which this Policy applies without a permit granted by council, or in the case of vegetation clearing exceeding the biodiversity offset thresholds (as stated in Part 7 of the *Biodiversity Conservation Regulation 2017*), approval by the Native Vegetation Panel.

Proponents will need to consider whether the SEPP (Vegetation in Non-Rural Areas) applies to their proposal, and if any approvals under the BC Act.

Commonwealth

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 Commonwealth DEE 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. DEE has developed the Referral guideline for management actions in GHFF and 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 ≥10,000 GHFF in more than one year in the last 10 years, or
- been occupied by more than 2500 GHFF permanently or seasonally every year for the last 10 years.

Provided that management at nationally important camps follows the mitigation standards below, DEE has determined that a significant impact to 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 DEE 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 (HSE, cyclone event), or during a period of significant food stress.
- 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.

If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

Appendix 3 Flying-fox ecology and behaviour

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

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

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.

There is a wide range of ongoing threats to the survival of the grey-headed flying-fox, including:

- habitat loss and degradation
- conflict with humans (including culling at orchards)
- infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.)
- 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).

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).

Black flying-fox (*Pteropus alecto*)

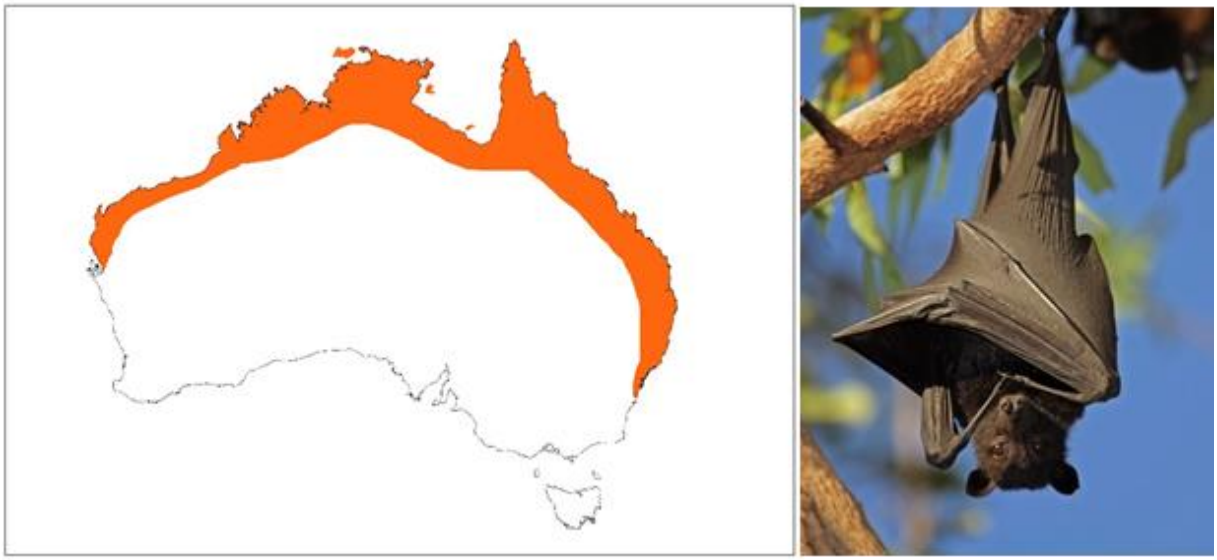


Figure 8 Black flying-fox indicative species distribution, adapted from OEH 2015a

The black flying-fox (BFF) (Figure 8) has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Queensland and into NSW (Churchill 2008; OEH 2015a). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann 1995). This shift has consequently led to an increase in indirect competition with the threatened GHFF, which appears to be favouring the BFF (DoE 2016a).

They forage on the fruit and blossoms of native and introduced plants (Churchill 2008; OEH 2015a), including orchard species at times.

BFFs 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 km of the camp site (Markus & Hall 2004).

BFFs 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.

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

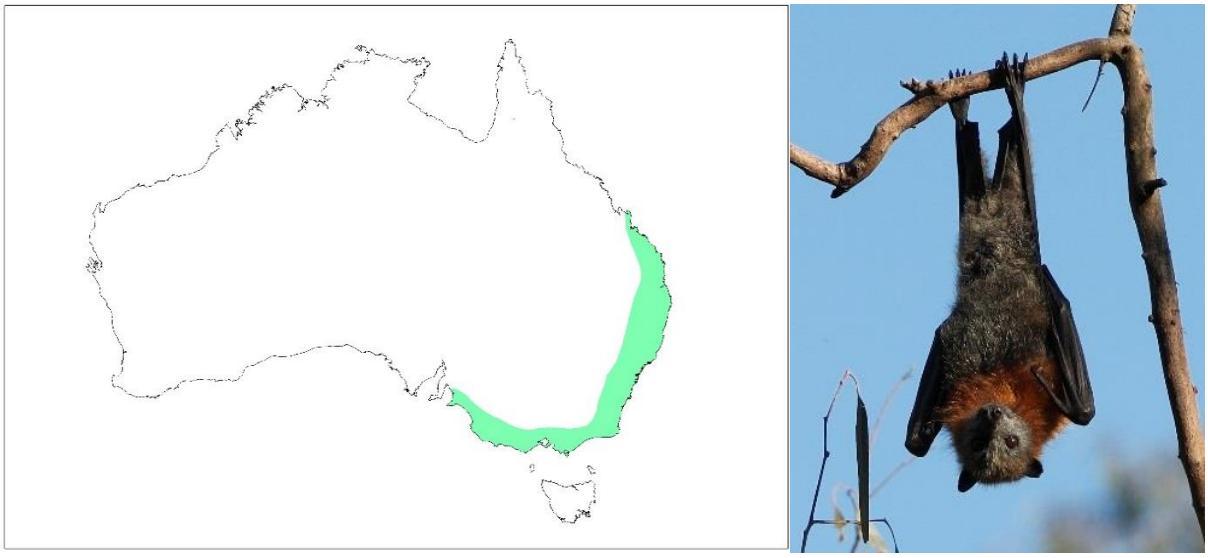


Figure 9 Grey-headed flying-fox indicative species distribution, adapted from OEH 2015a

The GHFF (Figure 9) is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (OEH 2015d). This species now ranges into South Australia and has been observed in Tasmania (DoE 2016a). It requires foraging resources and camp sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will raid orchards at times, especially when other food is scarce (OEH 2015a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb & Tidemann 1996; DoE 2015). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 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 NSW, 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 NSW (DECCW 2009).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000;

Richards 2000 cited in OEH 2011a). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, deliberate destruction associated with the commercial horticulture industry, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.) and competition and hybridisation with the BFF (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation (see Section 3).

Little red flying-fox (*Pteropus scapulatus*)

Figure 10 Little red flying-fox indicative species distribution, adapted from OEH 2015a

The little red flying-fox (LRFF) (Figure 10) is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

The LRFF forages almost exclusively on nectar and pollen, although will eat fruit at times and occasionally raids orchards (Australian Museum 2010). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability of food resources (predominantly the flowering of eucalypt species)(Churchill 2008), which means the duration of their stay in any one place is generally very short.

