ecosure

Cabramatta Creek Flying-fox Camp Management Plan

Final
October 2018

Liverpool City Council and Fairfield City Council

ecology / vegetation / wildlife / aquatic ecology / GIS

Acknowledgements

Fairfield City Council and Liverpool City Council would like to thank everyone who participated in community consultation, with all comments considered in the development of this Plan and incorporated where possible. Fairfield City Council and Liverpool City Council would like to acknowledge the provision of flying-fox monitoring data from New South Wales Office of Environment and Heritage collected as part of the National Flying-fox Monitoring Program.

We also recognise input by the New South Wales Office of Environment and Heritage to the draft Plan, in developing the template upon which this Camp Management Plan is based, and Dr Peggy Eby who provided advice which was included in the template.

Acronyms and abbreviations

ABLV	Australian bat lyssavirus
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BFF	Black flying-fox (*Pteropus alecto*)
the camp	Cabramatta Creek flying-fox camp
CCFFC	Cabramatta Creek Flying-fox Committee
Council	both Fairfield City Council and Liverpool City Council
DoEE	Department of the Environment and Energy (Commonwealth)
DPI	Department of Primary Industries (NSW)
E	Endangered
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FCC	Fairfield City Council
GHFF	Grey-headed flying-fox (*Pteropus poliocephalus*)
the Guideline	Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015
HeV	Hendra virus
LCC	Liverpool City Council
LEP	Local Environmental Plan
LGA	Local government area
LGNSW	Local Government 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)
OEH	Office of Environment and Heritage (NSW)
PEPs	Protection of the environment policies
the Plan	this Camp Management Plan
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
the Policy	Flying-fox Camp Management Policy 2015
SEPPs	State Environmental Planning Policies
TEC	Threatened ecological community
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
V	Vulnerable

Contents

List of figures

List of tables

1 Introduction

The Cabramatta Creek flying-fox camp is situated on land at the border of Fairfield City Council (FCC) and Liverpool City Council (LCC). The Cabramatta Creek Camp Management Plan (the Plan) has been developed as a joint Plan for FCC and LCC to provide a framework to conserve the camp, preserve environmental conditions at the site, and to manage community conflict should it arise. 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).

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.

The Cabramatta Creek flying-fox camp (the camp) is occupied by GHFF (Figure 1). Anecdotal accounts exist of the LRFF utilising the camp, however BFF are not known to have used the site to date.

Further detail of relevant legislation and policies related to flying-foxes is provided in Section 3. A description of flying-fox ecology, species profiles and roost characteristics is provided in Appendix 1.

Figure 1 Grey-headed flying-fox

1.1 Objectives

The objectives of the Plan are to:

- ensure management activities are consistent with legislative responsibilities, including the NSW Flying-fox Camp Management Policy (OEH 2015)
- ensure the conservation and long-term sustainability of the camp
- minimise the potential for the camp to negatively impact on surrounding residents and public using adjoining public open space
- improve environmental conditions at the site.

2 Context

2.1 Camp description

The camp is located on the border of FCC and LCC local government areas (LGAs) in the suburbs of Cabramatta and Warwick Farm along Cabramatta Creek, a tributary of the Georges River. The camp extent at 4 April 2018 is shown in Figure 2 and tenures provided in Table 1. The camp is bordered by playing fields to the south and west, with residential area, disused tennis courts and the Warwick Hotel carpark to the north and east.

Table 1 Cabramatta camp tenures

Area	Size	Tenure	Lot and DP	Zoned
Jacquie Osmond Reserve	~3.5 ha	Liverpool City Council	Lot 2/DP250138	RE1 Public Recreation
Flying-fox Reserve	2.8 ha	Fairfield City Council	Lot 3/DP617315	E2 Environmental Conservation
Small portion of parcel behind tennis courts	~0.1 ha	Private	Lot 2/DP617315	E2 Environmental Conservation SP3 Tourist

The site was believed to be a significant maternity colony (DECC 2008). Mainly males and sub-adult flying-foxes were observed during a site assessment in April 2018 (approximately 1200 total count) which may be contributing to the camp's resilience during recent heat stress events (HSE) (T Johnson pers. comm. April 2018). Given the birthing and rearing season occurs during spring and summer the most vulnerable demographic group during HSE is nursing mothers, because of the heat they retain through clustering with their offspring and their increased metabolic rates associated with lactation. Nursing females and their young are also more prone to heat stress because they spend more time fanning and therefore less time resting if there are continual days of high temperatures. Furthermore, juveniles have a lower thermoregulatory capacity (Bartholomew et al. 1964) which makes them the next most vulnerable demographic.

According to the EPBC Act Policy definition of a Nationally Important camp, Cabramatta camp does not meet the criteria of being occupied by more than 2500 GHFF permanently or seasonally every year for the last ten years. Five threatened species are known to occur or have been recorded within 1 km of Cabramatta camp (Table 2) (Figure 3). (Assessments for ecological values around the camp have excluded marine and migratory species).

Sensitive receptors within 1 km of the camp extent and within 13 km for aerodromes are provided in Table 3 and Figure 4. Although not considered to be a high risk category, the residential area closest to the camp exists to the north along Liverpool Street. It is recommended buffers greater than 300 m will fully mitigate amenity impacts for a community (SEQ Catchments 2012) and a buffer's usefulness declines if the camp is within 50 m of human habitation (Appendix 5). Residents in Liverpool Street are approximately 300 m from the centre of the camp and 150 m from the edge of the maximum known camp extent (Figure 4) indicating that nearby homes are sufficiently shielded from potential flying-fox impacts by the vegetation within the Reserve.

Table 2 Threatened species known to occur or recorded within 1 km of Cabramatta camp

Protection level	Source	Category	Values/significance	Details
Federal	NFFMP (DoEE 2018)	Nationally important camp	See definition Section 3.3.1	Site does not meet criteria
	Protected Matters (DoEE 2018)	Threatened species	Regent honeyeater (*Anthochaera phrygia*) (CE) Koala (*Phascolarctos cinereus*) (V) Downy wattle (*Acacia pubescens*) (V)	3 species (2 birds, 1 mammal) known to occur within the area (SPRAT data not mapped)
State	Bionet (OEH 2018)	Threatened species	Downy wattle (*Acacia pubescens*) (V) White-bellied sea-eagle (*Haliaeetus leucogaster*) (V) Powerful owl (*Ninox strenua*) (V)	3 species (2 birds, 1 plant) have been recorded within 1 km of camp (Figure 3)

Table 3 Sensitive receptors within 1 km (13 km for aerodromes/helipads) from the camp

Sensitive receptor	Distance from camp extent
Warwick Farm Racecourse	220 m
Lansdowne Nursing Home	648 m
Vattana Early Learning Centre	727 m
Cabramatta High School	970 m
Liverpool hospital helipad	1817 m
Bankstown airport	3970 m

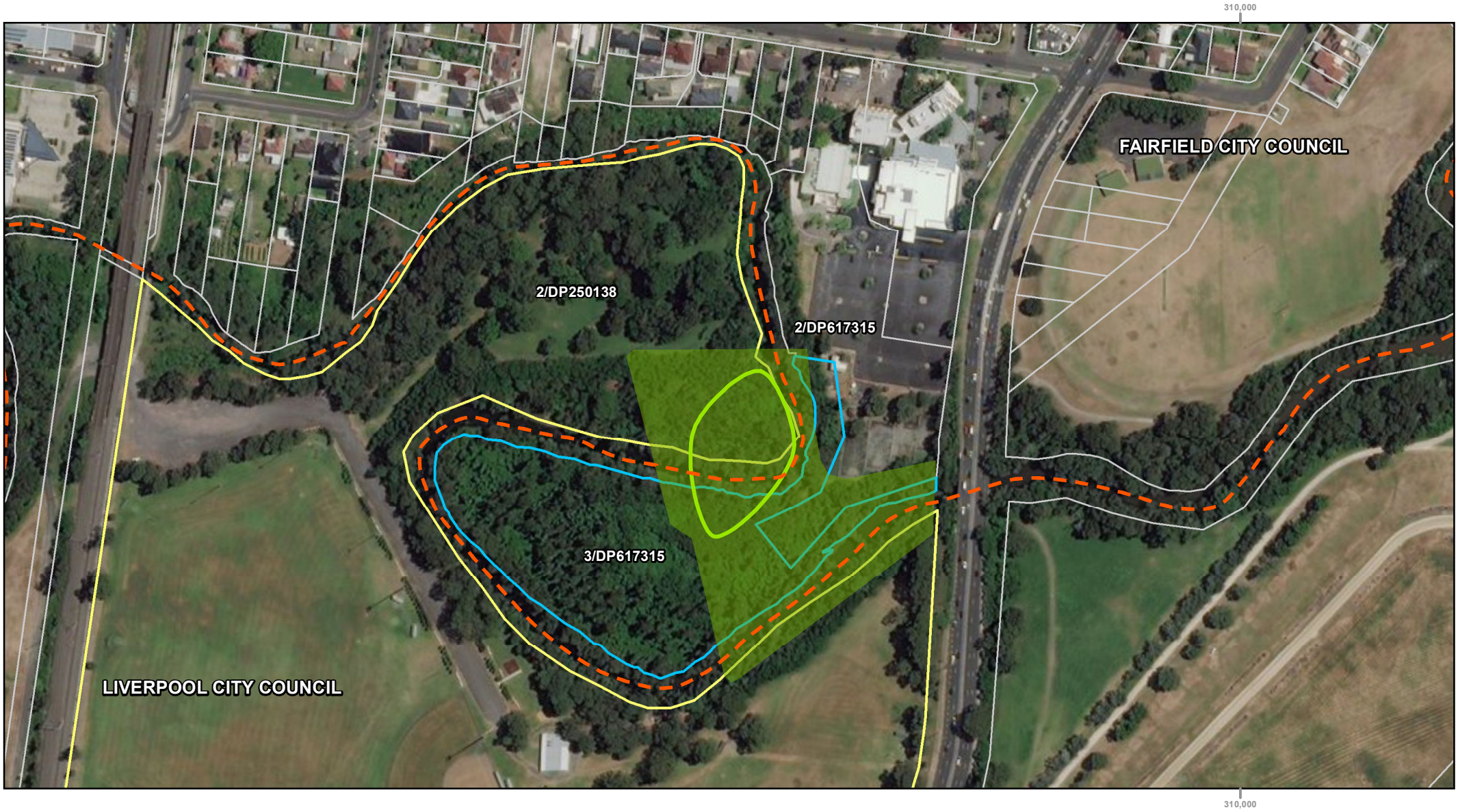


Figure 4: Camp extent (April 2018)

Liverpool City Council

Cabramatta Creek Camp Management Plan

Maximum known camp extent
Current camp extent
Flying-fox Reserve
Jacquie Osmond Reserve
LGA
Property boundary

ecosure

Job number: PR3277
Revision: 0
Author: KF
Date: 24/05/2018

0 50 100 200
Metres

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

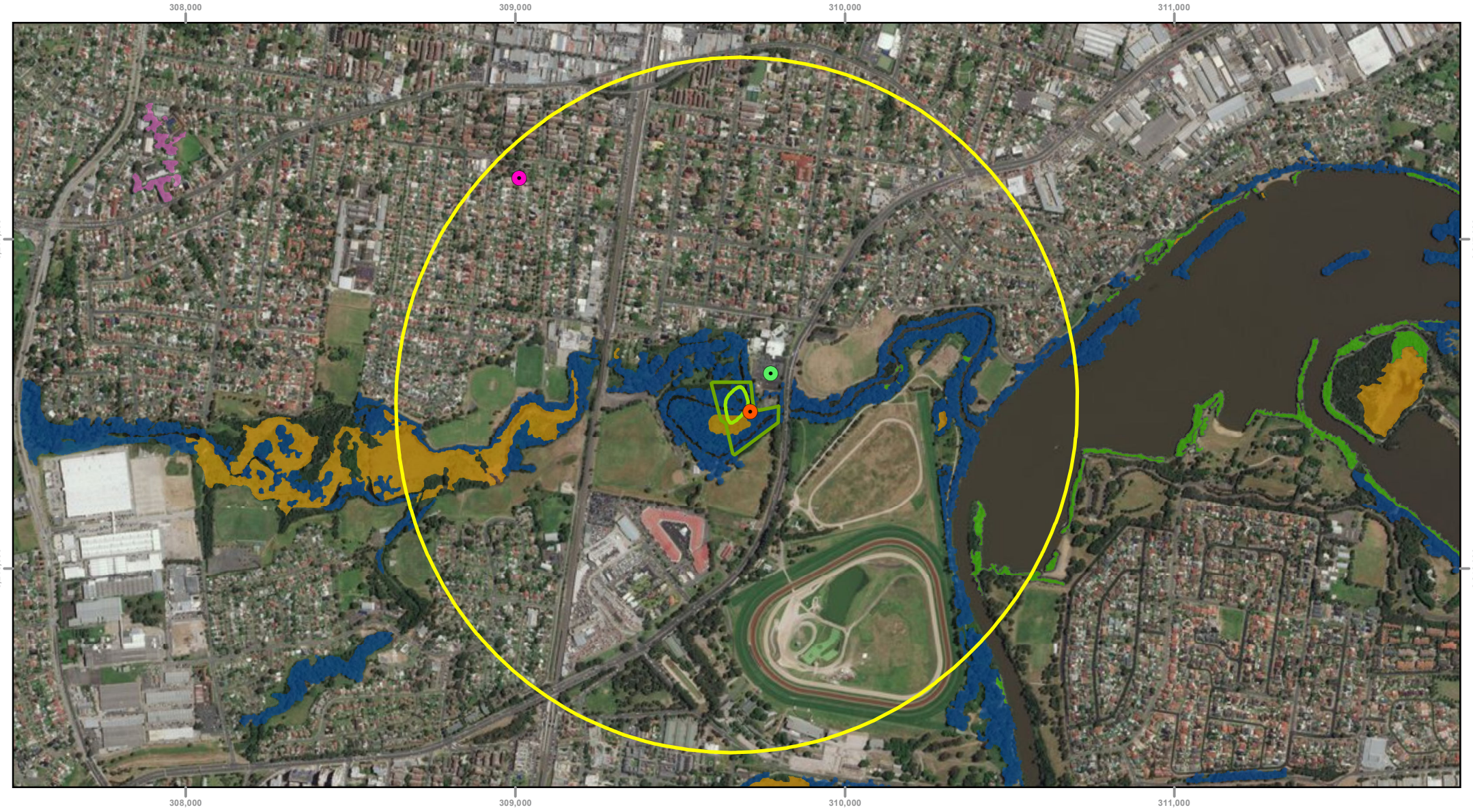


Figure 3: Threatened Ecological Communities (TEC) and Bionet species records

Liverpool City Council

Cabramatta Creek Camp Management Plan

Current camp extent

Maximum known camp extent

1 km buffer

Bionet EVNT record

- *Acacia pubescens*
- *Haliaeetus leucogaster*
- *Ninox strenua*

TEC

- Swamp Oak Floodplains
- River Flat Eucalypt Forest
- Shale Gravel Transition Forest
- Swamp Oak Floodplain Forest

ecosure

Job number: PR3277
Revision: 0
Author: KF
Date: 24/05/2018

0 250 500 1,000
Metres

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

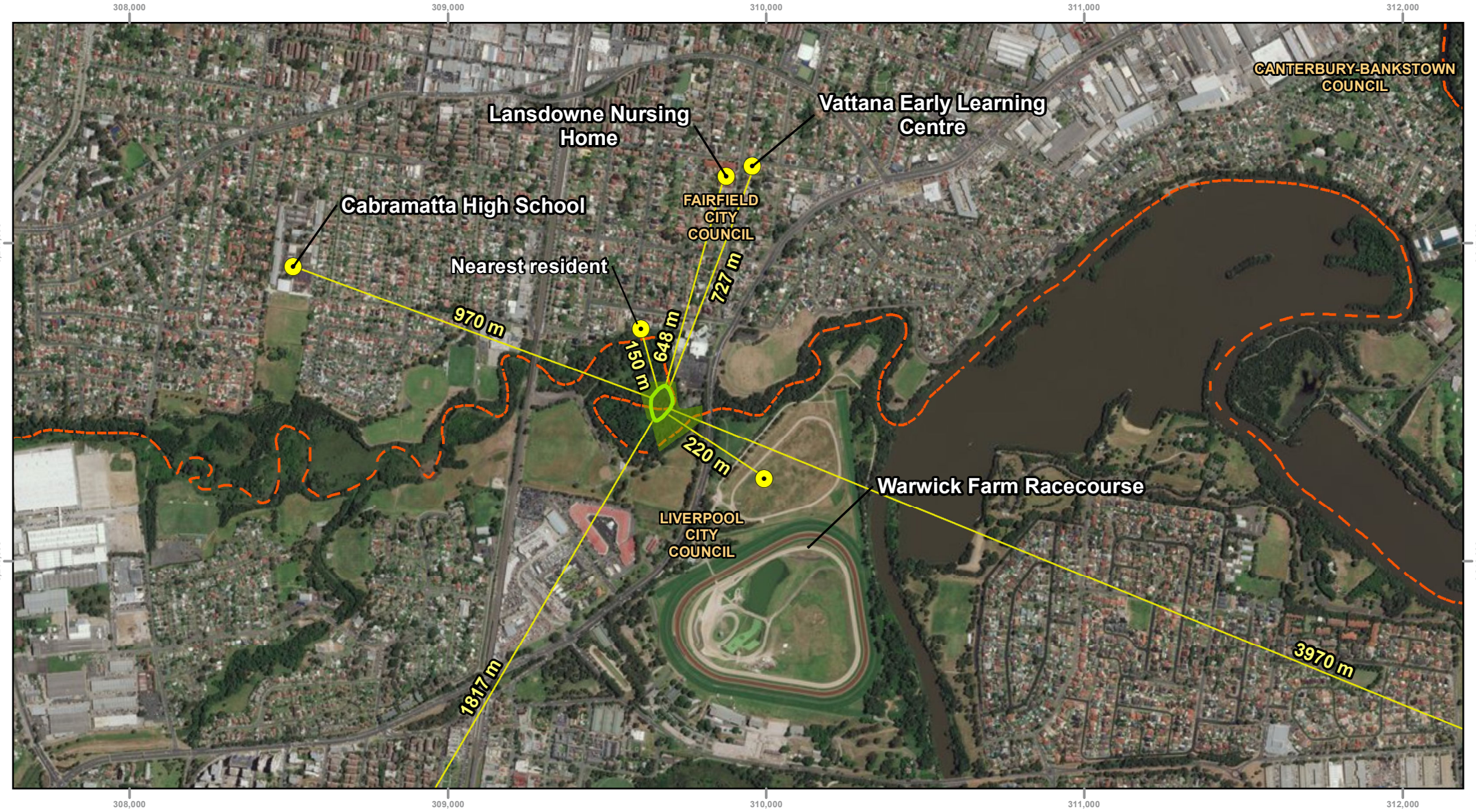


Figure 4: Sensitive receptors and nearest residents

Liverpool City Council

Cabramatta Creek Camp Management Plan

- Sensitive receptors
- Current camp extent
- Maximum known camp extent
- LGA

ecosure

Job number: PR3277
Revision: 0
Author: KF
Date: 25/05/2018

0 250 500 1,000
Metres

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

PR3277_MPX_SR
A4

The site is located on the Cumberland Plain with vegetation communities comprising two severely degraded remnants of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest (FCC 2001) (DECC 2008) (Figure 3). River Sheoak (*Casuarina glauca*) dominates the creek banks and with *Eucalyptus moluccana* and *E. tereticornis* existing on well drained soils. Other canopy species on the site such as blue box (*Eucalyptus baueriana)* Grey Myrtle (*Backhousia myrtifolia*) and black wattle *(Acacia parramattensis*) exist in areas that have undergone restoration. Flying-foxes are primarily roosting in casuarina (Figure 6) and broad-leaved privet (*Ligustrum lucidum*) (Figure 7).