Habitat preferences of this species are quite diverse and range from semi-arid areas to tropical and temperate areas, and can include sclerophyll woodland, melaleuca swamplands, bamboo, mangroves and occasionally orchards (IUCN 2015). LRFF are frequently associated with other *Pteropus* species. In some colonies, LRFF individuals can number many hundreds of thousands and they are unique among *Pteropus* species in their habit of clustering in dense bunches on a single branch. As a result, the weight of roosting individuals can break large branches and cause significant structural damage to roost trees, in addition to elevating soil nutrient levels through faecal material (SEQ Catchments 2012).

Throughout its range, populations within an area or occupying a camp can fluctuate widely.

There is a general migration pattern in LRFF, whereby large congregations of over one million individuals can be found in northern camp sites (e.g. Northern Territory, North Queensland) during key breeding periods (Vardon & Tidemann 1999). LRFF travel south to visit the coastal areas of south-east Queensland and NSW during the summer months. Outside these periods LRFF undertake regular movements from north to south during winter–spring (July–October) (Milne & Pavey 2011).

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. Young 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 is generally from August (when females are in final trimester) to the end of peak conception around April. Dependent pups are usually present from September to March (Figure 11).

Little red flying-fox

The LRFF breeds approximately six months out of phase with the other flying-foxes. Peak conception occurs around October to November, with young born between March and June (McGuckin & Blackshaw 1991; Churchill 2008) (Figure 11). Young are carried by their mother for approximately one month then left at the camp while she forages (Churchill 2008). Suckling occurs for several months while young are learning how to forage. LRFF generally birth and rear young in temperate areas (rarely in NSW).

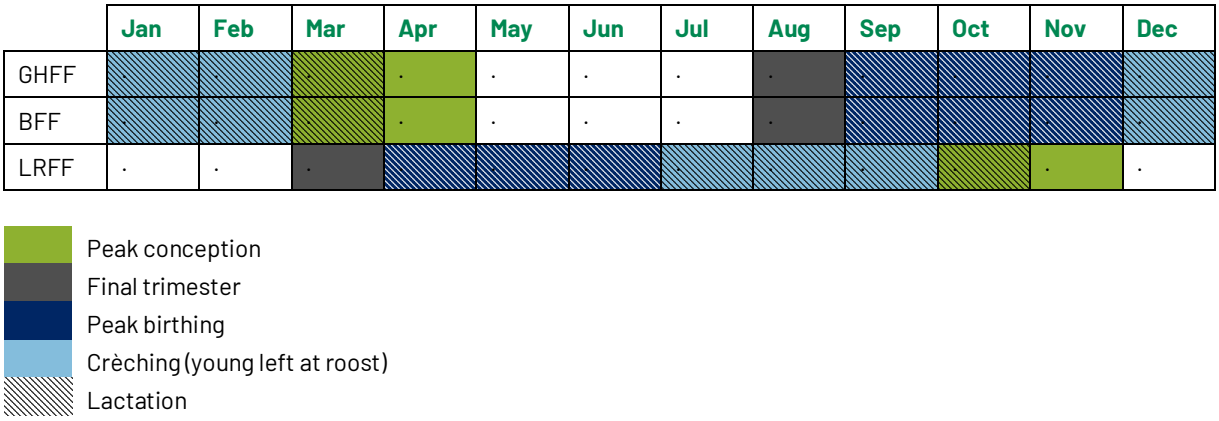


Figure 11 Indicative flying-fox reproductive cycle.

Note that LRFF rarely birth and rear young in NSW. The breeding season of all species is variable between years and location, and expert assessment is required to accurately determine phases in the breeding cycle and inform appropriate management timing.

Heat stress events

Flying-foxes suffer from heat stress when the ambient temperature exceeds the physiological limits flying-foxes can endure for maintaining a comfortable body temperature (Bishop 2014). Flying-foxes are susceptible to heat stress due to their inability to sweat (Snoyman et al 2012), therefore they need to expend energy on cooling mechanisms such as fanning. BFF are considered to be more susceptible to HSE than GHFF due to the southern expansion of their range with temperature extremes increasing in severity with latitude in eastern Australia (Welbergen et al 2008).

Appendix 4 Human and animal health

Human and animal health

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

Excluding those people whose occupations require contact with bats, such as wildlife carers and vets, human exposure to ABLV, HeV and Menangle virus, their transmission and frequency of infection is extremely rare. HeV infection in humans requires transfer from an infected intermediate equine host (i.e. close contact with an infected horse) and spread of the virus directly from bats to humans has not been reported.

These diseases are also easily prevented through vaccination, personal protective equipment, safe flying-fox handling (by trained and vaccinated personnel only) and appropriate horse husbandry. Therefore, 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 also judged to be low (Qld Health 2016).

Disease and flying-fox management

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

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

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

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

- forcing flying-foxes into closer proximity to one another, increasing the probability of disease transfer between individuals and within the population.
- resulting in abortions and/or dropped young if inappropriate management methods are used during critical periods of the breeding cycle. This will increase the likelihood of

direct interaction between flying-foxes and the public, and potential for disease exposure.

- adoption of inhumane methods with potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying or deceased 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.

Australian bat lyssavirus

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

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

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

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

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

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

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

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

Hendra virus

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

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

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

Previous studies have shown that HeV spillover events have been associated with foraging flying-foxes rather than camp locations. Therefore, risk is 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 2014), as can appropriate horse husbandry (e.g. covering food and water troughs, fencing flying-fox foraging trees in paddocks, etc.).

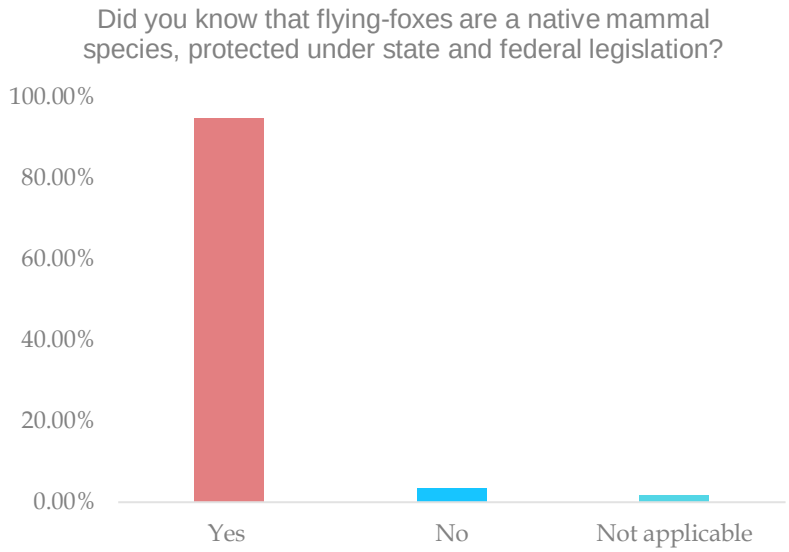
Although all human cases of HeV to date have been contracted from infected horses and direct transmission from bats to humans has not yet been reported, particular care should be taken by select occupational groups that could be uniquely exposed. For example, persons who may be exposed to high levels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

Appendix 5 Protected matters

Refer to separable linked report.

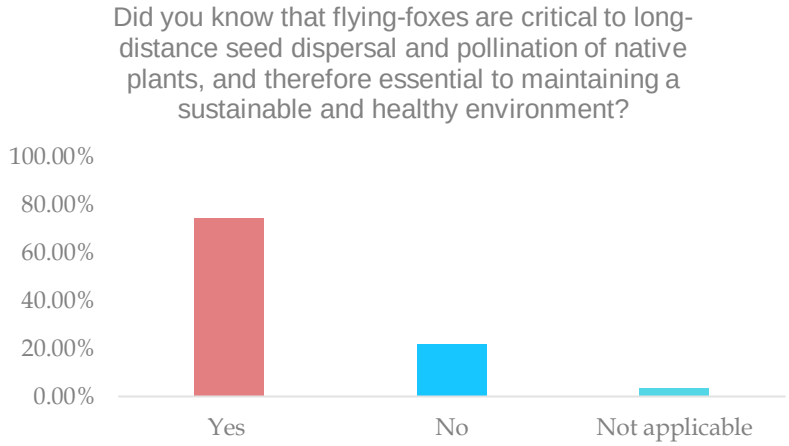
Appendix 6 Community survey results

Question 1



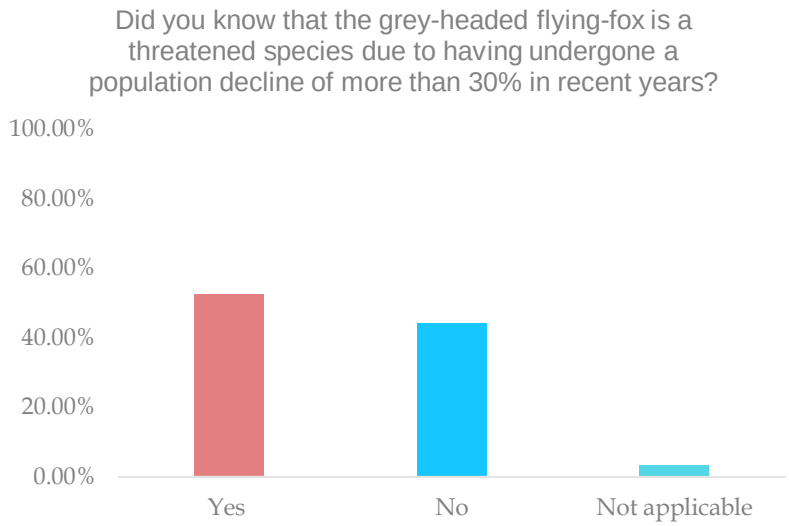
Answer	Responses	%
Yes	56	94.92
No	2	3.39
Not applicable	1	1.69

Question 2



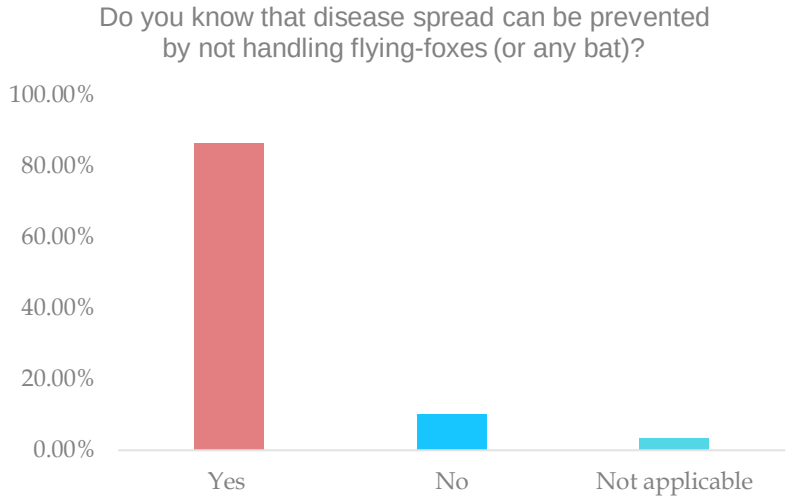
Answer	Responses	%
Yes	44	74.5
No	13	22.03
Not applicable	2	3.39

Question 3



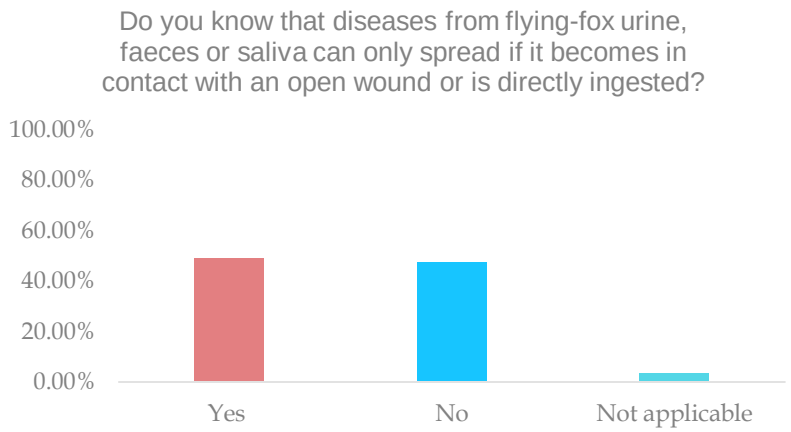
Answer	Responses	%
Yes	31	52.54
No	26	44.07
Not applicable	2	3.39

Question 4



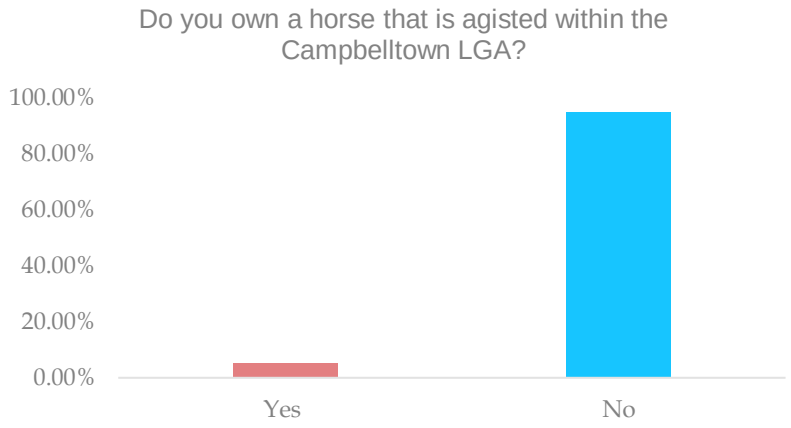
Answer	Responses	%
Yes	51	86.44
No	6	10.17
Not applicable	2	3.39

Question 5



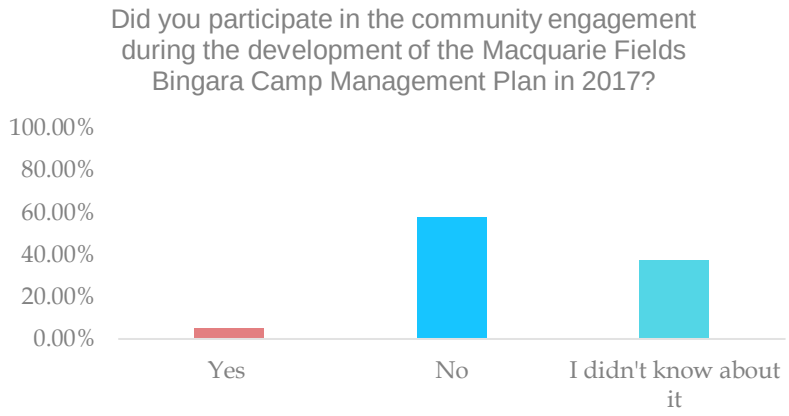
Answer	Responses	%
Yes	29	49.15
No	28	47.46
Not applicable	2	3.39