Figure 6 Flying-foxes in casuarina

Figure 7 Flying-foxes roosting in privet

Figure 5 Weeds smothering native vegetation at the camp

The site is highly degraded and infested with numerous weed species, particularly Madeira vine (*Anredera cordifolia*), morning glory (*Ipomoea indica*), lantana (*Lantana camera*), and broad-leafed privet (Figure 5). The soil seed bank is also dominated by weeds (T. Johnson FCC pers. comm. 2018). The site is regularly inundated from upstream with rubbish occurring throughout the site. Concrete and old metal from previous land uses also litter the site.

2.2 History of the camp

First recorded in 1890, the camp is one of the oldest known flying-fox camps in Australia (FCC 2001). The land was first purchased by the Ireland family in the 1930s and cleared for its fertile alluvial soils to grow grapes. Figure 8 shows an aerial image of the site in 1943.

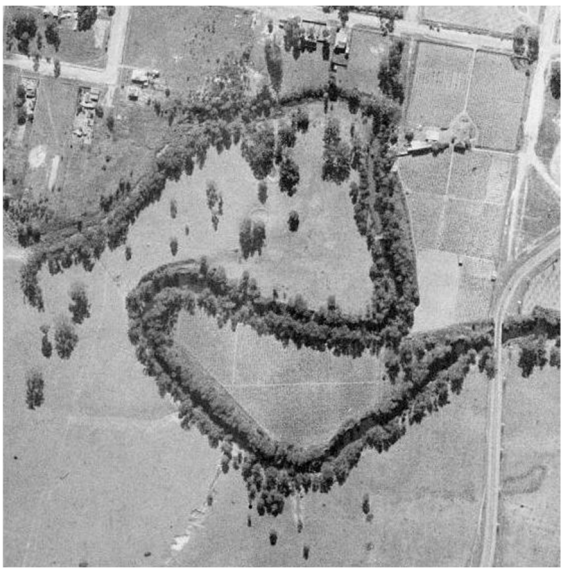


Figure 8 Cabramatta Creek camp site 1943 (Source: NSW Government SIX maps)

FCC purchased the land on the northern side of the creek in 1984. Cabramatta Creek Flying-fox Committee (CCFFC) was formed in 1995 to care for and monitor the reserve and colony (FCC 2001). The group dedicated hundreds of hours of voluntary time each year to habitat restoration but ceased activity in 2017.

The camp is usually occupied from September to April with either low to no flying-foxes in the winter months. The camp has recorded a maximum of 30,000 individuals (FCC 2001). Since quarterly monitoring began in 2012 as part of the National Flying-fox Monitoring Program (NFFMP) the maximum number recorded was 14,000 in February 2015 (Figure 9). Despite reports of LRFF using the camp (FCC 2001), none have been recorded since the NFFMP began.

During days where temperatures exceeded 44ºC, the CCFFC and other wildlife care organisations have previously implemented water spraying practices and first aid by trained wildlife carers with the aim of helping flying-foxes cool down, hydrate and reduce mortality (DECC 2008).

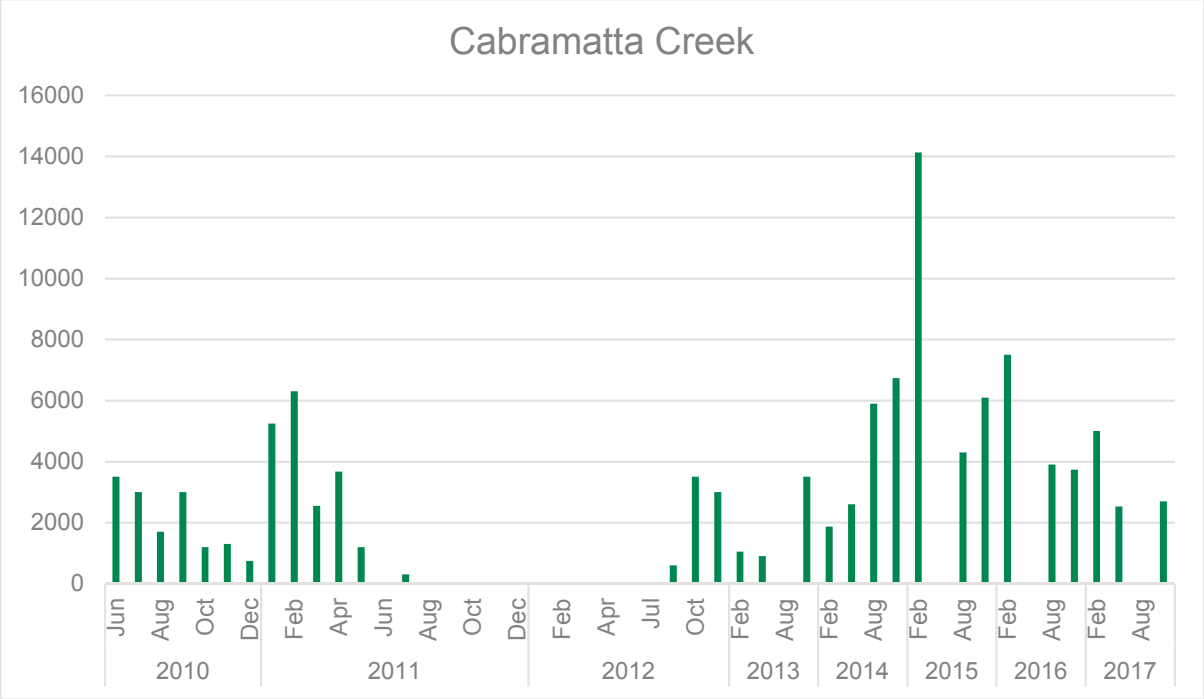


Figure 9 Cabramatta Creek flying-fox monitoring data since November 2010 (source: OEH Master Data – NSW NFFMP; Royal Botanic Gardens 2017).

2.3 Reported impacts related to the camp

In general, very few negative impacts associated with the Cabramatta Creek camp have been reported from the community. During the online survey period, the majority of impacts reported were related to foraging flying-foxes; noise at night, droppings and excrement in pools, on washing and outdoor areas. Education programs can provide an understanding of the difference between roosting and foraging flying-foxes and, that noise at night is likely to be associated with foraging flying-foxes. Flying-foxes can travel up to 100 km a night in search of food, therefore foraging flying-foxes may also come from camps other than Cabramatta Creek.

There was also some concern for potential diseases (e.g. Australia Bat Lyssa Virus (ABLV), Hendra virus) (see Appendix 2 for human health and flying-fox disease). Education programs should seek to include information regarding disease, including that the incidence of ABLV is extremely low in flying-foxes.

Impacts within the camp are mainly related to weed invasion smothering the canopy and year-round roosting breaking and stripping the existing canopy trees, causing flying-foxes to roost in the privet. This site's characteristics make it particularly challenging for restoration due to its regular inundation. Weed removal must be staged and considerate of flying-fox habitat requirements, ensuring microclimate, vegetation structure, roost space and protection from HSE are preserved. Weed control will also increase the risk of fire due to the dry organic matter left as potential fuel.

Flying-foxes at this camp can be easily disturbed by human presence; flying-fox welfare should be considered (Appendix 3) when undertaking vegetation management / restoration in the camp.

2.4 Management response to date

Previous management plans for the camp have included:

- Flying-fox Reserve Plan of Management (FCC 1996)
- Cabramatta Creek Flying-fox Reserve Action Plan (Urban Bushland Management Consultants 1997)
- Flying-fox Reserve Cabramatta Plan of Management (FCC 2001).

The 2001 Plan of Management identified opportunities to promote the historical, educational and scientific values of the site and the colony to the community including *providing improved facilities including but not limited to a viewing platform with enhanced interpretation and signage to allow visitors to view the flying-foxes and learn more about them* (FCC 2001) (Figure 10).

Figure 10 Flying-fox viewing platform

Previous actions from the 2001 Plan included:

- *Improve access and linkages with areas of open space such as pedestrian/cycle path or walking track along the creek as appropriate (including improved linkages between the Flying-fox Reserve and Jacquie Osmond Reserve). Enhance the linkages along the creek and improve access to water.*
- *Scientific study of the colony and monitoring the effects of the weed removal and revegetation works and increased numbers of people visiting the site.*
- *Manage the creek on a catchment basis considering upstream and downstream impacts.*

Previous vegetation management has been deliberate in maintaining a buffer between the camp and nearby residents by not planting roost trees along the edges of Cabramatta Creek; instead planting dense mid-storey shrubs to discourage flying-foxes and to provide a sound barrier to reduce noise levels and minimise odour (DECC 2008).

During the site assessment, entry to the viewing platform and the directional signs was obscured by vegetation (Figure 11). With the addition of a warning site at the entrance (Figure 12), it is not clear whether the public are welcome or safe to access the site. Improving accessibility to the camp, and linkages with Jacquie Osmond Reserve, could either lead to increased antisocial activity (e.g. graffiti, vandalism, illegal camps) (A Gilchrist LCC pers. comm. April 2018), or may improve public surveillance due to increased pedestrian traffic.

Figure 11 Entry to viewing platform

Both FCC and LCC (from herein referred to as Council) have also installed various signs throughout the camp on both sides of the creek that aim to promote the site, increase awareness and improve visitor experience (FCC 2001) (Figure 12). Resourcing is required to maintain these assets.

Figure 12 Flying-fox signage around the camp

Management actions including weed control, revegetation and restoration within the Flying-fox Reserve and Jacquie Osmond Reserve has been ongoing by Council staff and sub-contractors (Figure 13). Maintenance activities such as mowing that disturb flying-foxes are ceased during the birthing period and while flightless young are present.

Figure 13 Restoration work sites in and around the camp

2.5 Stakeholders

There are a range of stakeholders who could be directly or indirectly affected by management of flying-foxes at Cabramatta Creek, or who are interested in its management. Stakeholders include those shown in Table 4.

During April 2018, the community was consulted as part of the development of this Plan; results are provided in Appendix 4. Results of this consultation were used to inform the Plan.

Table 4 Stakeholders of Cabramatta Creek camp

Stakeholder group	Stakeholder	Interest/reported impacts
Community	Residents and business owners	Residents living near the camp may experience impacts associated with foraging flying-foxes. Homeless people were observed camping in three locations on both sides of Cabramatta Creek.
	Indigenous community	Traditional owners have a general interest in flying-foxes, including the ecological services they provide and the potential for sustainable harvesting for food or medicinal purposes.
	Horse owners and managers (e.g. Warwick farm racecourse)	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 raiding orchards and should have access to safe-netting guidelines.
	Hospitals	Any helicopter operator associated with Liverpool hospital should be made aware of flying-foxes in the area and follow risk mitigation measures (especially during dusk or dawn operations).
	Bankstown Airport	Airport managers have a responsibility to reduce the risk of wildlife-aircraft strike, as do land managers within 13 km of an aerodrome. Bankstown Airport is located 2.8 km to the west of the camp and should be consulted regarding any management that may influence flying-fox movements or behaviour.
Government	Fairfield City Council	Council is responsible for administering local laws, plans and policies, and appropriately managing assets (including land) for which it is responsible.
	Liverpool City Council	Council is responsible for administering local laws, plans and policies, and appropriately managing assets (including land) for which it is responsible.
	Office of Environment and Heritage	OEH 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 (DoEE)	DoEE is responsible for administering federal legislation relating to matters of national environmental significance, such as the grey-headed flying-fox which roosts at Cabramatta Creek.
	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 and conservation organisations have an interest in flying-fox welfare and conservation of flying-foxes and their habitat. (CCFFC now disbanded)
	Researchers/universities/CSIRO	Researchers have an interest in flying-fox behaviour, biology and conservation.

3 Legislation

The following statutes, plans or policies are relevant to managing flying-foxes or their habitat.

3.1 Local

3.1.1 Liverpool City Council

The site is zoned RE1 Public Recreation and Environmentally Significant Land within the Liverpool Local Environmental Plan 2008. One of the core objectives of the Biodiversity Management Plan 2012 (LCC) is to: *Maintain, protect, enhance and restore naturally occurring ecosystems, populations and species within Liverpool LGA, based on best practice biodiversity principles so that threats to listed species, populations and communities and their habitats are reduced* (2012:10).

3.1.2 Fairfield City Council

The site is zoned 'E2 Environmental Conservation' within the Fairfield Local Environmental Plan 2013 with the objective *to protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values* and *to prevent development that could destroy, damage or otherwise have an adverse effect on those values.* Fairfield Biodiversity Strategy 2012 (FCC) aims to *provide for the conservation of native plants, animals, habitat and ecological process in Fairfield City* (2012:4).

3.2 State

3.2.1 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 OEH 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.

3.2.2 Draft Code of Practice Authorising Flying-fox Camp Management Actions 2018

The objectives of this draft code aim to enable camp management actions on public land near human settlements in a way that has minimal impact on biodiversity values and avoids harm to flying-foxes or their habitat, while streamlining the approvals process.

Part 3 of the Draft Code of Practice provides recommendations for the manner of carrying out camp management actions including but not limited to: *Trees must not be felled, lopped or have large branches removed when flying-foxes are in or within 20 metres of the tree and likely to be harmed*.

3.2.3 *Biodiversity Conservation Act 2016*

The purpose of the *Biodiversity Conservation Act 2016* (BC Act) is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development including conserving biodiversity, maintaining the diversity and quality of ecosystems, regulating human interactions with wildlife, and supporting conservation and threat abatement action to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature.

The Grey-headed Flying-fox is listed as a threatened species under the BC Act.

Part 2 Division 3 of the BC Act provides for the issuing of Biodiversity Conservation Licences to authorise the doing of an act likely to result in one or more of the following:

a. harm or attempted harm to any animal that is of a threatened species or is part of threatened ecological community
b. harm or attempted harm, dealing in, or liberating a protected animal
c. the picking of any plant that is of a threatened species or is part of threatened ecological community
d. picking or dealing in protected plants
e. damage to declared areas of outstanding biodiversity value
f. damage to any habitat of a threatened species or threatened ecological community.

Part 7 of the BC Act provides for the biodiversity assessment and approvals required under the *Environmental Planning and Assessment Act 1979* for development other than complying development, activities and state significant development and infrastructure.

An assessment of impacts is required for any threatened species or threatened ecological community, or their habitats, that are likely to be harmed by the doing of an act proposed in the Plan.

Note: that the definition of 'harm' includes kill, injure or capture the animal, but does not include harm by changing the habitat of the animal, and attempt to harm an animal includes hunting or pursuing, or using anything, for the purpose of harming the animal. The definition of 'pick' includes to gather, take, cut, remove from the ground, destroy, poison, crush or injure the plant or any part of the plant. The definition of habitat includes an area periodically or occasionally occupied by a species or ecological community and the biotic and abiotic components of an area 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.

3.2.4 *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.

3.2.5 *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 Appendix 3 will ensure compliance with this Act.

3.2.6 *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 and Environment.

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

Development given consent under Part 4 or activities assessed under Part 5 of the EP&A Act do not require licensing under the BC Act. Consent and determining authorities are required to consider the impacts of such proposals on threatened species, threatened ecological communities, and their habitats in accordance with Part 7 of the BC Act.

Where development consent under Part 4 or assessment under Part 5 of the EP&A Act is not required, a licence under the BC Act may be required to authorise the doing of an act that harms protected animals, threatened species, or threatened ecological community, or which damages the habitat of a threatened species or ecological community. This includes the doing of an act likely to harm any flying fox or damaging the habitat of grey-headed flying-foxes.

Where a proposal to manage a flying-fox camp involves the cutting down, destruction, lopping or removal of a substantial part of a tree or other vegetation that is not covered by a development consent or assessment under Part 5 it may still require authorisation. Depending on the land on which the vegetation occurs and the character of the vegetation, it may require an approval or a permit under the State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 or an approval under the Local Land Services Act 2013.

Where flying-fox camps occur or impact on private land, private land owners are advised to contact their local council to explore management options and the appropriate approval

processes for addressing arising issues.

3.2.7 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 State Environmental Planning Policy (Vegetation in Non-Rural Areas) applies to their proposal, and if any approvals under the BC Act.

3.3 Commonwealth

3.3.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the Commonwealth DoE 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. DoE 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, DoE 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 DoEE will be required.

Mitigation standards

The action must not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.

The action must not occur during or immediately after climatic extremes (heat stress event, 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 make an assessment of the relevant conditions and advise the proponent whether the activity can go ahead consistent with these standards.

The action must not involve the clearing of all vegetation supporting a nationally-important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

These standards have been incorporated into mitigation measures detailed in Appendix 3. If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

4 Planned management approach

An analysis of the camp management options available to Council and the suitability of implementing those options at Cabramatta Creek Camp is provided in Appendix 5. The management options to be adopted or investigated further by Council in this five year Plan are described below and outlined in Table 6 and Figure 14.

The proposed management approach also considers community responses received during community engagement. While some impacts associated with foraging flying-foxes were reported, the camp's current location appears to be appropriate because of the low impacts received in the immediate surrounds. The open space and vegetation surrounding Cabramatta Camp provide the community with sufficient buffers. Moving this camp, or a newly formed camp, could create greater conflict with the community.

The community indicated a preference for:

- education and awareness programs, particularly using multimedia, talks in schools and for community groups
- routine camp maintenance
- increasing flying-fox habitat.

Council takes a risk-based approach to management, where camp intervention is generally only considered where there is actual risk that cannot be otherwise managed. Management options within this Plan constitute Level 1 actions in accordance with the Policy.