Question 6



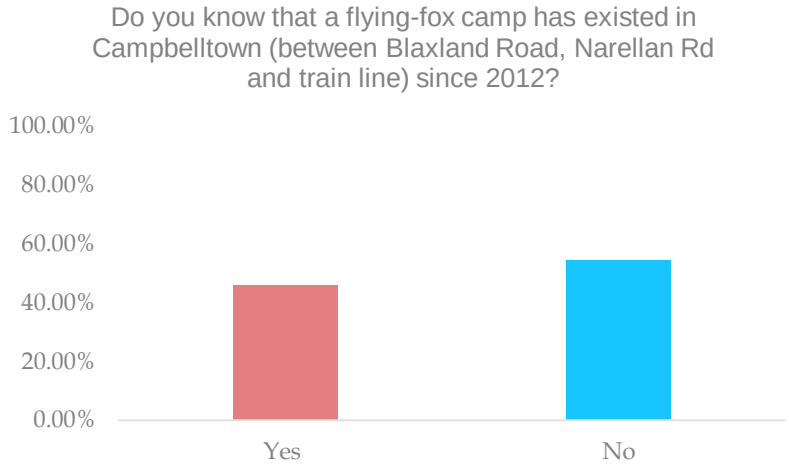
Answer	Responses	%
Yes	3	5.08
No	56	94.92

Question 7



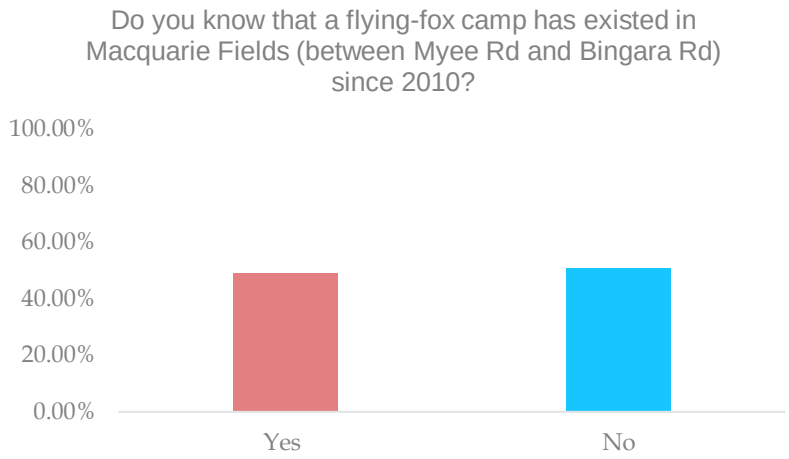
Answer	Responses	%
Yes	3	5.08
No	34	57.63
I didn't know about it	22	37.29

Question 8



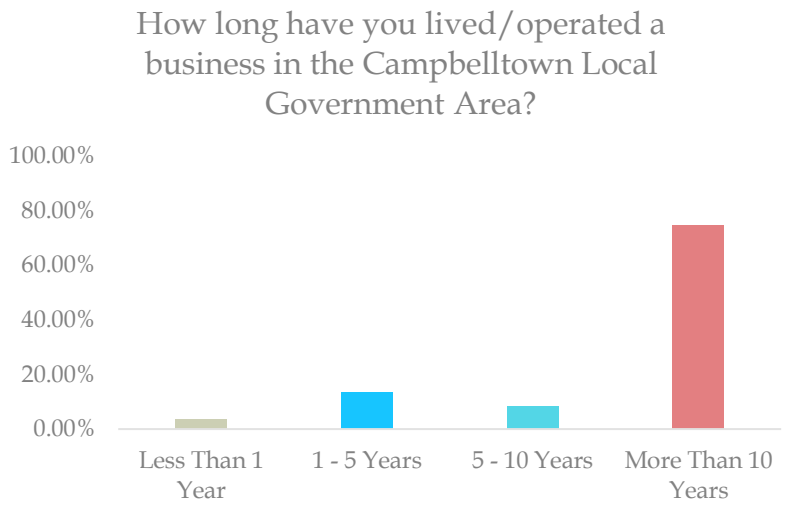
Answer	Responses	%
Yes	27	45.76
No	32	54.24

Question 9



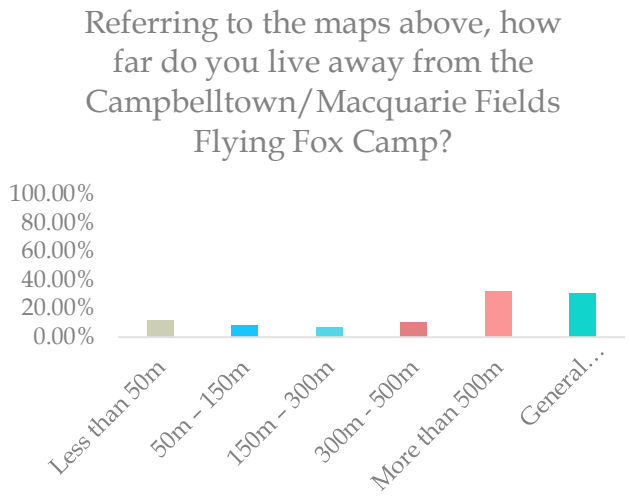
Answer	Responses	%
Yes	29	49.15
No	30	50.85

Question 10



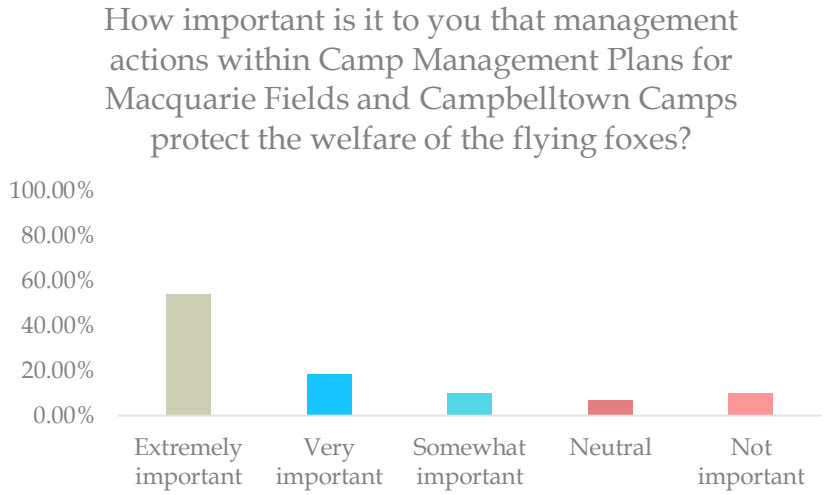
Answer	Responses	%
Less Than 1 Year	2	3.39
1 - 5 Years	8	13.56
5 - 10 Years	5	8.47
More Than 10 Years	44	74.58

Question 11



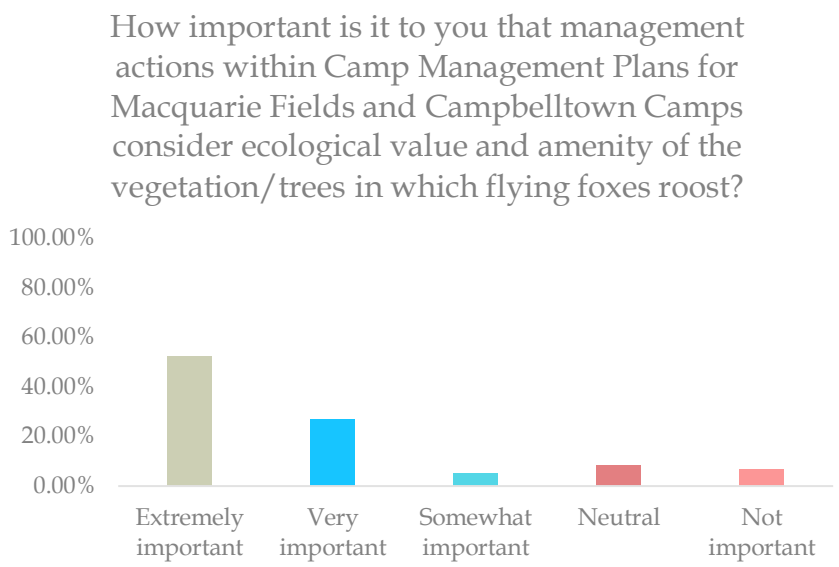
Answer	Responses	%
Less than 50m	7	11.86
50m – 150m	5	8.47
150m – 300m	4	6.78
300m - 500m	6	10.17
More than 500m	19	32.20
General resident away from Camps	18	30.51

Question 12



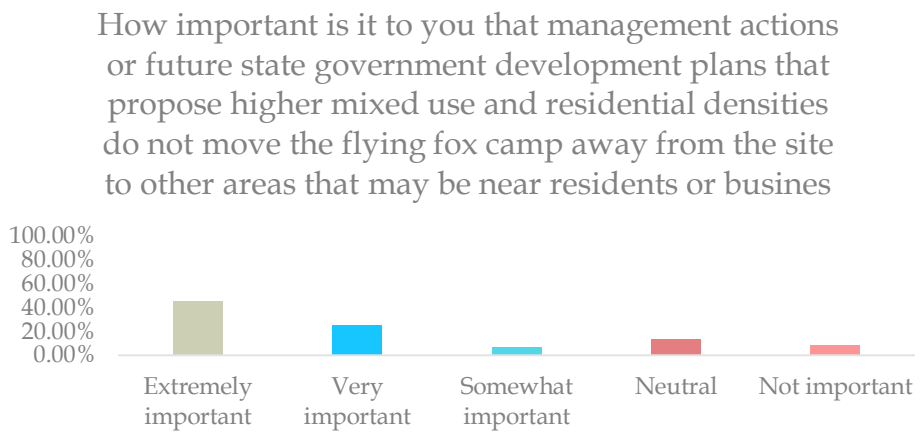
Answer	Responses	%
Extremely important	32	54.24
Very important	11	18.64
Somewhat important	6	10.17
Neutral	4	6.78
Not important	6	10.17

Question 13



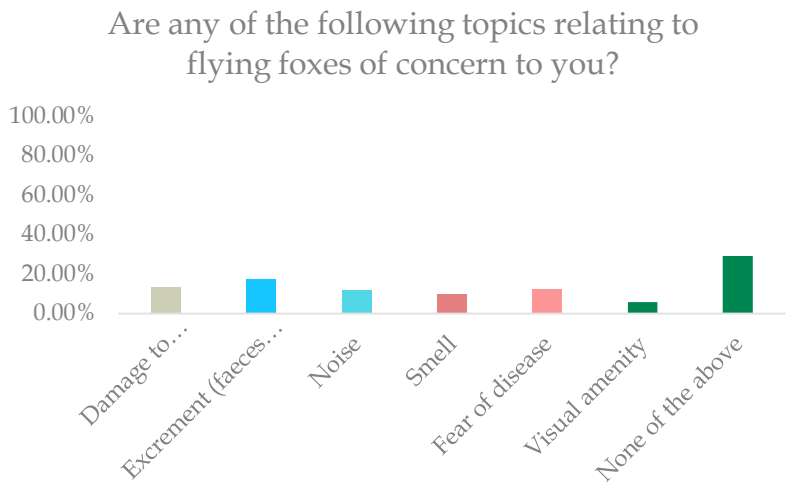
Answer	Responses	%
Extremely important	31	52.54
Very important	16	27.12
Somewhat important	3	5.08
Neutral	5	8.47
Not important	4	6.78

Question 14



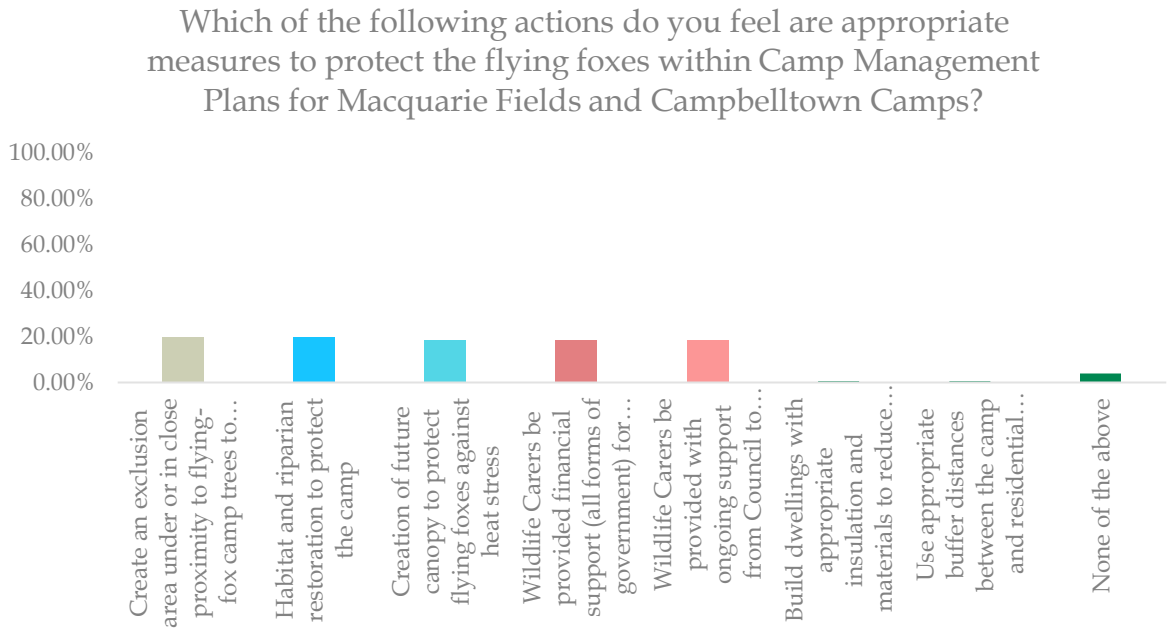
Answer	Responses	%
Extremely important	27	45.76
Very important	15	25.42
Somewhat important	4	6.78
Neutral	8	13.56
Not important	5	8.47