4.1 Education and awareness program

Community survey results indicated there may be some confusion regarding health risks associated with roosting and foraging flying-foxes. Therefore, it is recommended to adopt an education and awareness program to reduce misconceptions and appease fears. Messages may be based on:

- what to do if a dead, injured or orphaned flying-fox is encountered
- what to do if someone is bitten or scratched
- how to install wildlife friendly netting around fruit trees.

These educational messages can also be adapted as protocols for staff and sub-contractors working in the camp. Although Cabramatta Creek camp has shown resilience during recent HSE compared with nearby camps (T. Johnson FCC pers. comm. April 2018), Council is taking a proactive stance in preparing a draft HSE Plan as part of this Plan.

Increasing awareness of the camp through tours or talks may also involve improving physical infrastructure or access including walkways and cycleways and linkages (between the Flying-fox Reserve and Jacquie Osmond Reserve) to the site. Temporary fencing or permanent exclusion areas may be need if flying-foxes are being disturbed by public access (especially during birthing and rearing).

4.2 Routine camp maintenance

Routine camp maintenance includes both reinvigorating signage at the site and on-ground vegetation restoration works. Stained or faded signs should be maintained or updated as necessary. Best practice restoration methods need to be applied consistently in the Flying-fox Reserve even when there are changes to on-ground management teams or sub-contractors. Camp restoration must be considerate of flying-fox habitat requirements and ensure flying-fox welfare. Large sections of privet will need to remain until native vegetation has regenerated.

A mosaic approach to weed removal must primarily be based on the area the flying-foxes do not occupy. Depending on the structure, this action could trigger an impact assessment of significance (Part 5 activities under EP&A Act) and may require a Threatened Species licence under BC Act 2016. Appendix 3 provides details on standard measures to avoid impacts to flying-foxes during management of a camp. To better understand how flying-foxes use the camp, a monitoring program that spatially maps the extent of the camp throughout the year should be developed. Field staff could utilise a mobile application to upload data to the cloud which could be accessed by both FCC and LCC. All bush regeneration works should be undertaken through the respective land managers' 132C Scientific Licence.

4.3 Increasing flying-fox habitat

Routine camp maintenance serves to improve the condition and quality of the habitat within the Flying-fox Reserve, however flying-foxes also use vegetation within Jacquie Osmond Reserve. This section of the riverbank is higher and does not have the same level of weed invasion (influenced in the Flying-fox Reserve by flooding and inundation). Restoration and regeneration works should continue in Jacquie Osmond Reserves as the site serves a spill over for flying-fox influxes.

Council should partner with a research institute to trial artificial roosting habitat (e.g. ropes and other structures) to supplement the deteriorating canopy as the speed of restoration is limited by flying-fox presence. Depending on the structure, could trigger an impact assessment of significance (Part 5 activities under EP&A Act) or may require a Threatened Species licence under the BC Act. Appendix 3 provides details on standard measures to avoid impacts to flying-foxes during management of a camp.

FCC and LCC will develop a joint up-to-date restoration plan, in consultation with a flying-fox expert, that details staged weed removal considerate of flying-fox habitat requirements, working practices to avoid impacting roosting flying-foxes, health and safety considerations for personnel, considers movements of flying-foxes within the camp and potential locations for artificial roosting structures.

4.4 Management areas

Table 5 describes and Figure 14 illustrates the management areas for buffers and habitat enhancement for the camp.

Table 5 Cabramatta camp management areas

Management area	Description	Requirements
50 m residential buffer	The 50 m buffer on the northern side of Cabramatta Creek comprises the E2 zone and part of Jacqui Osmond Reserve.	E2 zone · no roost trees to occur along the northern edges of Cabramatta Creek; weed control works as required; plant only mid-storey shrubs to discourage flying-foxes and to provide a sound barrier to reduce noise levels and minimise odour RE1 zone: · tall trees in this area can be made undesirable to flying-foxes by maintaining a mown or sparse understorey which will enhance the function of the buffer on this side of the creek; weed control works as required.
25 m buffer	The 25 m buffer in Jacquie Osmond Reserve on the southern side of Cabramatta Creek buffering the sports fields	· Routine camp maintenance works to continue · Buffer here serves as a visual and sound barrier both for flying-foxes and people using the sports fields
Jacquie Osmond Reserve	Areas excluding management buffers in this Reserve	· Routine camp maintenance works to continue
Habitat enhancement area	The area comprising the Flying-fox Reserve and a small portion of Jacquie Osmond Reserve will form the area required for the Restoration Plan	· Mosaic approach to weed management based on areas of flying-fox occupation · Trials for artificial roosting structures could be installed in the southern section of the flying-fox reserve

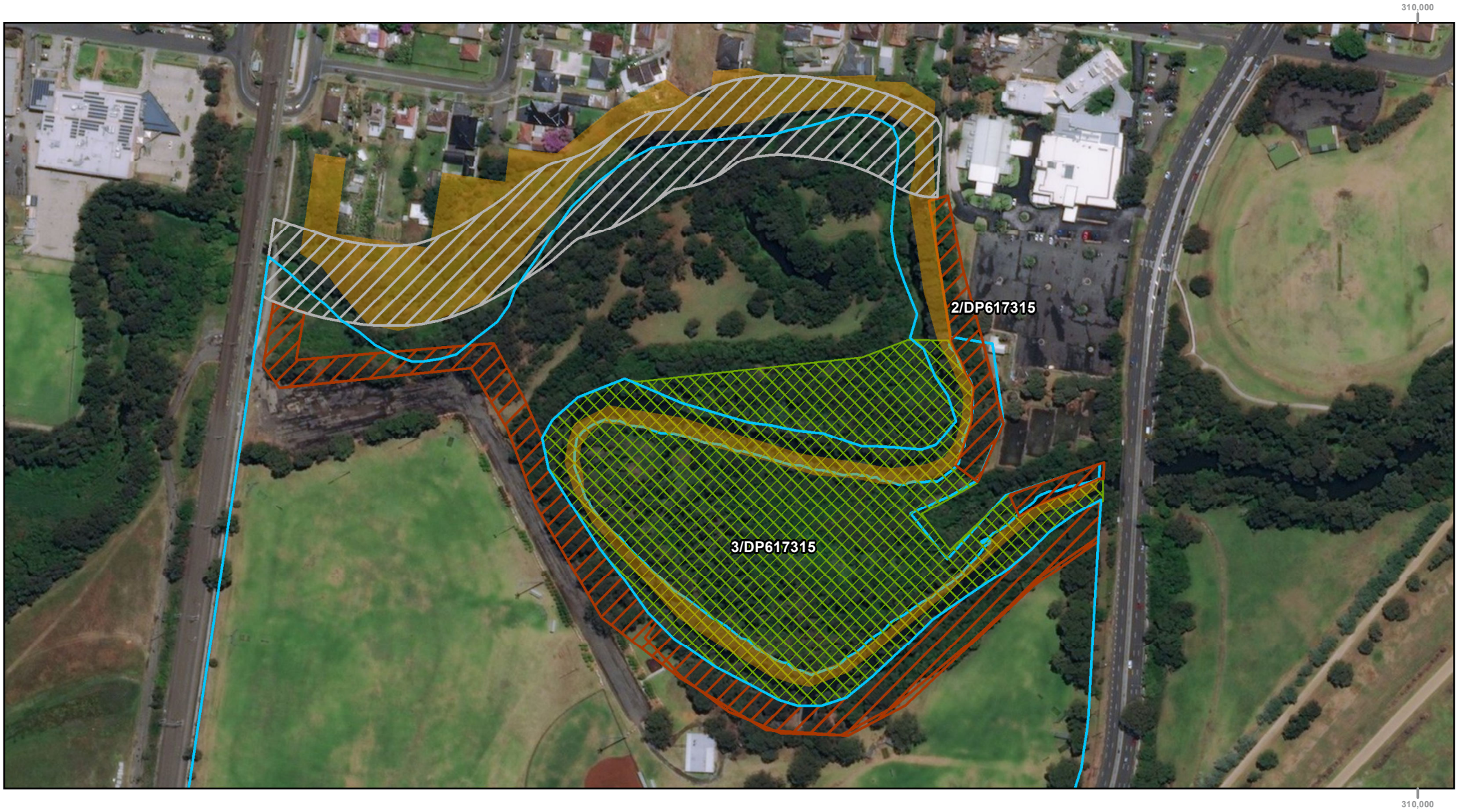


Figure 14: Management areas

Liverpool City Council

Cabramatta Creek Camp Management Plan

Jacquie Osmond Reserve

E2 zone

Habitat enhancement

Buffer management area (25 m)

Buffer management area (50 m)

ecosure

Job number: PR3277
Revision: 0
Author: KF
Date: 5/06/2018

0 50 100 200
Metres

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

Table 6 Staged approach to management at Cabramatta Creek flying-fox camp

Management option (Table 8)	Management level	Appraisal	Action(s)	Timing	Measure
Education and awareness programs	Level 1	Adopt	Develop and implement an education strategy to promote understanding of flying-foxes and dispel misconceptions of flying-foxes. · produce webpage on Council's website summarising Council's approach to flying-fox management and awareness raising topics · encourage positive media coverage and stories on Facebook so community is intrigued rather than fearful · conduct a letterbox drop to promote awareness of flying-fox issues (a) flying-foxes are a native species with critical role in maintaining natural areas (b) GHFF are threatened (c) contact details for sick and injured flying-foxes (d) public health information (e) tips for living with flying-foxes - wildlife friendly netting (e) local aromatic plant species that do not attract foraging flying-foxes · clean and maintain signs around camp - update faded signs at viewing platform (purchase new photos or consult with professional photographer) – consider sloped covers to prevent faecal drop · include educational stalls in markets events with speakers, live animal displays etc. · Council to consult with conservation organisations (e.g. Australian Bat Society / WIRES) to consider school talks or camp tours · promote ecotourism opportunities. For example, since 1984 Batty Boat Cruises have been run regularly for tourists to watch flying-foxes leave their roosts from the Brisbane River; one of the top-rated attractions in Texas is to watch 1.5 million Mexican free-tail bats fly-out from their roost - the Radisson Hotel offers special bat packages from viewing bedrooms (Kerr and Thiret, 2016).	short term	Education and awareness program designed and initiated

Management option (Table 8)	Management level	Appraisal	Action(s)	Timing	Measure
Protocols to manage incidents	Level 1	Adopt	Protocols (e.g. Appendix 6) and messages regarding flying-fox health and risks in place for staff, and to advise the community: · what to do if a dead, injured or orphaned flying-fox is encountered. · what to do if someone is bitten or scratched. · requirements for working in and around a camp. Develop draft HSE plan (Appendix 7) in collaboration with wildlife rescue and care organisations, monitor for potential heat stress events during predicted hot weather using the online heat stress forecaster http://www.animalecologylab.org/ff-heat-stressforecaster .	short term	Clear internal policy and procedure for dealing with flying-fox welfare incidents Finalise HSE Plan
Routine camp management	Level 1	Adopt	Remove vegetation blocking flying-fox signs and access to viewing platform. Weed removal should be staged and undertaken in consideration with area of the camp occupied by flying-foxes (Appendix 4 for standard measures to avoid impacts to flying-foxes). Develop a Plan of Management for Jacquie Osmond Reserve that informs the extent of habitat enhancement, 25 m buffers and standard measures to avoid impacts to flying-foxes (Appendix 3) Ensure monitoring of colony occurs when works occur around camp management · develop spatial records of colony extent to understand areas of the camp flying-foxes use throughout the year. Data should be uploaded to a shared file to access by FCC and LCC staff. Use this information to inform updated restoration plan. · maintain Council database of flying-fox population at camp and mortalities (HSE).	short term	FCC and LCC will develop a joint up-to-date restoration plan, in consultation with a flying-fox expert Field staff to undertake monitoring of camp extent
Service subsidies	Level 1	Adopt	Subsidies will be considered for wildlife friendly netting or assistance with netting installation for members of the community with limited mobility. A plant swap program could be initiated to assist with removal of harmful / non-native foraging attractants from private property (e.g. Cocos palms).	medium term	Information added to education and awareness program

Management option (Table 8)	Management level	Appraisal	Action(s)	Timing	Measure
Research	Level 1	Adopt	Support research including projects which will · assist in understanding local flying-fox movements · develop understanding of native flowering events in area · artificial roost space to alleviate pressure on canopy	medium term	Council to keep up-to-date on contemporary research and provide relevant updates to the community
Alternative habitat creation	Level	Adopt - ongoing	Jacquie Osmond Reserve provides spillover habitat during flying-fox influxes. Ensure monitoring of camp occurs when works occur around camp management · develop spatial records of colony extent to understand areas of the camp flying-foxes use throughout the year. Data should be uploaded to a shared file to access by FCC and LCC staff. Use this information to inform restoration plan.	long term	Continue restoration works in Jacquie Osmond Reserve. Field staff to undertake monitoring of camp extent
Odour reducing / masking plants	Level 1	Investigate further	Residents could be encouraged to modify properties by planting dense screens and fragrant plants to assist with odour. Provide a plant list to community to replace flying-fox attracting plants with alternative aromatics including: · *Arthropodium milleforum* · *Bursaria spinosa* · *Hardenbergia violacea* · *Hibbertia scandens* · *Indigofera australis* · *Homalanthus populifolius* · *Hymenosporum flavum* · *Kunzea ambigua* · *Lomandra longifolia* · *Melaleuca erubescens* · *Ozothamnus diosmifolius*	medium term	Information added to education and awareness program

Management option (Table 8)	Management level	Appraisal	Action(s)	Timing	Measure
Provision of artificial roosting habitat	Level 1	Investigate further	Investigate suitable options to trial artificial roosting habitat (ropes and other structures) to supplement available roosting space in the camp. Depending on the structure, could trigger an impact assessment of significance (Part 5 activities under EP&A Act) and may require a Threatened species licence under Biodiversity Conservation Act 2016.	medium term	Council will seek a research partner to trial different artificial roost options
Appropriate land-use planning	Level 1	Investigate further	Measures to avoid future impacts will be considered when assessing development applications around the camp. Seek the dedication of a portion of Lot 2/DP617315 to FCC as part of any future subdivision, rezoning or development application to enable FCC to manage that land more effectively with respect to the adjacent flying-foxes.	long term	To be investigated by Council's land use planning department

5 Evaluation and review

This Plan will be in operation for five years with annual review of management actions set out in Section 4.

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.

Monitoring and reporting requirements are detailed in Section 6.

If the Plan is to remain current, a full review including stakeholder consultation and expert input will be undertaken in the final year of the Plan prior to being re-submitted to OEH.

6 Plan administration

5.1 Monitoring of the camp

Reports for Level 1 actions that comply with this Plan are not required to be submitted to OEH.

It is recommended that Council keep internal records so that the effectiveness of each management action can be evaluated.

Council can access seasonal monitoring (February, May, August, November) of flying-fox numbers as part of the NFFMP. It is recommended to map the spatial extent of the colony during these monitoring events as well as when restoration works are undertaken at the camp. This information will provide a greater understanding of how flying-fox use the camp and should also serve to inform the Restoration Plan.

5.2 Responsibilities

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

All Council personnel, contractors and volunteers working in the camp are responsible for complying with mitigation measures detailed in Appendix 4. FCC and LCC will ensure non-Council staff and volunteers are aware of this responsibility and will provide assistance if required. All on-ground works towards implementation of this Plan, will be performed in accordance with a Safe Work Method Statement that includes risks and mitigation measures for working in a flying-fox camp.

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.

5.3 Funding commitment

FCC and LCC will commit available funds on an annual basis over the life of the Plan to implement actions in Table 6. Allocation of Council funding will be dependent on resources available and annual priorities. Council will also seek opportunities for funding through relevant grant programs, such as the NSW Flying-fox Grants Program, and will seek contribution from other stakeholders where appropriate.

References

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.

AIHW 2012, *Risk factors contributing to chronic disease*, Cat no. PHE 157, Australian Institute of Health and Welfare, viewed 12 January 2016, www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737421546.

Atlas of Living Australia 2015, viewed 12 January 2016, www.ala.org.au.

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.

CDC 2014, *Hendra virus disease (HeV): Transmission,* Centers for Disease Control and Prevention, updated 17 March 2014, viewed 12 January 2016, www.cdc.gov/vhf/hendra/transmission/index.html.

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

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 April 2018, 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 12 January 2016, www.dpi.nsw.gov.au/agriculture/livestock/horses/health/general/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.

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.

FCC 2001, Flying-fox Reserve Cabramatta Plan of Management, Fairfield City Council.

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.

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 Government 2018, Aerial imagery, viewed 30 April 2018, http://spatialservices.finance.nsw.gov.au/mapping_and_imagery/aerial_imagery

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

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.

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.

Welbergen, J., Shoo, L., Karoly, D., Kearney, M., Ratnayake, H., Govekar, P. and MacDonald, S. 2015, 'Flying-fox Heat Stress Forecaster', viewed 10 May 2018 https://www.animalecologylab.org/ff-heat-stress-forecaster.html

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 Flying-fox ecology & behaviour

Ecological role

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

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

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

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

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

Flying-foxes in urban areas

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

- loss of native habitat and urban expansion
- opportunities presented by year-round food availability from native and exotic species found in expanding urban areas

- disturbance events such as drought, fires, cyclones
- human disturbance or culling at non-urban roosts or orchards
- urban effects on local climate
- refuge from predation
- movement advantages, e.g. ease of manoeuvring in flight due to the open nature of the habitat or ease of navigation due to landmarks and lighting.

Under threat

Flying-foxes roosting and foraging in urban areas more frequently can give the impression that their populations are increasing; however, the grey-headed flying-fox is in decline across its range and in 2001 was listed as vulnerable by the NSW Government through the TSC 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 that the national population may have declined by up to 30%. It was also estimated that the population would continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling.

The main threat to grey-headed flying-foxes in NSW is clearing or modification of native vegetation. This threatening process removes appropriate roosting and breeding sites and limits the availability of natural food resources, particularly winter–spring feeding habitat 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, and this threatening process continues.

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

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

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

Camp characteristics

All flying-foxes are nocturnal, roosting during the day in communal camps. These camps may range in number from a few to hundreds of thousands, with individual animals frequently moving between camps within their range. Typically, the abundance of resources within a 20–50 kilometre radius of a camp site will be a key determinant of the size of a camp (SEQ

Catchments 2012). Therefore, flying-fox camps are generally temporary and seasonal, tightly tied to the flowering of their preferred food trees. However, understanding the availability of feeding resources is difficult because flowering and fruiting are not reliable every year, and can vary between localities (SEQ Catchments 2012). These are important aspects of camp preference and movement between camps and have implications for long-term management strategies.

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

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

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

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

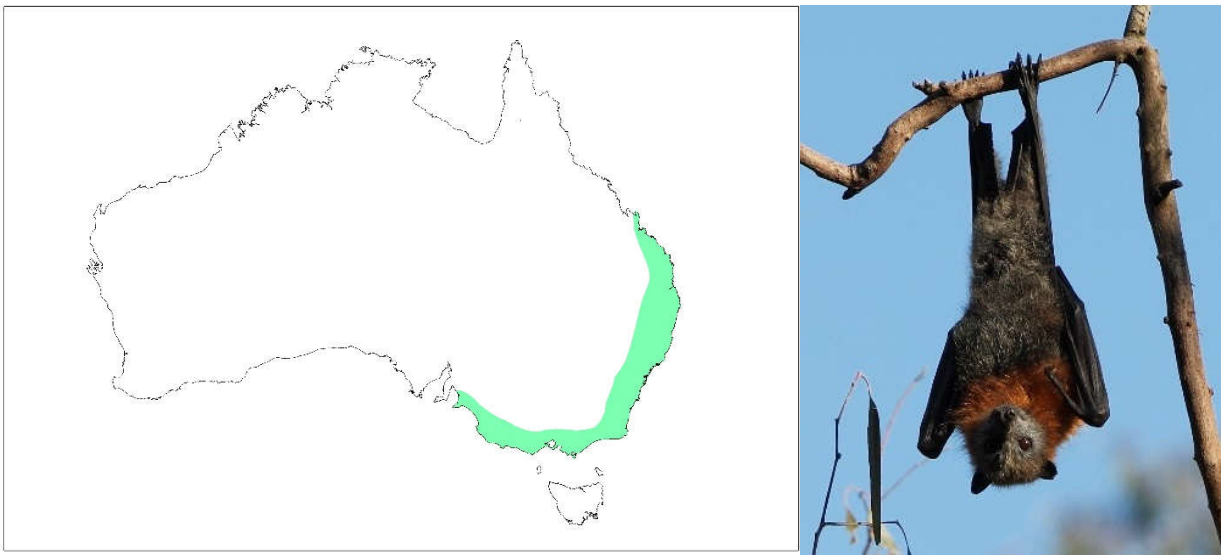


Figure 1.1 Grey-headed flying-fox indicative species distribution, adapted from OEH 2015a

The GHFF (Figure 1.1) 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.

Little red flying-fox (*Pteropus scapulatus*)

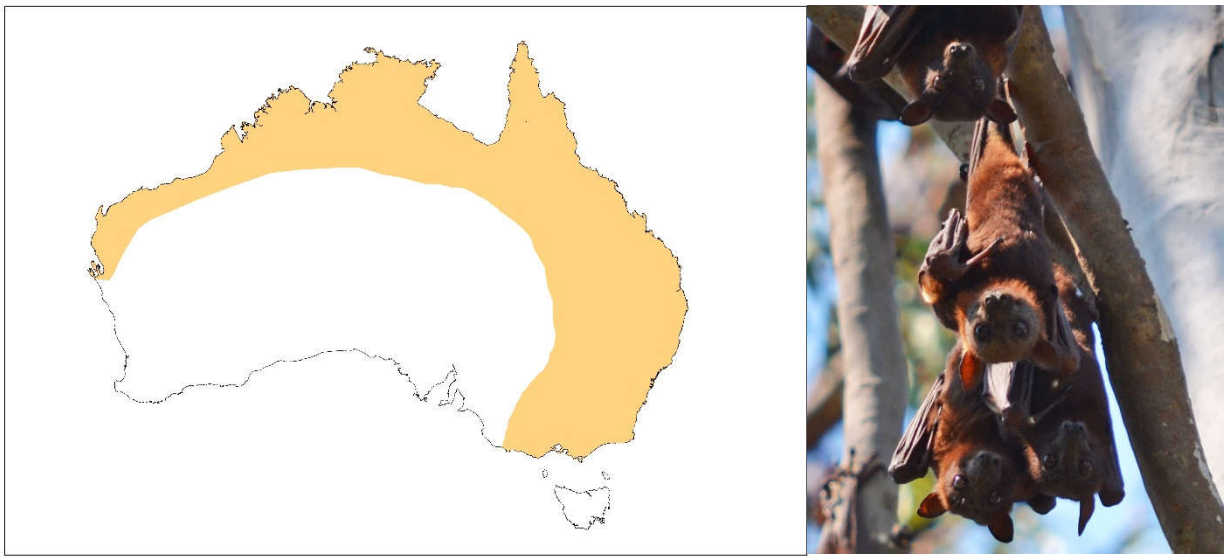


Figure 1.2 Little red flying-fox indicative species distribution adapted from OEH 2015a

The little red flying-fox (LRFF) (Figure 1.2) 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

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 1.3)

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 1.3). 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).

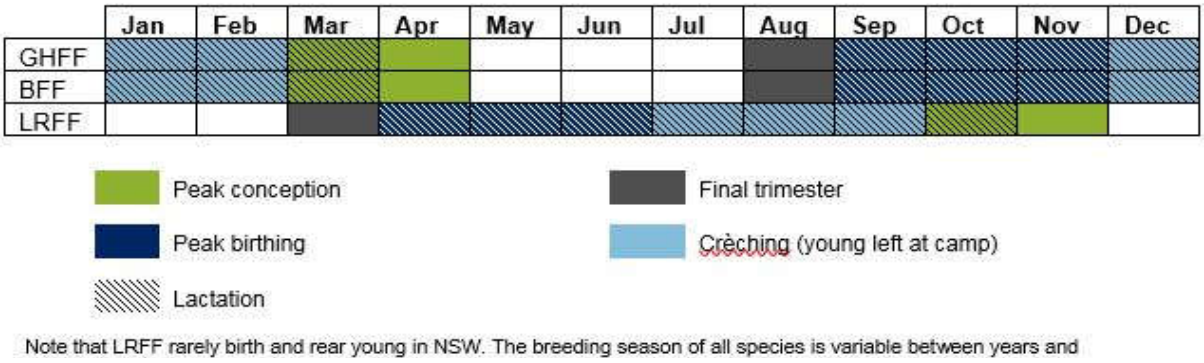


Figure 1.3 Indicative flying-fox reproductive cycle

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.

Appendix 2 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 3 Standard measures to avoid impacts to flying-foxes

The following mitigation measures will be complied with at all times during implementation of any activities within or immediately adjacent the camp.

- All personnel will be appropriately experienced, trained and inducted. Induction will include each person's responsibilities under this Plan.
- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and OEH consulted in accordance with the 'stop work triggers' section of the Plan.
- Large crews will be avoided where possible.
- The use of loud machinery and equipment that produces sudden impacts/noise will be limited. Where loud equipment (e.g. chainsaws) is required they will be started away from the camp and allowed to run for a short time to allow flying-foxes to adjust.
- Activities that may disturb flying-foxes at any time during the year will begin as far from the camp as possible, working towards the camp gradually to allow flying-foxes to habituate.
- Any activity likely to disturb flying-foxes so that they take flight will be avoided during the day during the sensitive GHFF/BFF birthing period (i.e. when females are in 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.).
- OEH will be immediately contacted if LRFF are present between March and October or are identified as being in 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, in very cold temperatures or during periods of likely population stress (e.g. food bottlenecks). Wildlife carers will be consulted to determine whether the population appears to be under stress.

- Works will be postponed on days predicted to exceed 35°C (or ideally 30°C), and for one day following a day that reached ≥35°C. If an actual heat stress event has been recorded at the camp or at nearby camps, a rest period of several weeks will be scheduled to allow affected flying-foxes to fully recover. See the OEH fact sheet on Responding to heat stress in flying-fox camps.
- Any proposed variations to works detailed in the Plan will be approved, in writing, by OEH before any new works occur.
- OEH may require changes to methods or cessation of management activities at any time.
- Ensure Level 2 management actions and results are recorded to inform future planning. See the OEH fact sheet on Monitoring, evaluating and reporting.

Vegetation trimming/removal (if required)

- Dead wood and hollows will be retained on site where possible as habitat.
- Vegetation chipping/mulching is to be undertaken as far away from roosting flying-foxes as possible (at least 100 m).

Canopy vegetation trimming/removal (if required)

Prior to works

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

During works

- Any tree lopping, trimming or removal is undertaken under the supervision of a suitably qualified arborist (minimum qualification of Certificate III in Horticulture (Arboriculture) who is a member of an appropriate professional body such as the National Arborists Association).
- 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 OEH 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 (i.e. Landcare groups), with at least one supervisor knowledgeable about flying-fox habitat requirements (and how to retain them for Level 1 and 2 actions) with knowledge regarding 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 for Level 1 and 2 actions.
- Weed removal should follow a mosaic pattern, maintaining refuges in the mid- and lower storeys at all times. This may require leaving stands of 'caretaker' weed to maintain habitat (DECC 2008).
- Weed control in the core habitat area will be undertaken using hand tools only (or in the evening after fly-out while crèching young are not present).
- Species selected for revegetation will be consistent with the habitat on site, and in buffer areas or conflict areas should be restricted to small shrubs/understorey species to reduce the need for further roost tree management in the future.
- Due to the close proximity to Cabramatta Creek, herbicide use should be kept to a minimum.

Stop work triggers

Management activities in or near Cabramatta Creek camp will cease and will not recommence without consulting OEH if:

- any of the animal welfare triggers occur on more than two days during the program, such as unacceptable levels of stress (Table 3.1)
- 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.

Table 3.1 Planned action for potential impacts during any works under or near the camp. A person with experience in flying-fox behaviour (as per Appendix 6) 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 2 m 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 5 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 m from roosting animals.
Injury/death	· A flying-fox appears to have been injured/killed on site (including aborted foetuses) · dependent/crèching young present and adults likely to take flight or abandoned camp	Works to cease immediately and OEH notified AND rescheduled OR adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by an independent expert OR stopped indefinitely and alternative management options investigated.

Appendix 4 Community engagement results

Extensive effort has been made to engage with the community regarding the flying-fox camp. The aim of the engagement was to:

- raise awareness about the ecological importance of flying-foxes
- understand the impacts, positive and negative, directly and indirectly affecting the community
- correct misinformation and alleviate fears regarding health risks to people and domestic animals
- share information and seek ideas about possible future management options.

During April 2018, the community was consulted as part of the development of this plan; an online survey and an evening workshop facilitated by Ecosure (Table 4.1).

Table 4.1 Community engagement methods

Engagement method	Key dates	Outcomes
Online survey	26 March – 13 April	Results included within this Plan
Evening workshop	4 April	Community feedback included within this Plan

The community was invited to participate in an online survey linked to both Councils' websites. The survey was open for two weeks and comprised 18 questions around:

- flying-fox awareness (6 questions)
- flying-fox issues (4 questions)
- flying-fox management (5 questions)
- respondent demographic (2 questions)
- open comment (1).

Workshop

A two hour workshop facilitated by Ecosure on 4th April 2018 was attended by four members of the community, as well as Council staff. A presentation on flying-fox identification and ecology, flying-fox legislation and camp management including heat stress events was supplemented with two group activity sessions.

The first group session was an opportunity for participants to share their attitudes and perceptions towards flying-foxes and the second group activity invited participants to select management options to apply to Cabramatta Creek camp and consider whether to intervene during heat stress events 4.2 provides a selection of comments from participants during the workshop group sessions.

Table 4.2 Workshop group session responses.

Group session	Comments
1 Attitudes and perceptions	· "*Carer of a special needs girl, (we) would walk from their home in Warwick Farm and the girl in her wheelchair would react with excitement at the large numbers of flying foxes taking flight."* · *"Local reputation is that the Cabramatta flying-foxes are poisonous"* · *"Bad publicity on radio 2GB Alan Jones show and likewise politician Craig Kelly"* · *"What I've heard – diseased, messy, destroying vegetation – need education ⚹media is an issue here"* · *"Would be great to get across how important they are for pollination, like bees."* · *"At home have foraging animals around Banksia longifolia when in flower and in Syzigiums"* · *"Appreciate their environmental role and they are cute"* · *"Media play a significant negative role regarding community perceptions."* · *"We used to watch them as kids flying along the creek – think they're gorgeous"* · *"Media does enormous damage – incorrect info"*
2 Management options at Cabramatta Creek camp	· *"Much needed education, awareness"* · Routine camp maintenance – *monitoring, reveg, waste removal"* · *"Change 'alternative' camp habitat to 'Additional' camp habitat"* · *"Trimming and thinning – only the invasive stuff"* · *"Buffers though canopy mounted sprinklers – not sure this is necessary or required"* · Routine camp maintenance **"✓"** · *Appropriate land use planning* **"✓"** · Education and awareness programs –*"* ❤ ❤ ❤ *"* · Education and awareness programs – *"this may lead to invasive visits to the site by humans"* · Routine camp maintenance –" *yes, an endless job is weed control"* · *"Try to plant more vegetation so as to increase area available for bat habitat"* · Appropriate land use planning – *"much needed is awareness amongst Council's strategic planners"* · *"Site is reasonably remote from human neighbours, so should not need buffers."*
2 Heat stress events	· *"Scientific advice/evidence to show if intervention is successful or not"* · *"If intervention is proven to be successful – Council should take the lead in HSE coordination and mobilisation"* · *"Intervention may not always be in the best interest of the entire colony"* · *"Council should take the lead in HSE Coordination and mobilisation* "

The first group session highlighted the media's negative influence on the community's attitude and perceptions. In the second group session participants emphasised the importance of education and awareness, routine camp maintenance and increasing flying-fox habitat. Participants believed Council should take the lead in heat stress event management as well as increasing the awareness of Council staff who deal with appropriate land use planning for flying-foxes.

Survey responses

A total of 74 survey responses were received during the survey period. A brief summary of the results is provided briefly before survey results report.

The majority of respondents were aware that flying-foxes are a protected native species (54, 72.97%) while the remaining didn't know (27.03%).

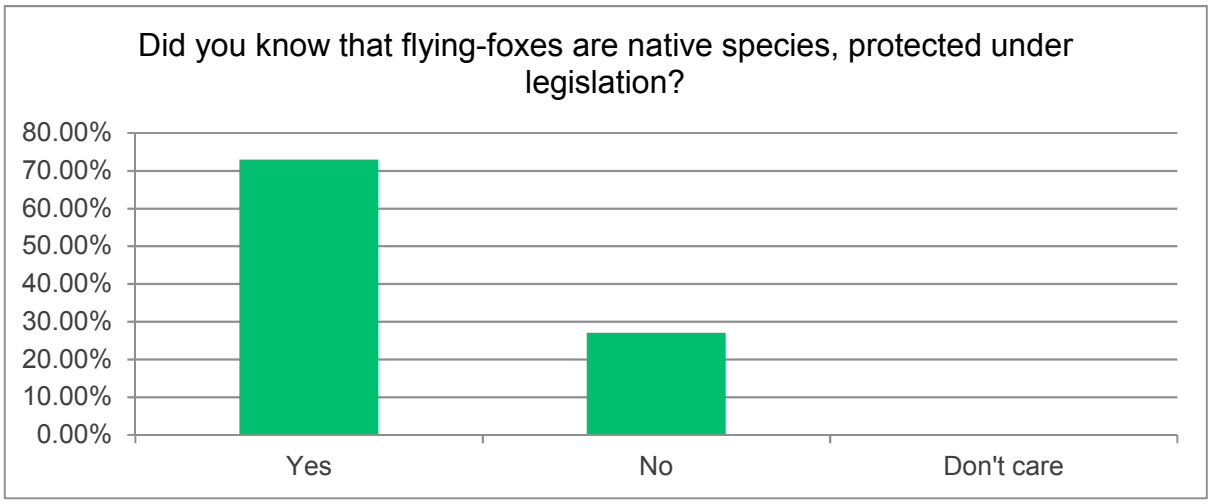


Figure 4.1 Knowledge of the status of flying-foxes

The majority of survey respondents were not aware that ABLV incidence is extremely low in flying-foxes (No 62.16%; yes 37.84%). However, most are aware that disease can be prevented by not handling the animals and by appropriate horse husbandry (77%). Furthermore, 56.76% of respondents were *not* aware that the grey-headed flying-fox is a threatened species, 40.54% did know and 2.7% didn't care. 61.64% of respondents did not know where to find information about flying-fox ecology, health or management options.

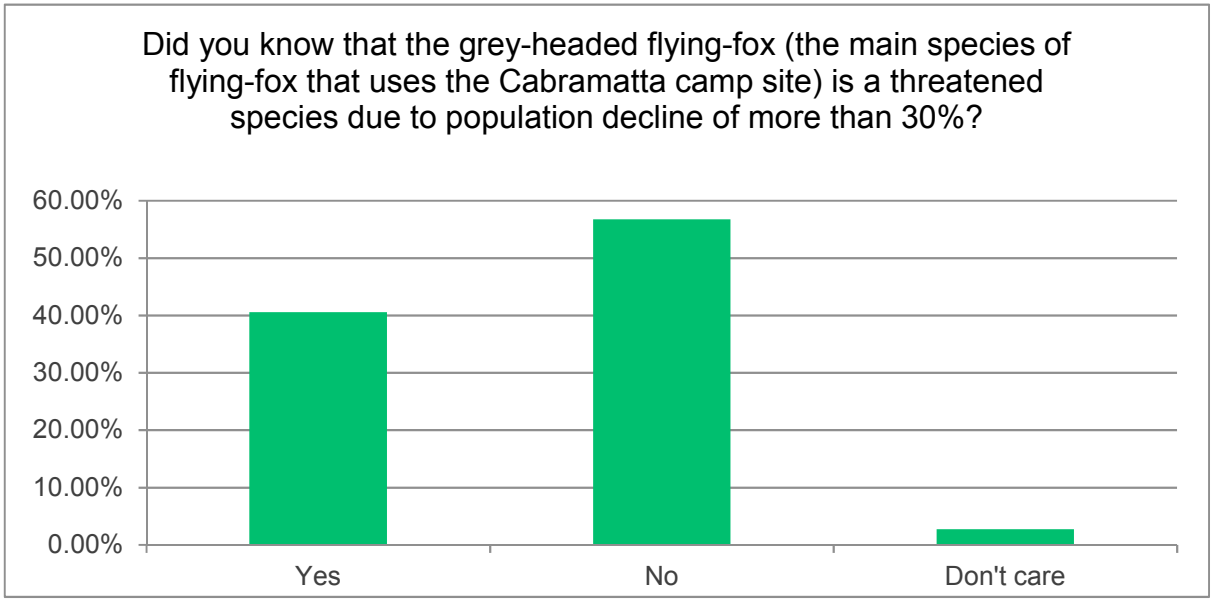


Figure 4.2 Responses regarding knowledge of incidence of ABLV in flying-foxes

Respondents were asked to indicate whether one or more of the following statements applied to them. 35 respondents or 47.3% of responses indicated 'none of the above' applied to them.