Question 15



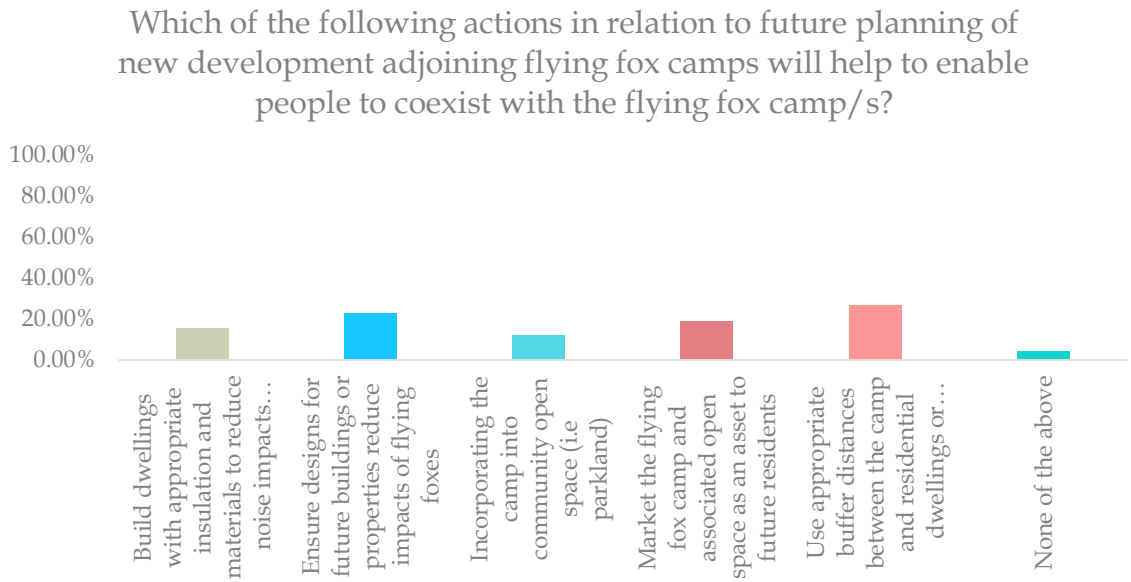
Answer	Responses	%
Damage to vegetation	16	13.33
Excrement (faeces or urine) on property	21	17.50
Noise	14	11.67
Smell	12	10.00
Fear of disease	15	12.50
Visual amenity	7	5.83
None of the above	35	29.17

Question 16



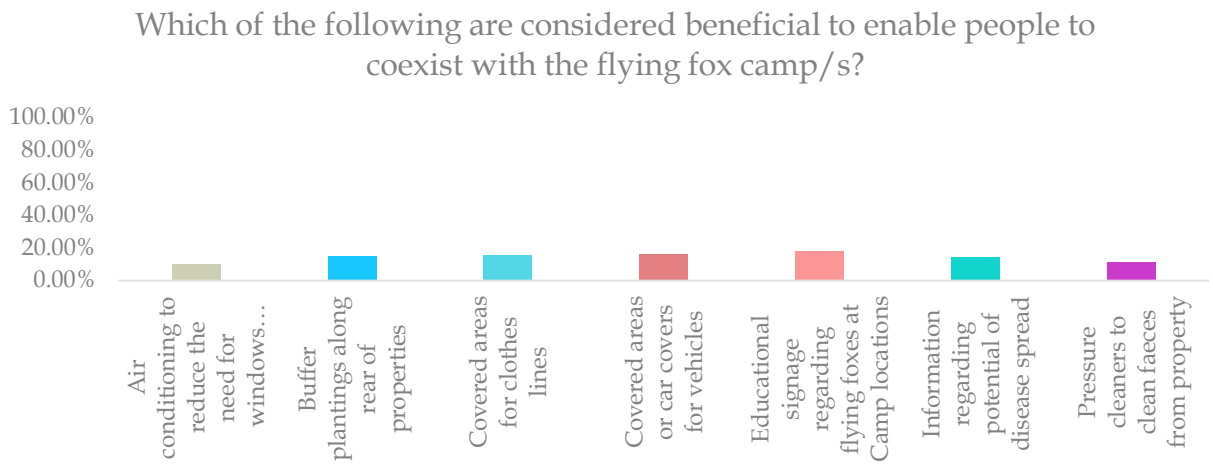
Answer	Responses	%
Create an exclusion area under or in close proximity to flying-fox camp trees to avoid unnecessary disturbance	41	19.90
Habitat and riparian restoration to protect the camp	41	19.90
Creation of future canopy to protect flying foxes against heat stress	38	18.45
Wildlife Carers be provided financial support (all forms of government) for rehabilitating sick or injured flying foxes	38	18.45
Wildlife Carers be provided with ongoing support from Council to access camps to treat sick or injured flying foxes	38	18.45
Build dwellings with appropriate insulation and materials to reduce noise impacts from bats	1	0.49
Use appropriate buffer distances between the camp and residential dwellings or offices	1	0.49
None of the above	8	3.88

Question 17



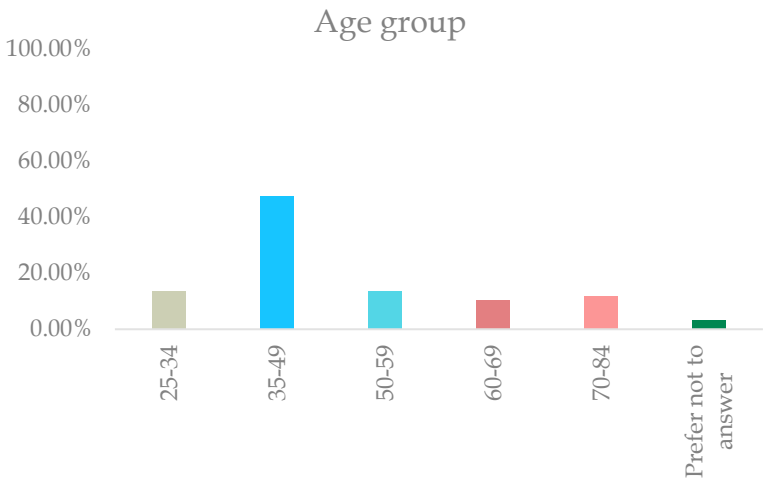
Answer	Responses	%
Build dwellings with appropriate insulation and materials to reduce noise impacts from bats	27	15.52
Ensure designs for future buildings or properties reduce impacts of flying foxes	40	22.99
Incorporating the camp into community open space (i.e parkland)	21	12.07
Market the flying fox camp and associated open space as an asset to future residents	33	18.97
Use appropriate buffer distances between the camp and residential dwellings or offices	46	26.44
None of the above	7	4.02