Table 4.3 Responses for interactions with flying-foxes

Answer Choices	Responses	
Flying-foxes have come into contact with my cat, dog or other domestic animal	0.00%	0
Flying-foxes have come into contact with my horse	0.00%	0
I have been scratched or bitten by a flying-fox	2.70%	2
I have come into contact with flying-fox urine, blood or faeces	4.05%	3
I have had to remove flying-fox droppings that soiled my clothing	6.76%	5
I have touched a live, dead or injured flying-fox	9.46%	7
I have seen sick or injured flying-foxes near my home or business	13.51%	10
I have had to remove flying-fox droppings from my property	22.97%	17
I have had to remove flying-fox droppings from my car or other vehicle	35.14%	26
None of the above	47.30%	35
Total responses		**105**

Respondents were invited to indicate their level of concern regarding the impacts of flying-foxes. 70.42% and 61.64% of respondents were *not* concerned about noise or smell respectively. 20.55% of respondents were concerned about damage to infrastructure such as powerlines, 13.51% were very concerned with fear of disease in humans and 9.59% were extremely concerned regarding flying-foxes striking aircraft. 75.68% of respondents were not being impacted by flying-foxes.

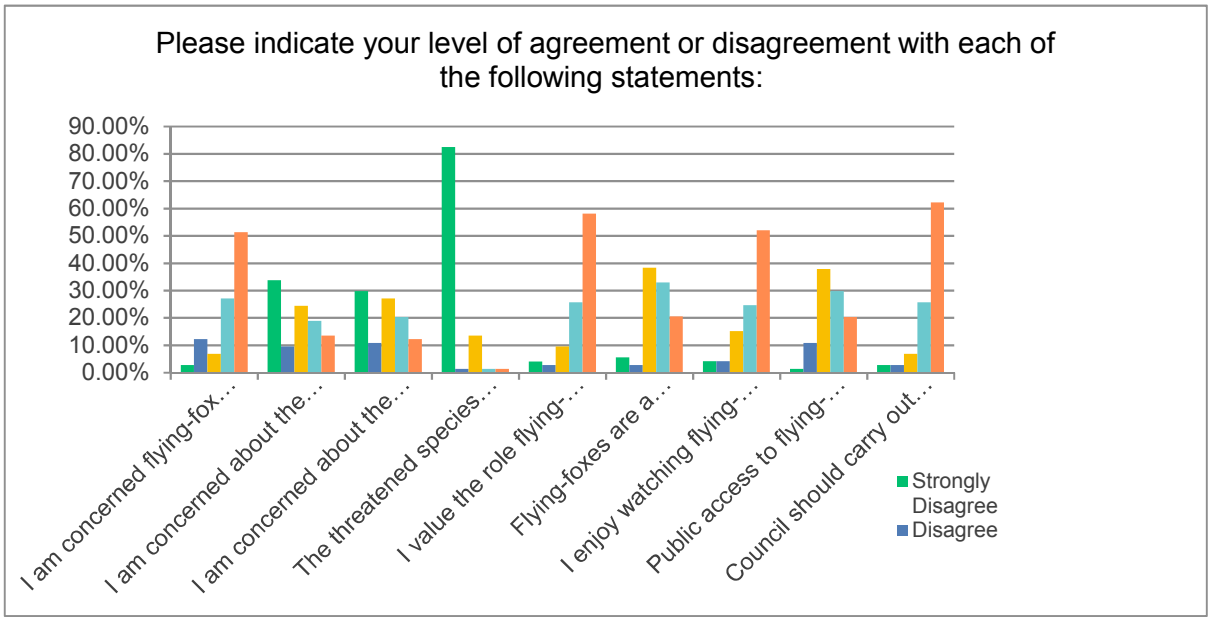


Figure 4.3 Respondents level of agreement or disagreement with various statements

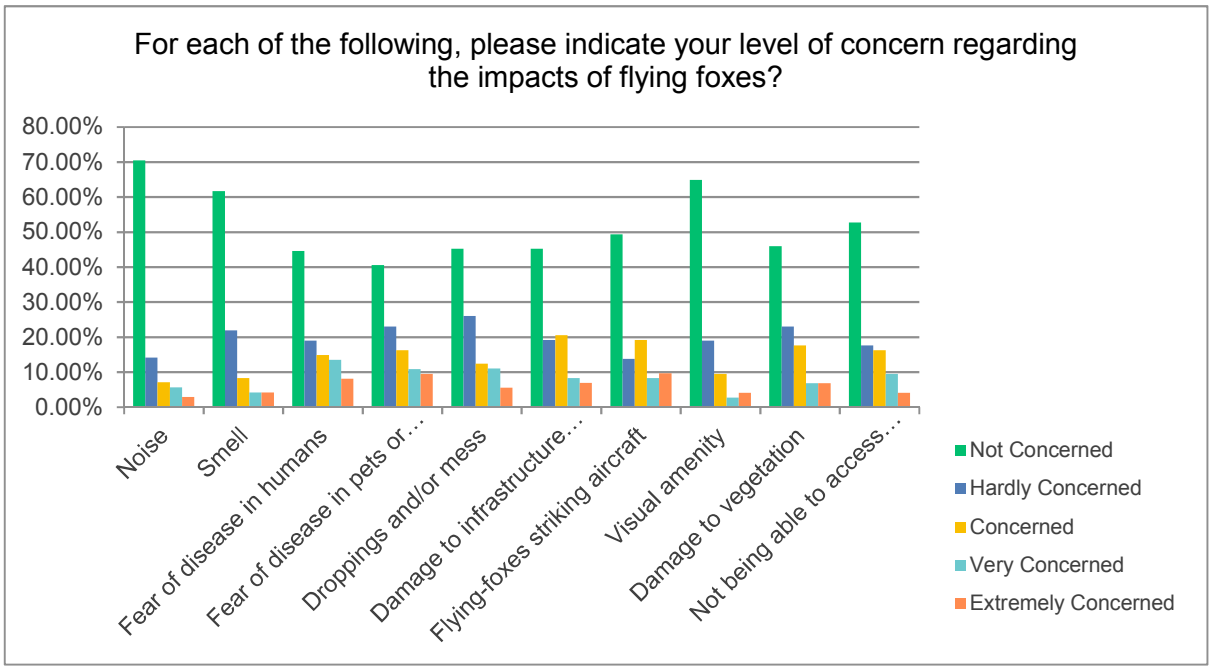


Figure 4.4 Respondents level of concern regarding impacts of flying-foxes

Respondents were asked their level of agreement or disagreement with a number of statements regarding flying-foxes. 82.43% of respondents strongly *disagree* (green) that the threatened species listing, and legal protection afforded to flying-foxes should be removed. 87.84% strongly agree or agree that Council should carry out its legal obligation to manage threatened species including flying-foxes and 76.71% strongly agree or agree that they enjoy watching flying-foxes forage or fly overhead.

Respondents were asked to rank management options in order of preference, education and research ranked the highest with 52.23% of respondents indicating this was the most important, followed by land use planning including zoning of flying-fox camps (38.33%) and routine camp maintenance including weed removal and habitat enhancement as the third most important management option (31.25%).

Regarding educational options, respondents indicated a wildlife educator to visit local schools or clubs as the their most preferred option (45.76%), followed by flying-fox information on social media (33.87%) and detailed information about flying-foxes on Council website (28.42%).

29 respondents provided additional suggestions for educational options they would like to see. The comments have been grouped according to the category that the educational option could be delivered Table 4.4. Respondents suggested education techniques utilising print media, multimedia, talks in schools, interpretative activities for the community such as tours, workshops or displays. Table 4.5 presents additional comments from the respondents which includes mainly positive feedback and flying-fox support.

.

Table 4.4 Additional suggestions for educational options

Category	Respondents comments
Multimedia	*"Videos on youtube"*
Multimedia	*"Virtual tour of Cabramatta Creek Flying Fox reserve. Study of options for reducing fatalities from high voltage overhead wires."*
Multimedia	*"Could send out web links suitable for education."*
Multimedia	*Tv advertisement to educate people in their importance, minimal disease risk and to advise the public to report anyone that's is seen harming them eg farmers*
Print media	*"Educational article in local papers once or twice a year"*
Print media	*"Regular information including the educational kind in printed media."*
Print media	*"Some brochures handed out in the mail"*
Print media	*"Info include in council leaflets"*
Print media	*Mailbox, Newsletter features, Nabo community based apps*
Print media	*"Articles in the Local newspapers"*
Print media	*Regular updates on the health and progress of our local flying fox colony in local newspapers to make the community more familiar with the species.*
Print media/multimedia	*"Social media, council website, local and state newspapers/magazines & other media."*
Print media/multimedia	*"Local papers and facebook info on local sites"*
Print media/multimedia	*Articles on Social Media and in the Local Papers about what to do if you find an injured Flying Fox. eg. Phone Wires.*
Schools	*"Mainly raising awareness to educational institutes such as Primary school. Teach them at a young age and also children have a high interest in animals so it will be good to keep that interest consistent and existant throughout their teen years too."*
Schools	*"In school"*
Schools	*"To the general public as well as school children."*
Schools	*"School talks"*
Schools	*"Schools involvement"*
Tours/workshop/display	*"Community group visits. Holsworthy Family Group would love to have a wildlife educator visit us. coordinator@holsworthyfamilygroup.org "*
Tours/workshop/display	*"Camp tours to demystify flying-foxes"*
Tours/workshop/display	*"Community workshop about local endangered flora and fauna, provide interested community members accurate information and data"*

Category	Respondents comments
Tours/workshop/display	*"Displays at shopping centres"*
not specified	*"how to help them or avoid them in/around your home"*
not specified	*"Advise people not to panic about flying foxes, that normal common sense and not handling these animals unless properly equipped and qualified. Humans are far more damaging to ones physical and mental health."*
not specified	*"more care"*
not specified	*"we need more vets trained to handle FFs. As a registered handler it can be challenging to find a vet to assist in bat care."*
not specified	*"Bust the myths and educate people on more benefits than risks"*
not specified	*"important to really make clear how important they to nature, the ecology and Australian bush/environment... they get negative feedback and portrayal in general ... "*

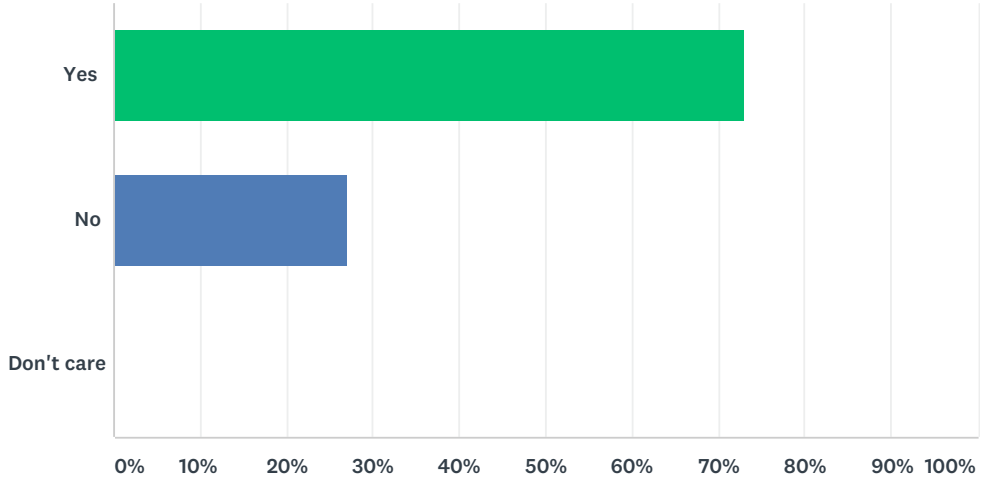
Table 4.5 Other comments

Response type	Any other comments
Feedback for Council	*"I wish to be included in any conversations including public exhibition of any plans relating to flying foxes."*
Feedback for Council	*"It's nice to see council take initiative"*
Feedback for Council	*"Fantastic to see a joint approach from both Councils"*
Feedback for Council	*"Livo council green thumbs do an amazing job for our community *hugs*"*
Feedback for Council	*"I have seen FF first time in Australia and have very little knowledge about them..."*
Feedback for Council	*"I put a request into help on the FCC bat committee"*
Feedback for Council	*"Find Chadley Beranek's Gumnut Naturalist and ask if he'd assist in education resources or involvement"*
Feedback for Council	*"better outcomes must come into play for the environment of Fairfield and Liverpool, it is under real threat due to land clearing and degradation. resources with ecological improvement and preservation of the little that is left under threat... better practice towards long term care.. needs better people advocating for it, to step up and not play safe because it is too hard or political. people in environment sectors of government remember why you first wanted to work for the environment. Attitudes must change and work tirelessly to achieve the best for the critical EEC cumberland plain vegetation types... with the full unwavering support of higher management, simple dedication with heart the plants and life forms deserve it...!!!!"*
Flying-fox advocate	*"If there was a reserve for flying foxes please make it available for the public to see the beauty in the animals. Please allow children be able to come up close to clean flying foxes and be able to take photos with them and upload it on social media,further raising awareness and keeping thier love for animals alive."*

Flying-fox advocate	*"Please continue to help these flying foxes, they are such beautiful animals"*
Flying-fox advocate	*"In the Lurnea area deaths are occuring due to power lines. I saved a baby last year as its mother had been electricuted, I handled the baby with a towel and rang wires to collect and nurture until it could be re-released."*
Flying-fox advocate	*"Bats are great, we need pollinators."*
Flying-fox advocate	*"Lovely to see them fly over at night and hear them in the bottle brushes."*
Flying-fox advocate	*"The flying foxes fly over my home every night. Their calls are reminders that we are part of nature. They are beautiful."*
Flying-fox advocate	*"education is the key to public acceptance and value of flying foxes, they are an intrical part of the pollination process. Information is key"*
Flying-fox advocate	*"I love the flying foxes! We need to protect them and as always it seems population growth and habitat destruction is the main problem. We need to ensure more areas of bushland are preserved for them."*
Flying-fox advocate	*"I love bats i always stand outside and watch them fly over especially the baby bats i sometimes see"*
Wildlife enthusiast	*"Save our wildlife"*
Wildlife enthusiast	*"I think we should be learning how to live successfully with our wildlife neighbours"*
Wildlife enthusiast	*"I am an amatuer astronomer and have spent many nights enjoying the flying foxes flying over my house as I observe. Our environment would be a sadder place without them. It's not like we have to content with bears, rogue elephants or marauding tigers in our communities, so how hard can it be to look after them wonderful mammals?"*
Wildlife enthusiast	*"I think its great that the south-west region has wildlife within close range and the opportunity for education about the plight of native fauna should be taken "*

Q1 Did you know that flying-foxes are native species, protected under legislation?

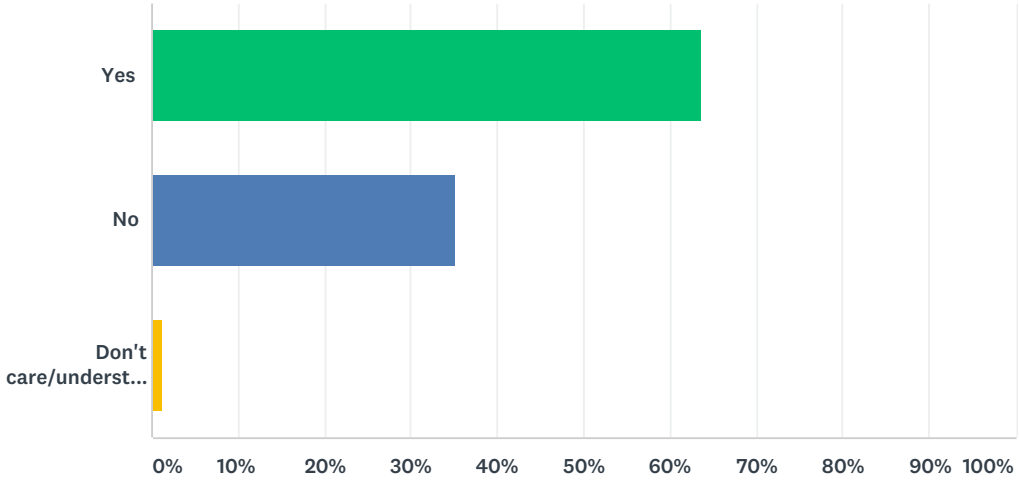
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	72.97%	54
No	27.03%	20
Don't care	0.00%	0
TOTAL		74

Q2 Did you know flying-foxes are critical to long-distance seed dispersal and pollination, and therefore the long-term persistence of our natural areas?

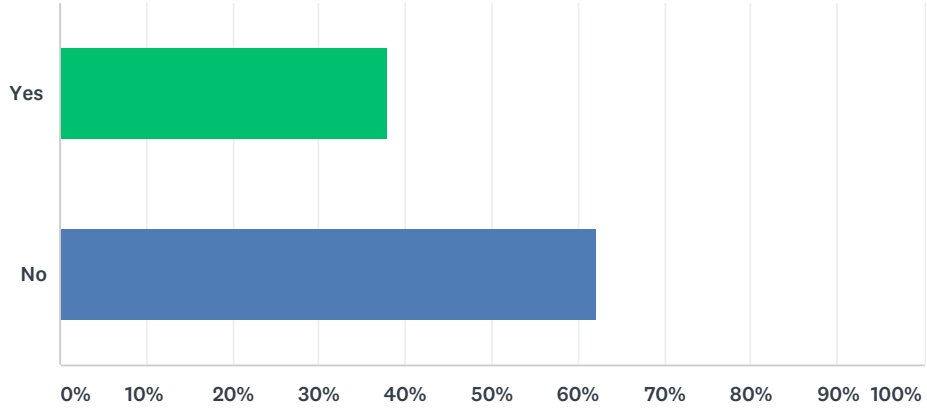
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	63.51%	47
No	35.14%	26
Don't care/understand the question	1.35%	1
TOTAL		74

Q3 Did you know that the incidence of Australian Bat Lyssavirus (ABLV) in flying-foxes is extremely low (less than 1%)?

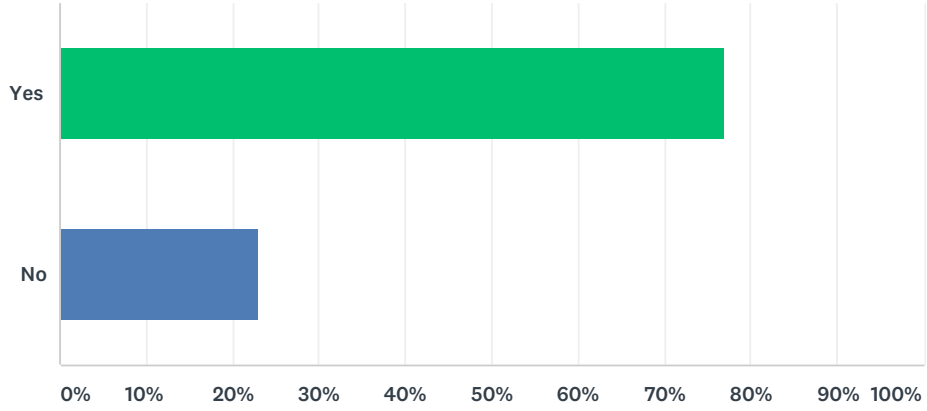
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	37.84%	28
No	62.16%	46
TOTAL		74

Q4 Did you know that diseases from flying-foxes can be prevented by not handling the animals, and appropriate horse husbandry?

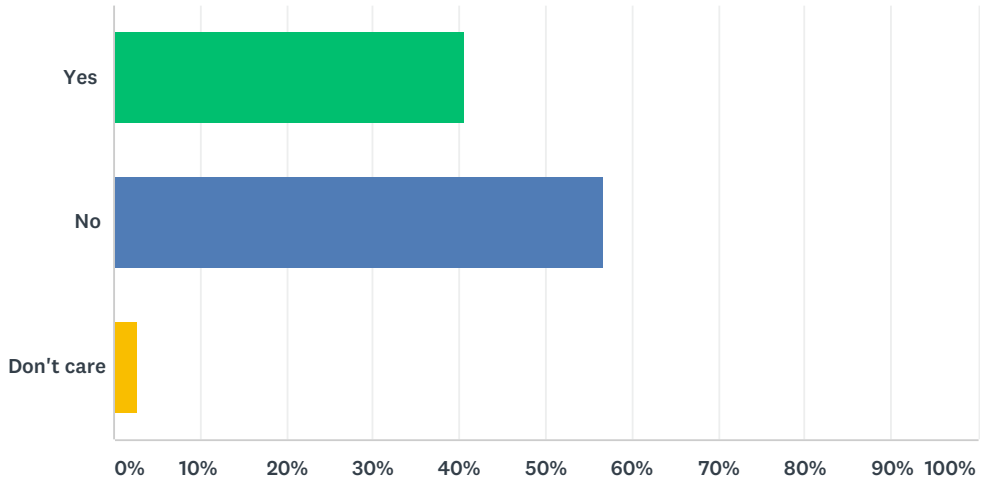
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	77.03%	57
No	22.97%	17
TOTAL		74

Q5 Did you know that the grey-headed flying-fox (the main species of flying-fox that uses the Cabramatta camp site) is a threatened species due to population decline of more than 30%?

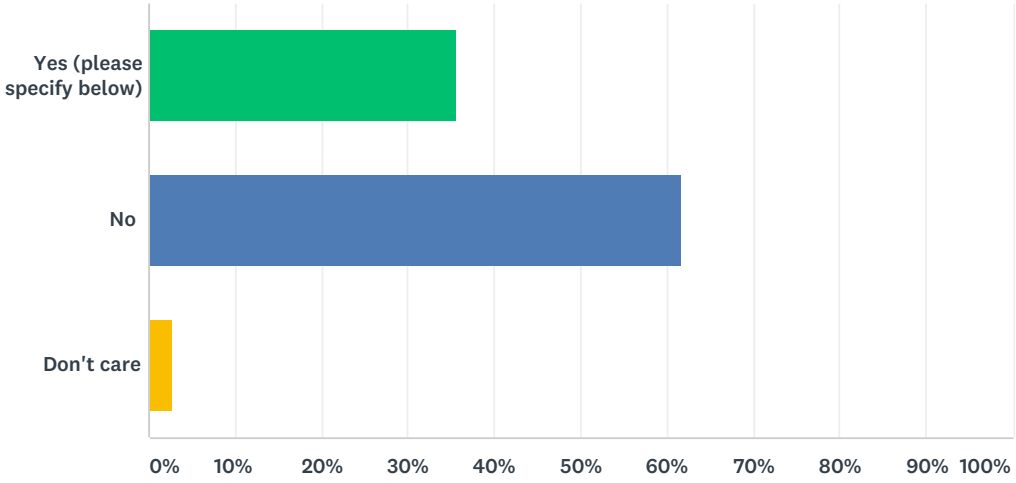
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	40.54%	30
No	56.76%	42
Don't care	2.70%	2
TOTAL		74

Q6 Do you know where to find information about flying-foxes (e.g. ecology, human/animal health, management options for private properties, etc.)?

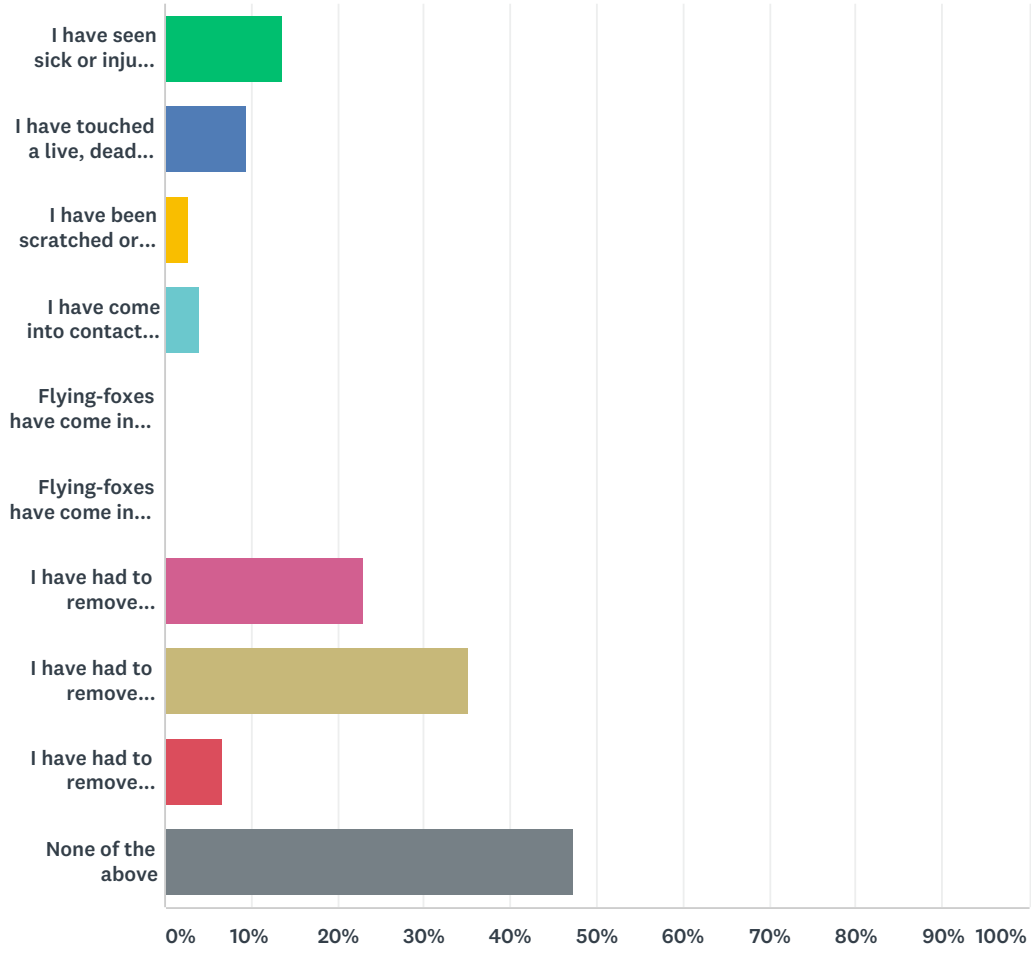
Answered: 73 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes (please specify below)	35.62%	26
No	61.64%	45
Don't care	2.74%	2
TOTAL		73

Q7 Please tick all of the following that apply to you (multiple response):

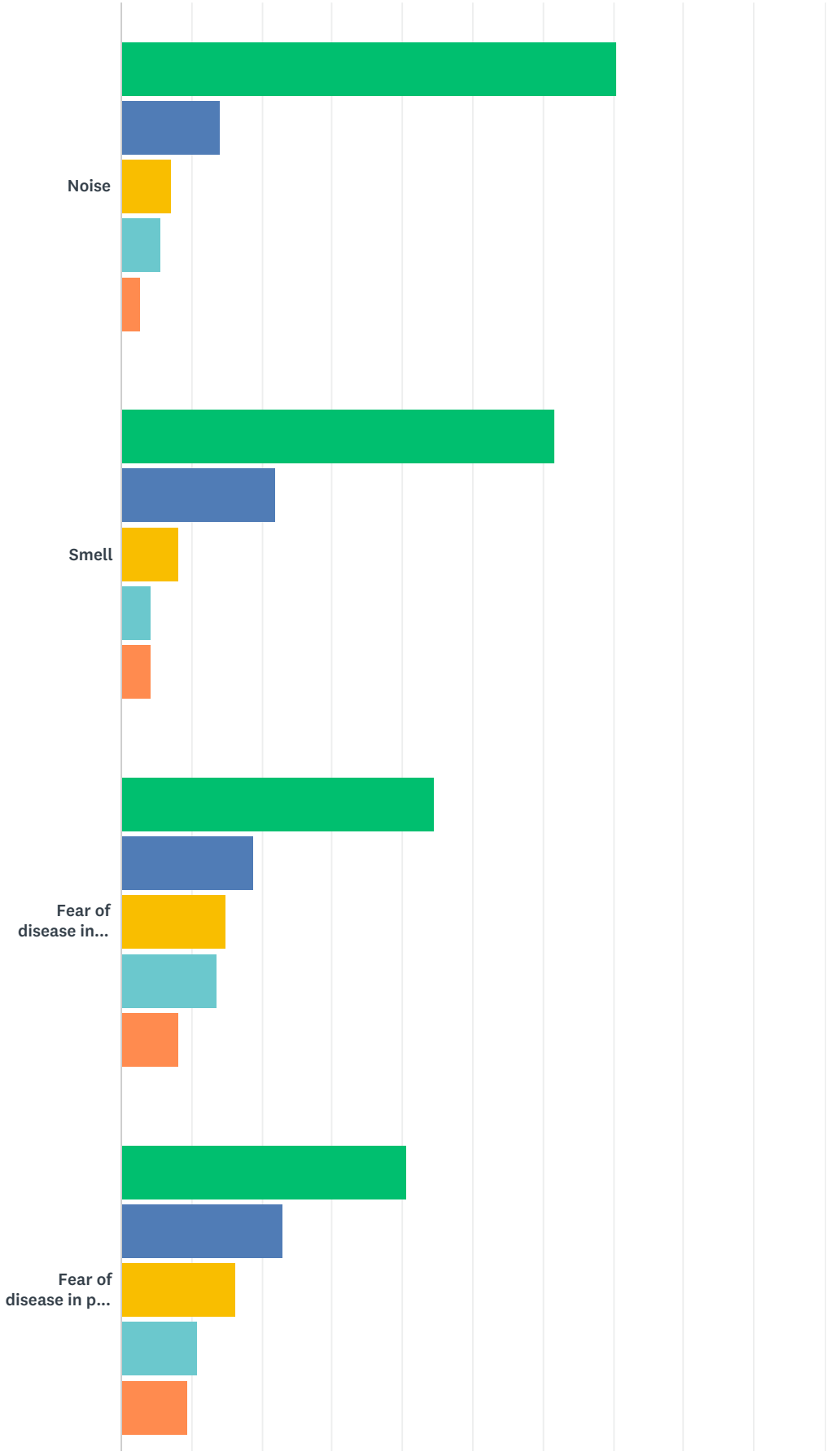
Answered: 74 Skipped: 0

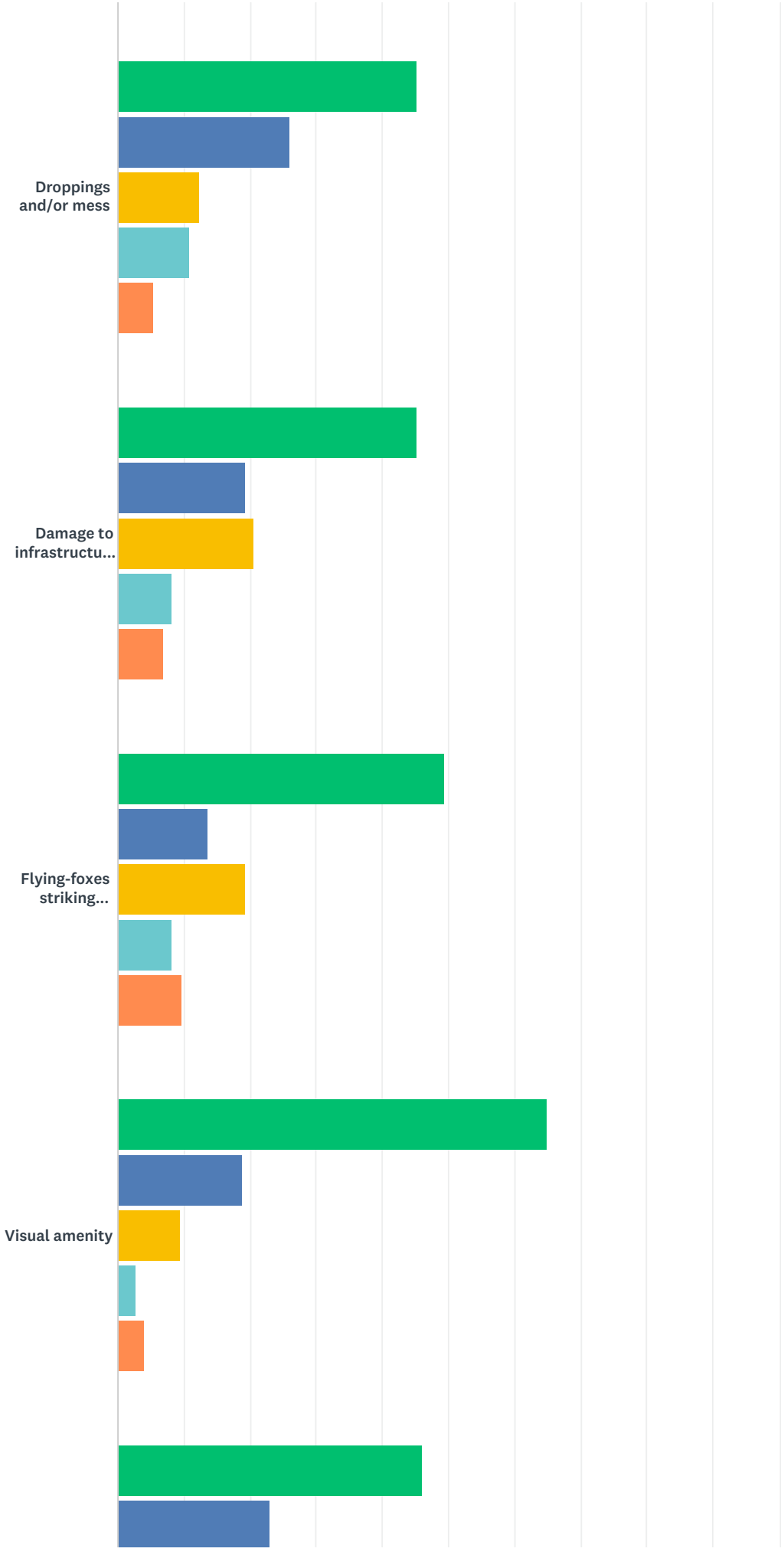


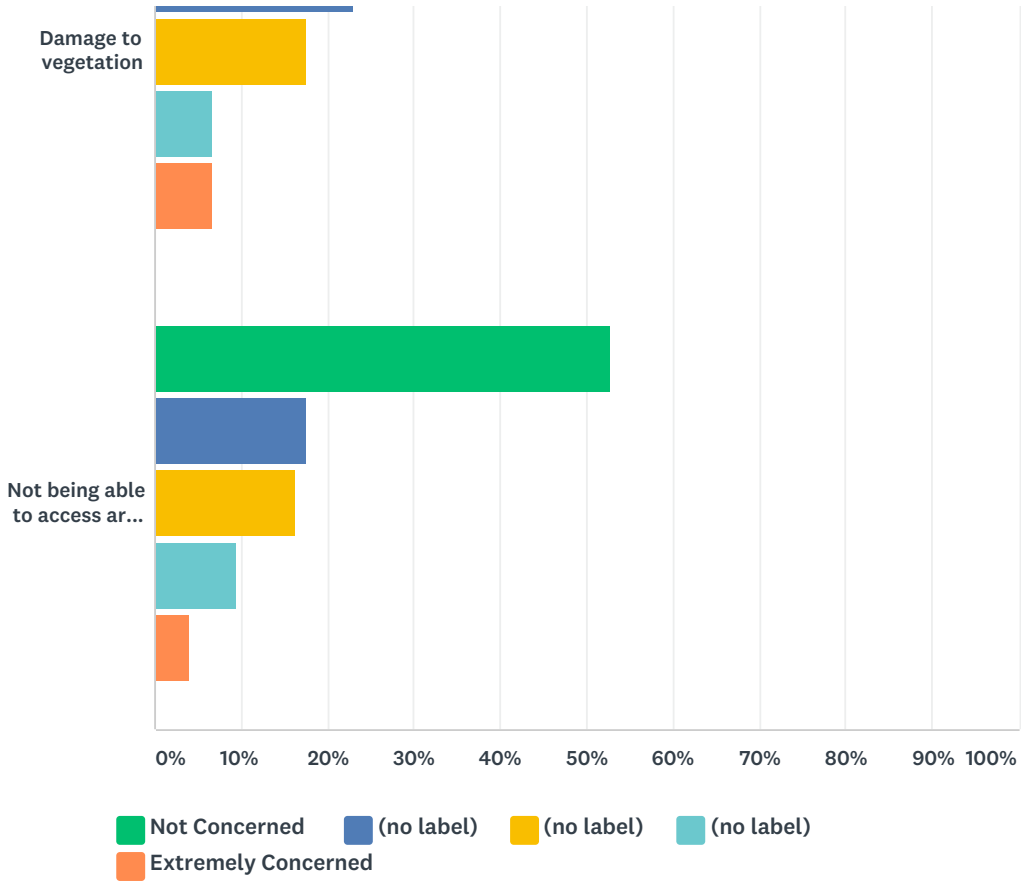
ANSWER CHOICES	RESPONSES	
I have seen sick or injured flying-foxes near my home or business	13.51%	10
I have touched a live, dead or injured flying-fox	9.46%	7
I have been scratched or bitten by a flying-fox	2.70%	2
I have come into contact with flying-fox urine, blood or faeces	4.05%	3
Flying-foxes have come into contact with my cat, dog or other domestic animal	0.00%	0
Flying-foxes have come into contact with my horse	0.00%	0
I have had to remove flying-fox droppings from my property	22.97%	17
I have had to remove flying-fox droppings from my car or other vehicle	35.14%	26
I have had to remove flying-fox droppings that soiled my clothing	6.76%	5
None of the above	47.30%	35
Total Respondents: 74		

Q8 For each of the following, please indicate your level of concern regarding the impacts of flying foxes?