Question 18



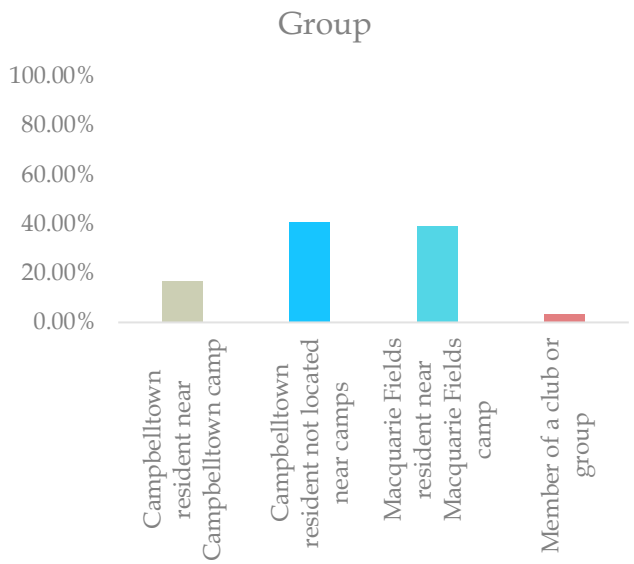
Answer	Responses	%
Air conditioning to reduce the need for windows during summer (smell and noise)	23	9.91
Buffer plantings along rear of properties	35	15.09
Covered areas for clothes lines	36	15.52
Covered areas or car covers for vehicles	37	15.95
Educational signage regarding flying foxes at Camp locations	42	18.10
Information regarding potential of disease spread	33	14.22
Pressure cleaners to clean faeces from property	26	11.21

Question 19



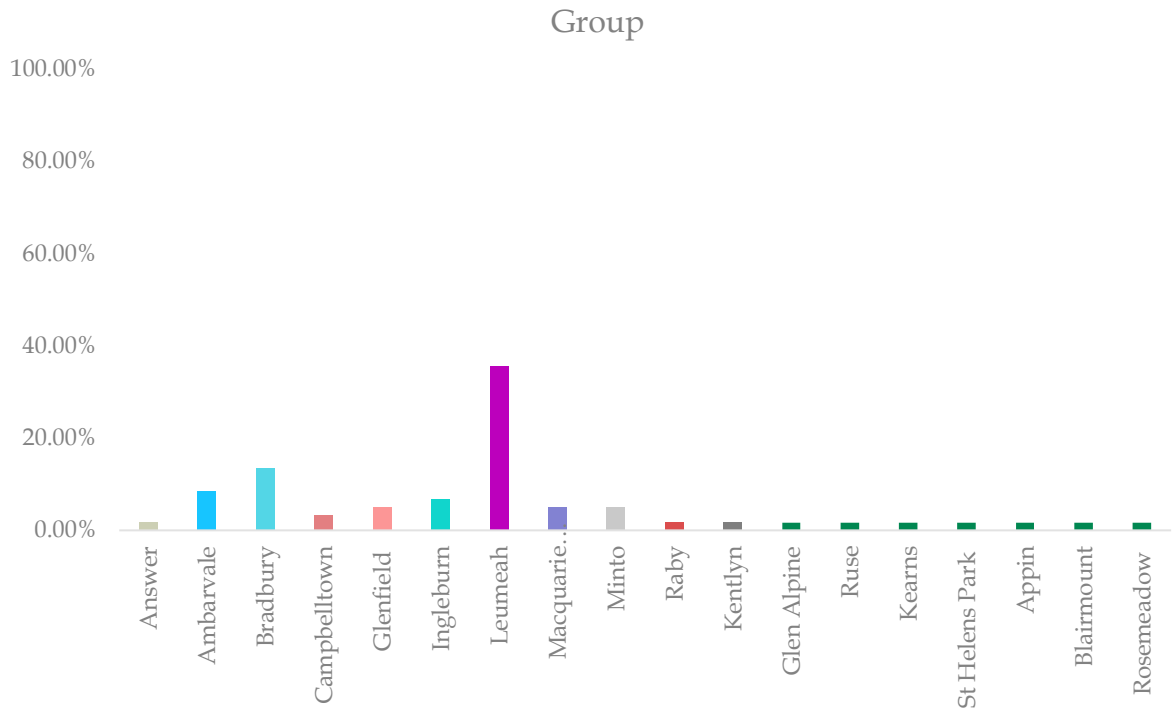
Answer	Responses	%
25-34	8	13.56
35-49	28	47.46
50-59	8	13.56
60-69	6	10.17
70-84	7	11.86
Prefer not to answer	2	3.39

Question 20



Answer	Responses	%
Campbelltown resident near Campbelltown camp	10	16.95
Campbelltown resident not located near camps	24	40.68
Macquarie Fields resident near Macquarie Fields camp	23	38.98
Member of a club or group	2	3.39

Question 21



Answer	Responses	%
Ambarvale	1	1.69
Bradbury	5	8.47
Campbelltown	8	13.56
Glenfield	2	3.39
Ingleburn	3	5.08
Leumeah	4	6.78
Macquarie Fields	21	35.59
Minto	3	5.08
Raby	3	5.08
Kentlyn	1	1.69
Glen Alpine	1	1.69
Ruse	1	1.69
Kearns	1	1.69
St Helens Park	1	1.69
Appin	1	1.69
Blairmount	1	1.69
Rosemeadow	1	1.69
Leppington	1	1.69

Is there any additional information you would like Council to know about the Macquarie Fields and Campbelltown camps that has not been captured as part of this survey?

The Campbelltown camp currently uses Bow Bowing lake at Macarthur Heights on a nightly basis as a souce of drinking water. The lake is low due to drought & no rain. The lake water levels are also being dramatically reduced due to the construction company in the area using the lake water to wet down several construction sites in the suburb. The flying foxes with suffer if there is no drinking water available.
I don't know about Macquarie Fields, but, there are no houses near the camp and there doesn't need to be any in that location. The nearby roads are already at capacity. And don't pretend that being near a train station will make a difference.
Just help them on hot days
I didnt even know we had flying fox camps until this survey
As appartment residents in Campbelltown, we don't have any problems with flying foxes. Please save the colonies.
We have a bat/flying fox that roosts in a palm tree at the back of our fence. It is not a problem for our family, we are educated on the dangers of diseases of bats/flying foxes. If we walk past it will fly away, we leave it alone but love its little sqwarks and sounds it makes.
I do have concerns with a neighbour who continually disrupts the bats during the day, banging on frypans and the fence to move them along, which of course does nothing but upset the bats. If you wish to discuss this further I am available on or email
i wish you could move them elsewhere. they are disgusting and gave killed yhe beautiful trees and scared away the beautiful birds we use to get. im sick if the shit all over my property
What are the risks of their poo in our pool and what about those impacted more than 500m from the zones?
Not sure how air conditioning to avoid opening windows, contributing to already high energy costs and usage is sustainable planning or even marketable. This can not even be combated with regulated solar panels given the potential damage from the flying foxes. Input from key stakeholders and Subject Matter Experts will be critical to the long term success of this.
I think bats get a bad rap. They're beautiful, natural, peaceful creatures. They deserve respect and care. People need to value cooexisting with nature more and be more informed and caring towards our precious native wildlife, especially since temperatures are on the rise. Our native animals need all the help and concern and care they can get. Thankyou ??
We need to educate people more and try to get them to join wildlife groups to help save these beautiful animals very hard when there's only about 5 of us in the hole of campbelltown area
Only that I love that Campbelltown has camps and I welcome them visiting my garden and am very sad about the reduced numbers due to heat stress last two years. I have really noticed the decline in numbers and feel it should be a priority to support the colonies
There is only one way to deal with pests and that is to get rid of them
The stream between the Milton Park and Myee Road Macquarie Field looks very unmanaged and looks like it has been neglected. I have seen the stream in other places such as Ingleburn and Glenfield has been properly managed and looks presentable. Stream in those places are cemented and looks very clean and odour free. But unfortunately, the stream between the Milton Park and Myee Road looks like a dumping zone. I think that if the steam is managed properly and make presentable, it will help to move the flying foxes away from that place. If that stream is made presentable, it will add value to Macquarie Fields and its beauty as a whole. I strongly request Campbelltown council to manage that stream and make it nice and presentable. There are lots of grasses growing around that area, I guess Campbelltown council need to consider doing something to improve the beauty and cleanliness of that area.
I enjoy them visiting my bottle brush trees at night during the flowering season.