Answered: 74 Skipped: 0



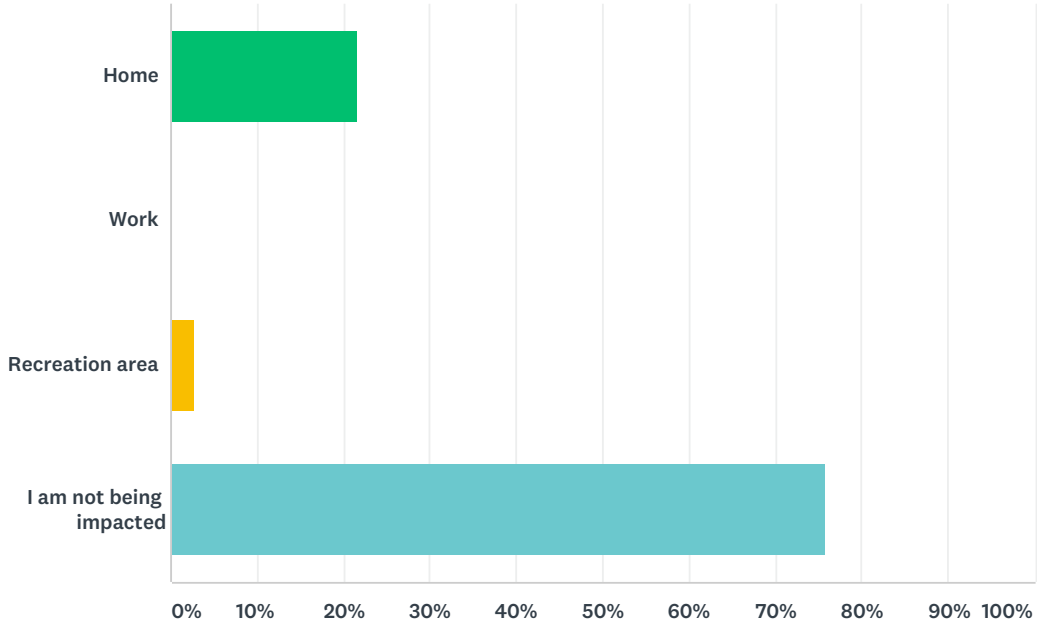

Droppings and/or mess
Damage to infrastructu...
Flying-foxes striking...
Visual amenity



	NOT CONCERNED	(NO LABEL)	(NO LABEL)	(NO LABEL)	EXTREMELY CONCERNED	TOTAL
Noise	70.42% 50	14.08% 10	7.04% 5	5.63% 4	2.82% 2	71
Smell	61.64% 45	21.92% 16	8.22% 6	4.11% 3	4.11% 3	73
Fear of disease in humans	44.59% 33	18.92% 14	14.86% 11	13.51% 10	8.11% 6	74
Fear of disease in pets or animals	40.54% 30	22.97% 17	16.22% 12	10.81% 8	9.46% 7	74
Droppings and/or mess	45.21% 33	26.03% 19	12.33% 9	10.96% 8	5.48% 4	73
Damage to infrastructure such as power lines	45.21% 33	19.18% 14	20.55% 15	8.22% 6	6.85% 5	73
Flying-foxes striking aircraft	49.32% 36	13.70% 10	19.18% 14	8.22% 6	9.59% 7	73
Visual amenity	64.86% 48	18.92% 14	9.46% 7	2.70% 2	4.05% 3	74
Damage to vegetation	45.95% 34	22.97% 17	17.57% 13	6.76% 5	6.76% 5	74
Not being able to access areas where flying-fox camps establish	52.70% 39	17.57% 13	16.22% 12	9.46% 7	4.05% 3	74

Q9 Where are you being impacted most?

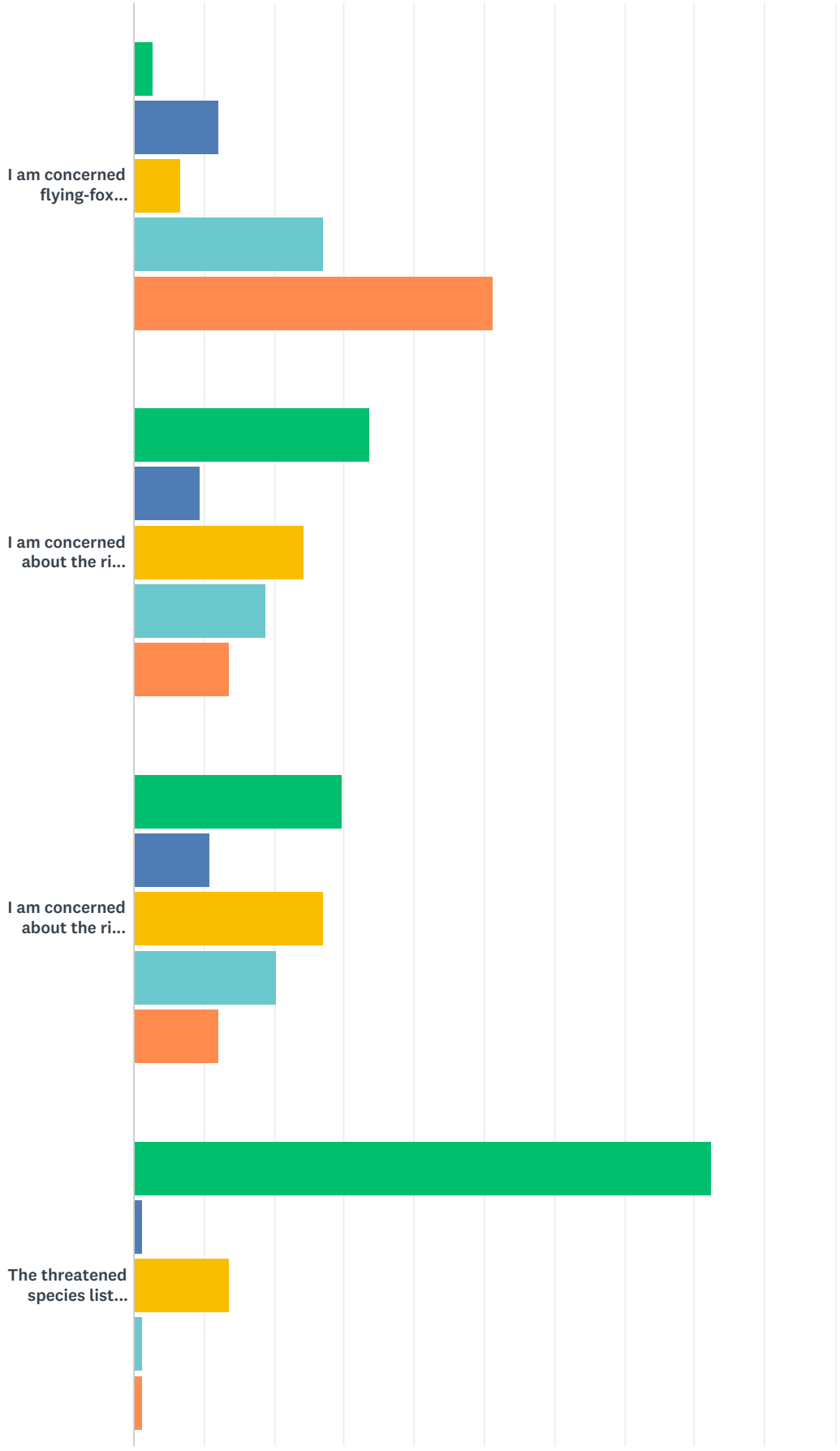
Answered: 74 Skipped: 0

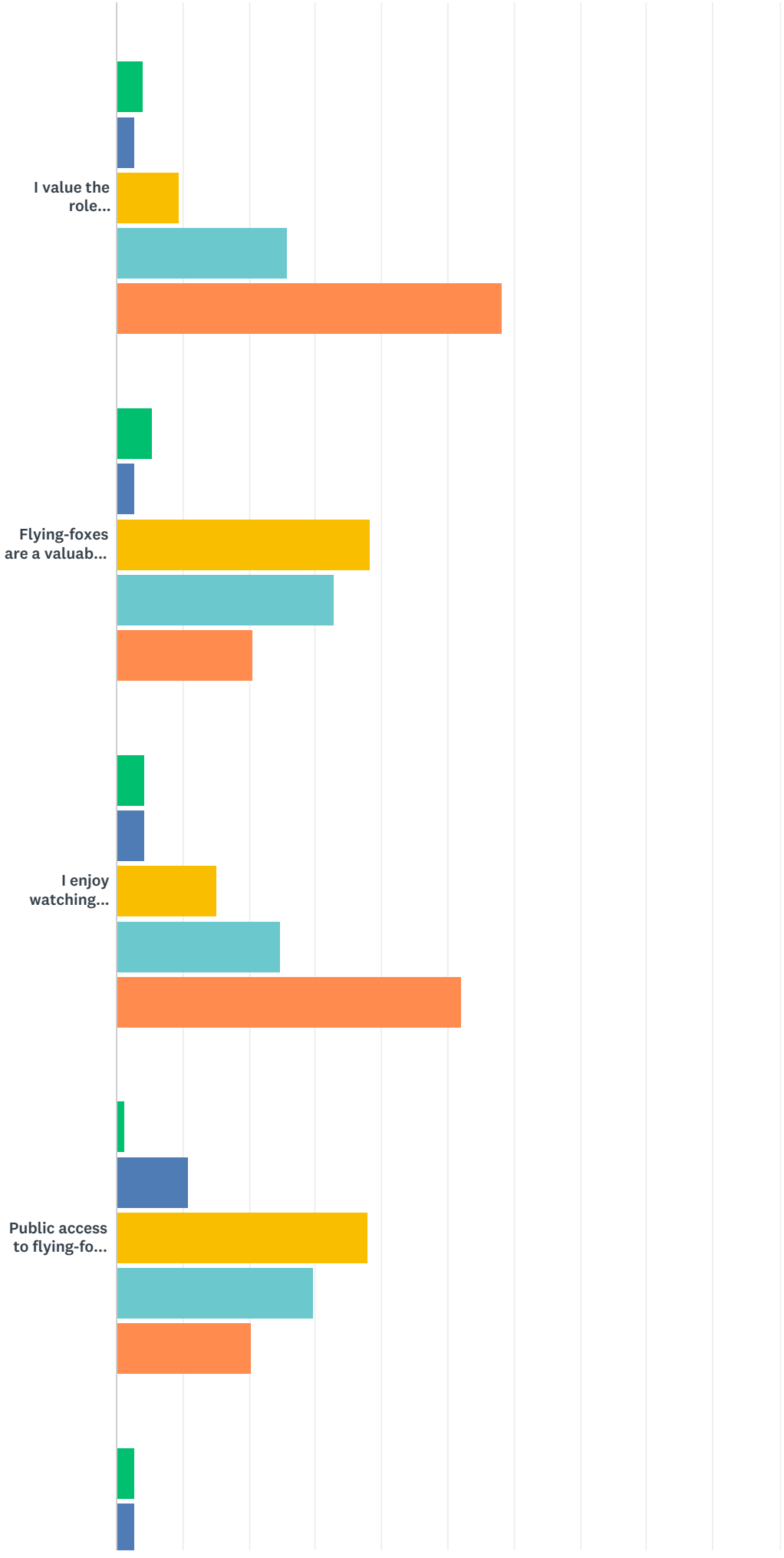


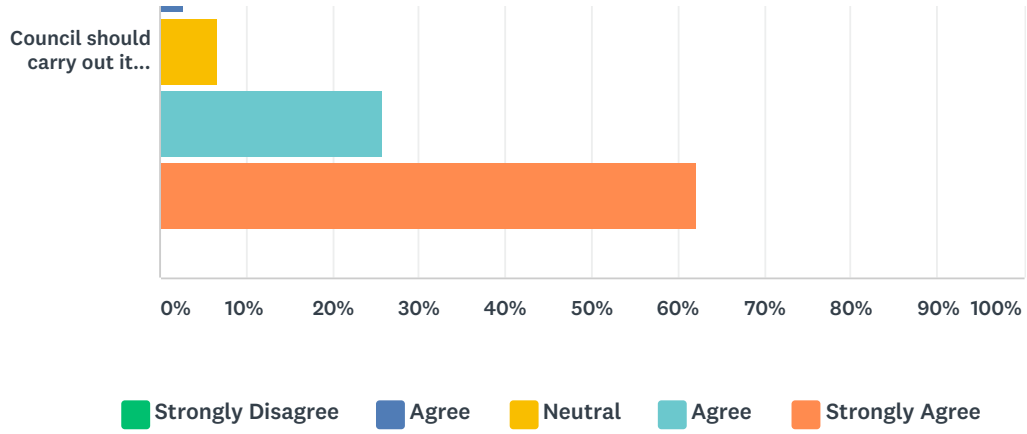
ANSWER CHOICES	RESPONSES	
Home	21.62%	16
Work	0.00%	0
Recreation area	2.70%	2
I am not being impacted	75.68%	56
TOTAL		74

Q10 Please indicate your level of agreement or disagreement with each of the following statements:

Answered: 74 Skipped: 0



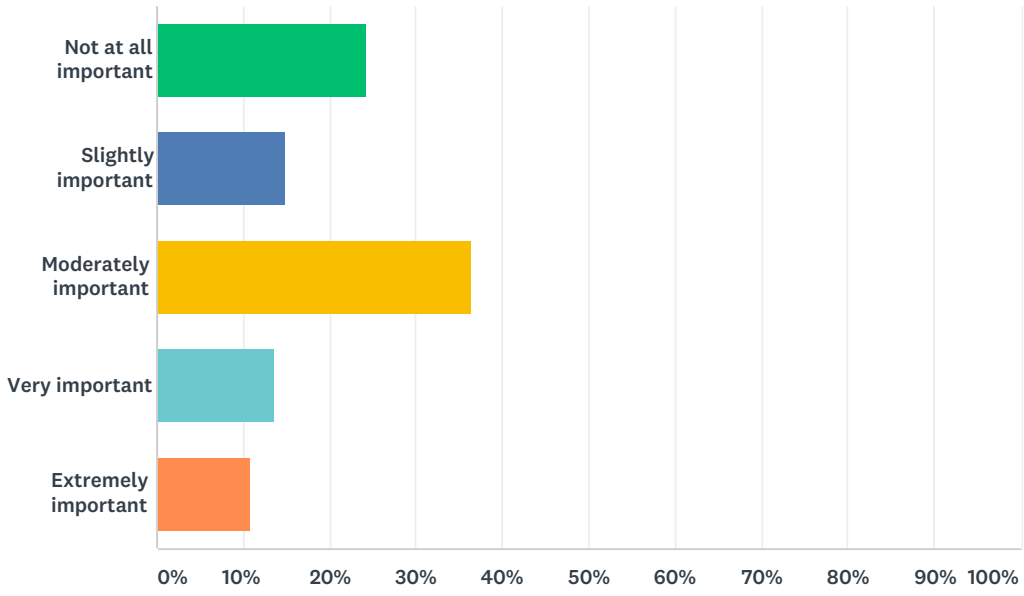

I value the role...
Flying-foxes are a valuab...
I enjoy watching...
Public access to flying-fo...



	STRONGLY DISAGREE	AGREE	NEUTRAL	AGREE	STRONGLY AGREE	TOTAL
I am concerned flying-fox numbers are declining	2.70% 2	12.16% 9	6.76% 5	27.03% 20	51.35% 38	74
I am concerned about the risk of disease to humans from flying-foxes	33.78% 25	9.46% 7	24.32% 18	18.92% 14	13.51% 10	74
I am concerned about the risk of disease to other animals from flying-foxes	29.73% 22	10.81% 8	27.03% 20	20.27% 15	12.16% 9	74
The threatened species listing and legal protection of flying-foxes should be removed	82.43% 61	1.35% 1	13.51% 10	1.35% 1	1.35% 1	74
I value the role flying-foxes play in improving the health and diversity of natural areas	4.05% 3	2.70% 2	9.46% 7	25.68% 19	58.11% 43	74
Flying-foxes are a valuable tourism opportunity	5.48% 4	2.74% 2	38.36% 28	32.88% 24	20.55% 15	73
I enjoy watching flying-foxes forage or fly overhead	4.11% 3	4.11% 3	15.07% 11	24.66% 18	52.05% 38	73
Public access to flying-fox camps should be restricted	1.35% 1	10.81% 8	37.84% 28	29.73% 22	20.27% 15	74
Council should carry out its legal obligation to manage threatened species including flying-foxes	2.70% 2	2.70% 2	6.76% 5	25.68% 19	62.16% 46	74

Q11 How important is it to you that potential management has a low financial cost to Council ratepayers?