Is there any additional information you would like Council to know about the Macquarie Fields and Campbelltown camps that has not been captured as part of this survey?

there is an area of weeds/plants between the flying foxes and the walking path. we fear that this is creating a habitat for snakes in order to create a home for ghff.
I live opposite the bat colony. Most recently the bats have become a nuisance. I have lived in my residence for 11 years now & the bats were not so much of a problem. There are thousands of them now, they smell & we have droppings all over the driveway, my garage door &even my front door. Since water restrictions have come into place & we are not allowed to hose hard surfaces, I would like to know how exactly we are meant to keep it clean. A bucket of water will not suffice all the mess they make. They really are becoming a huge pest & they are destroying our beautiful trees & environment.
I think we have been realistic in our observations - we do not want inner Sydney's colony
after 55years living without the colony - I find trying co-exist with the colony extremely distressful
I don't think there's so much of a worry about clotheslines - the bats are only out at night. I think the Mynah birds are more the issue for vegetation and native species in the area.
These camps re increaesing in size as they are finding any suitable trees to roost in at night
My recommendation is very simple. Eliminate the problem by eradicating them out of the area. Control their numbers by culling or totally rid the area of them. They should not be protected in residential areas.
Building in the close buffer rings around a camp should be restricted. the council should consider helping with mitigation measures to help local residents that are already in the buffer areas to cope with any issues. Council should be extremely rigorous in not allowing new buildings within close proximity of established camps in the region.
Just do your very best to give them protected and safe habitat. It's great to see Campbelltown taking an interest in its wildlife at last
There does not seem to have been anything left out.
Get rid them
A map of their most common flight path
Not at this time
How about moving the colony to an are that residents aren't close to. It's like saying to us "Ok, so you have lived in this house for years, but the bats have more rights than you". It's just so disheartening for us residents. They are everywhere. In our trees h everywhere.

Appendix 7 Camp management options analysis

Below is an overview of management options commonly used across NSW and Australia which have been considered in the development of the Plan. These are categorised as Level 1, 2 or 3 in accordance with the Policy.

Level 1 actions: routine camp management

Education and awareness programs

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

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

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

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

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

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

An education program may include components shown in Figure 12.

Figure 12 Possible components of an education program

Property modification without subsidies

The managers of land on which a flying-fox camp is located would promote or encourage the adoption of certain actions on properties adjacent to or near the camp to minimise impacts from roosting and foraging flying-foxes:

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. BBQs and tables) within close proximity to a camp or foraging tree to avoid contamination by flying-foxes.
- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.
- Follow horse husbandry and property management guidelines provided at the NSW Department of Primary Industries Hendra virus web page (DPI 2015a).

- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Turn off lighting at night which may assist flying-fox navigation and increase fly-over impacts.
- Consider removable covers for swimming pools and ensure working filter and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase camp noise.

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

Property modification subsidies

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

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

Service subsidies

This management option involves providing property owners with a subsidy to help manage impacts on the property and lifestyle of residents. An example service that could be subsidised is cleaning outside areas and property. Impacts will be assessed on a case-by-case basis to determine if subsidies will be provided.

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

Routine camp maintenance and operational activities

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

- removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist
- weed removal, including removal of noxious weeds under the *Biosecurity Act 2017* or species listed as undesirable by a council
- trimming of understorey vegetation
- the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals

- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or
- removal of leaf litter or other material on the ground
- flooding or drainage works
- bushfire mitigation
- rubbish removal.

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

Revegetation and land management to create alternative habitat

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

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

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

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

Protocols to manage incidents

This management option involves implementing protocols for managing incidents or situations specific to particular camps. Such protocols may include monitoring at sites within the vicinity of aged care or child care facilities, management of compatible uses such as dog walking or sites susceptible to heat stress incidents (when the camp is subjected to extremely high temperatures leading to flying-foxes changing their behaviour and/or dying).

Participation in research

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

Appropriate land-use planning

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

Do nothing

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

Level 2 actions: in-situ management

Buffers

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

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

The Campbelltown camp exists in a relatively narrow strip of vegetation in an urban area and therefore it is necessary to devise a suitable buffer distance that maintains the ecological and amenity values of the vegetation. This requires consideration of the approximate total area of the camp, and whether there is an equivalent replacement area available in an appropriate nearby location for displaced flying-foxes.

Previous studies have recommended that vegetation buffers consisting of habitat not used by flying-foxes, should be 300 m or as wide as the site allows to mitigate amenity impacts for a community (SEQ Catchments 2012). Buffers need to take into consideration the variability of use of a camp site by flying-foxes within and across years, including large, seasonal influxes of flying-foxes. The usefulness of a buffer declines if the flying-fox camp is within 50 m of human habitation.

Buffers through vegetation removal

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

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

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

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

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

Buffers without vegetation removal

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

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

Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012) and balloons (Ecosure, pers. comm.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. Potential for litter pollution should be considered and managed when selecting the type and placement of visual deterrents. In the absence of effective maintenance, this option could potentially lead to an increase in rubbish in the natural environment.

- Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. This is also likely to be disruptive to nearby residents.
- Smell deterrents – For example, bagged python excrement hung in trees has previously had a localised effect (GeoLINK 2012). The smell of certain deterrents may also impact nearby residents, and there is potential for flying-foxes to habituate.
- Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and current trials in Queensland are showing promise for keeping flying-foxes out of designated buffer zones. This option can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Design and use of sprinklers need to be considerate of animal welfare and

features of the site. For example, misting may increase humidity and exacerbate HSEs, and overuse may impact other environmental values of the site.

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

Noise attenuation fencing

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

Level 3 actions: disturbance or dispersal

Nudging

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

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

Dispersal

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

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

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

- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

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

Passive dispersal

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

Generally, a significant proportion of vegetation needs to be removed in order to achieve dispersal of flying-foxes from a camp or to prevent camp re-establishment. For example, flying-foxes abandoned a camp in Bundall, Queensland once 70% of the canopy/mid-storey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important camps (Appendix 2) sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

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

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

Active dispersal through disturbance

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

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

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

Early dispersal before a camp is established at a new location

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

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

Maintenance dispersal

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

Unlawful activities

Culling

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

Blank Page

Blank Page

CAMPBELLTOWN

campbelltown.nsw.gov.au
T 02 4645 4000
E council@campbelltown.nsw.gov.au