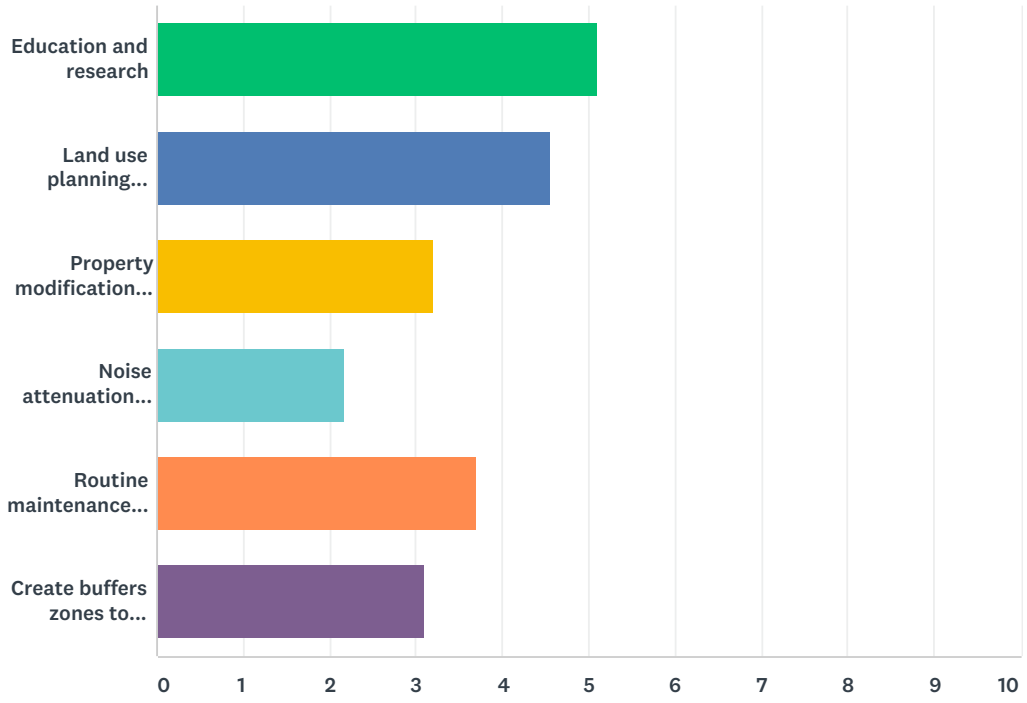
Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
Not at all important	24.32%	18
Slightly important	14.86%	11
Moderately important	36.49%	27
Very important	13.51%	10
Extremely important	10.81%	8
TOTAL		74

Q12 Please rank the following management options in order of preference (1 being the most important. Leave blank any that are not important to you):

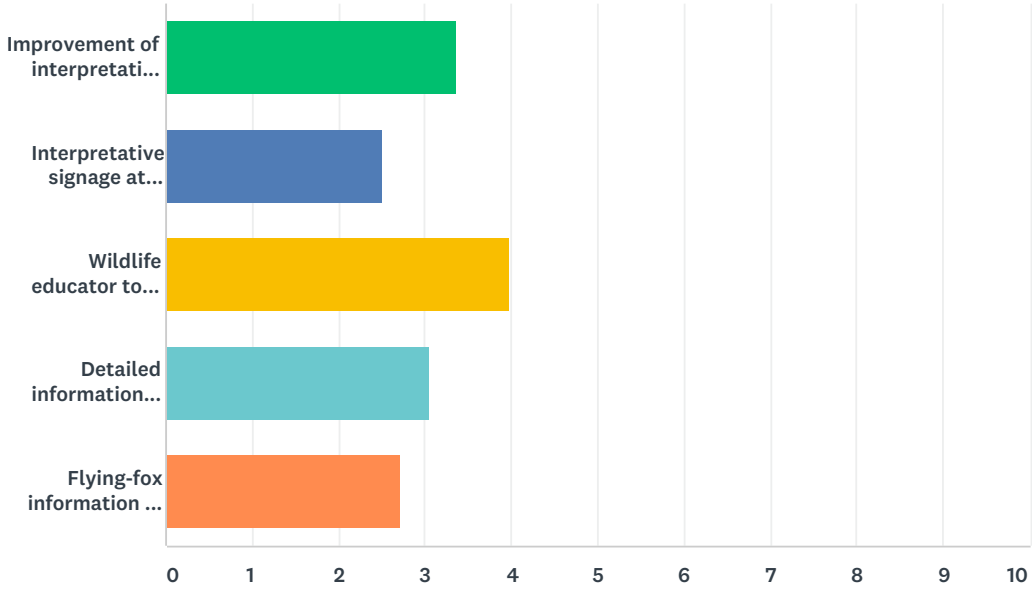
Answered: 72 Skipped: 2



	1	2	3	4	5	6	TOTAL	SCORE
Education and research	53.23% 33	20.97% 13	14.52% 9	6.45% 4	3.23% 2	1.61% 1	62	5.10
Land use planning including zoning of flying-fox camps	26.67% 16	38.33% 23	16.67% 10	6.67% 4	6.67% 4	5.00% 3	60	4.57
Property modification to eliminate flying-fox impacts (e.g. planting aromatic plants, removing foraging trees)	1.75% 1	19.30% 11	21.05% 12	24.56% 14	22.81% 13	10.53% 6	57	3.21
Noise attenuation fencing	5.56% 3	1.85% 1	0.00% 0	29.63% 16	22.22% 12	40.74% 22	54	2.17
Routine maintenance including weed removal and habitat enhancement works in camp	12.50% 8	17.19% 11	31.25% 20	12.50% 8	20.31% 13	6.25% 4	64	3.70
Create buffers zones to restrict flying-fox/community interaction	11.29% 7	9.68% 6	19.35% 12	22.58% 14	11.29% 7	25.81% 16	62	3.10

Q13 What, if any, educational options regarding flying-foxes would you like to see? Rank according to order of preference (1 being most preferred)

Answered: 69 Skipped: 5



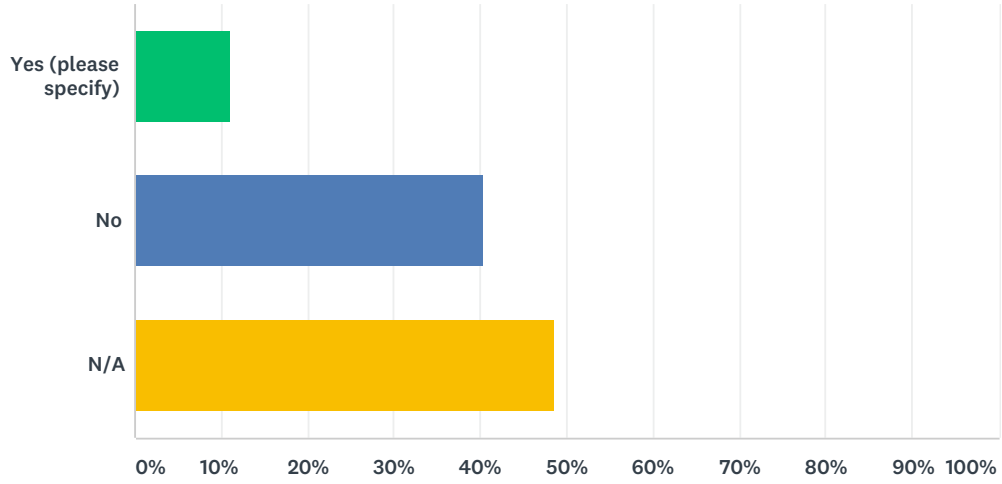
	1	2	3	4	5	TOTAL	SCORE
Improvement of interpretative signage at flying-fox viewing platform	26.42% 14	20.75% 11	24.53% 13	18.87% 10	9.43% 5	53	3.36
Interpretative signage at Jacqui Osmond Reserve	5.26% 3	17.54% 10	26.32% 15	24.56% 14	26.32% 15	57	2.51
Wildlife educator to visit local schools/clubs	45.76% 27	22.03% 13	22.03% 13	3.39% 2	6.78% 4	59	3.97
Detailed information about flying-foxes on Council website	17.54% 10	22.81% 13	19.30% 11	28.07% 16	12.28% 7	57	3.05
Flying-fox information on social media	16.13% 10	20.97% 13	14.52% 9	14.52% 9	33.87% 21	62	2.71

Q14 Are there any other educational options you would like to see regarding Flying-foxes?

Answered: 44 Skipped: 30

Q15 Would you be interested in options for your property if assistance was provided in some way? e.g. high-pressure water cleaner hire to remove droppings, advice regarding vegetation trimming and modification.

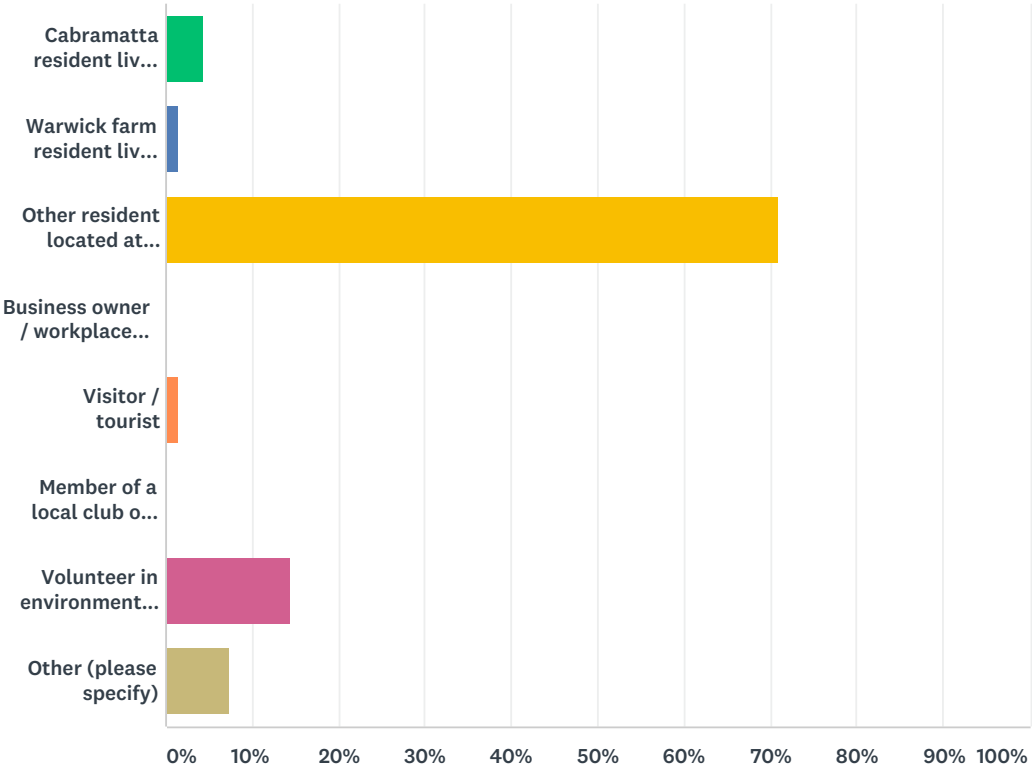
Answered: 72 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes (please specify)	11.11%	8
No	40.28%	29
N/A	48.61%	35
TOTAL		72

Q16 Which of the following best describes you?

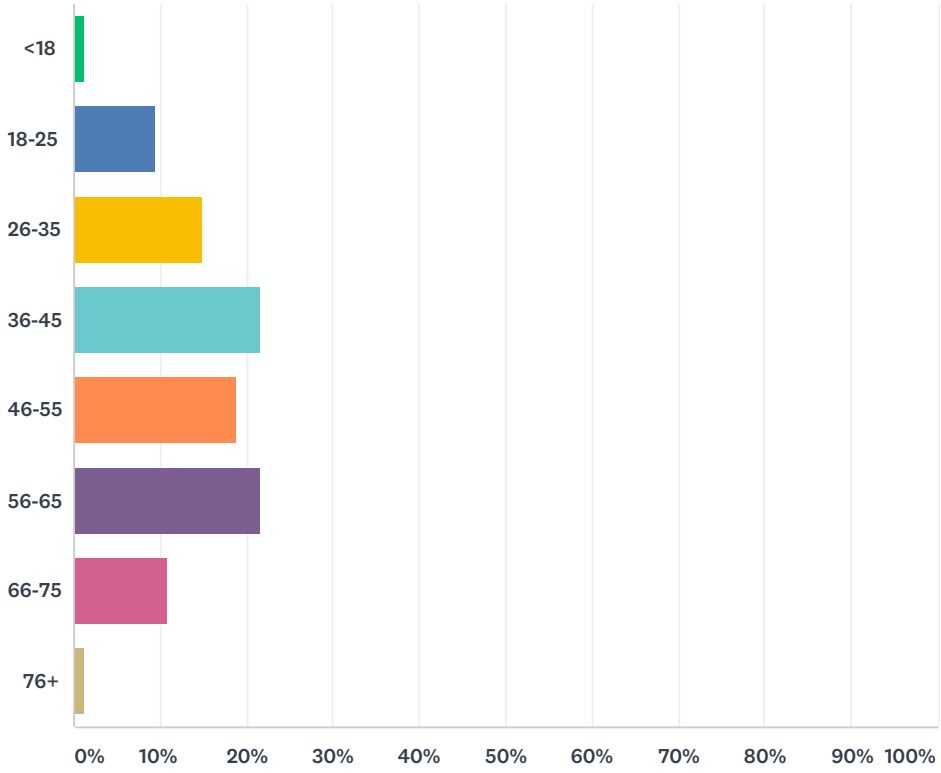
Answered: 69 Skipped: 5



ANSWER CHOICES	RESPONSES	
Cabramatta resident living near Cabramatta Creek camp	4.35%	3
Warwick farm resident living near Cabramatta Creek camp	1.45%	1
Other resident located at (please specify)	71.01%	49
Business owner / workplace near Cabramatta Creek camp	0.00%	0
Visitor / tourist	1.45%	1
Member of a local club or group? (please specify)	0.00%	0
Volunteer in environment program? (please specify)	14.49%	10
Other (please specify)	7.25%	5
TOTAL		69

Q17 What age group are you in?

Answered: 74 Skipped: 0



ANSWER CHOICES	RESPONSES	
<18	1.35%	1
18-25	9.46%	7
26-35	14.86%	11
36-45	21.62%	16
46-55	18.92%	14
56-65	21.62%	16
66-75	10.81%	8
76+	1.35%	1
TOTAL		74

Q18 Any other Comments?

Answered: 31 Skipped: 43

Appendix 5 Camp management options

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

5.1 Level 1 actions: routine camp management

5.1.1 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 5.1.

Figure 5.1 Possible components of an education program

5.1.2 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. Potential suitable native species which are unlikely to attract flying-foxes include:
    - *Arthropodium milleforum* (vanilla lily)
    - *Bursaria spinosa* (Christmas bush)
    - *Hardenbergia violacea* (false sarsaparilla)
    - *Hibbertia scandens* (golden guinea vine)
    - *Indigofera australis* (Austral indigo)
    - *Homalanthus populifolius* (bleeding heart)

  - *Hymenosporum flavum* (native frangipani)
  - *Kunzea ambigua* (tick bush)
  - *Lomandra longifolia* (spiny-head mat-rush)
  - *Ozothamnus diosmifolius* (rice flower).
- 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.

Residents and businesses are ultimately responsible for their own property on private land. The cost for property modification would be borne by the landholder.

5.1.3 Property modification subsidies

Fully funding or providing subsidies to property owners for property modifications may be considered to manage the impacts of the flying-foxes around camps. 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.

5.1.4 Service subsidies

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

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

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

5.1.5 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 2015*, 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
- cease mowing during maternity periods where necessary to prevent undue stress to flying-foxes
- application of mulch or
- removal of leaf litter or other material on the ground.

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

5.1.6 Revegetation and land management to create alternative habitat

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

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

When improving a site for a designated flying-fox camp, preferred habitat characteristics

detailed in Appendix 1 should be considered.

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

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

Potential habitat mapping using camp preferences 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.

5.1.7 Provision of artificial roosting habitat

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

5.1.8 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).

5.1.9 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.

5.1.10 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.

5.1.11 Property acquisition

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

5.1.12 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.

5.2 Level 2 actions: in-situ management

5.2.1 Buffers

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

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

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

Buffers through vegetation removal

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

Any vegetation removal should be done using a staged approach, with the aim of removing as little native vegetation as possible. This is of particular importance at sites with other values (e.g. ecological or amenity), and in some instances the removal of any native vegetation will not be appropriate. Thorough site assessment 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 heat stress events also requires consideration.

Buffers without vegetation removal

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

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

Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012) and balloons (Ecosure, 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 heat stress events, and overuse may impact other environmental values of the site.

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

5.2.2 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.

5.3 Level 3 actions: disturbance or dispersal

5.3.1 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).

5.3.2 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). See Appendix 4 for more details. 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 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.

5.4 Unlawful activities

5.4.1 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 BC Act and will not be permitted as a method to manage flying-fox camps.

5.5 Camp management options analysis

Table 5.5.1 provides an analysis of the camp management options described in Section 5 and their suitability for implementation at Cabramatta Creek Camp. An appraisal is provided for the options to be either adopted, investigated further or disregarded within this plan.

Table 5.5.1 Camp management options analysis

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
Level 1 options					
Education and awareness programs	Fear of disease Noise Smell Faecal drop	$	Low cost, increasing awareness will help the community coexist with flying-foxes, providing options for landholders to reduce impacts is an effective long-term solution and can be undertaken quickly.	Education and advice itself will not mitigate all issues, and on its own would not be acceptable to the community.	The camp does not generally directly create conflict for the community, with complaints associated with foraging flying-foxes (which is largely independent of camp location). Survey results indicate the community is in favour of a range of educational tools and methods, and this option can be implemented immediately. Appraisal: Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
Property modification	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$–$$	Property modification is one of the most effective ways to reduce amenity impacts of a camp without dispersal, relatively low cost, promotes conservation of FFs, can be undertaken quickly, will not impact on the site and may add value to the property. Property modification, such as glazing windows or installing noise attenuating insulation, will greatly assist with noise impacts inside residences and businesses.	May be cost-prohibitive for private landholders, however subsidies would assist.	Community is not currently being impacted by roosting flying-foxes at their properties. Given that a buffer between residences has been created through considerate planting (see Section 2.4), and assuming the camp is maintained appropriately, future conflict is considered unlikely. Appraisal: Disregard
Service subsidies	Noise Smell Faecal drop Health/wellbeing	$	Council could provide car covers, clothesline covers, free hire of pressure cleaners or consider rate reductions to assist with faecal drop impacts.		Council to provide assistance for impacts from foraging flying-foxes including installation advice of wildlife friendly netting or a plant swap program Appraisal: Adopt
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	Residents could be encouraged to modify properties by planting dense screens and fragrant plants Appraisal: Investigate further
Routine camp management	Health/well-being	$	Weed removal has the potential to reduce roost availability and reduce numbers of roosting FFs.	Will not generally mitigate amenity impacts for nearby landholders. Removing weeds also changes the microclimate which can increase camp temperature and therefore susceptibility to heat stress events	Within the Flying-fox Reserve, any weed removal should be staged and considerate of flying-fox requirements. An up-to-date restoration plan for the camp is required. Appraisal: Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
Alternative habitat creation	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$$-$$$	If successful in attracting FFs away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts and helps FF conservation. Rehabilitation of degraded habitat that is likely to be suitable for FF use could be a more practical and faster approach than habitat creation.	Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract FFs to a new site have not been known to succeed.	LCC has been undertaking restoration within the Jacquie Osmond Reserve Appraisal: Adopt (ongoing)
Provision of artificial roosting habitat	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$-$$	Artificial roosting habitat could be considered to supplement the canopy if weed invasion and restoration effects 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.	Preserving the canopy at the camp is a priority for the flying-foxes roosting in privet. Alternative structures should be investigated to supplement roosting areas in the camp that may have suitable understorey but lack a canopy of sufficient height ready for roosting flying-foxes. Appraisal: Investigate further
Protocols to manage incidents	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 but will reduce fear of disease.	Council could develop standard internal procedures as part of Heat Stress Event plan for engaging carers to respond to sick and injured wildlife in resident's backyards Engage with energy provider to bund or space powerlines near the camp to prevent electrocution. Appraisal: Adopt

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
Research	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$	Support research that improve understanding and more effectively mitigates impacts. Develop understanding of native flowering event in area.	Generally, cannot be undertaken quickly, management trials may require cost input.	Council staff are actively involved in attending conferences and events that assist in the management of threatened species. Appraisal: Adopt
Appropriate land-use planning	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$	Suitable planning for future development will reduce potential for future conflict by ensuring adequate distances are maintained between future residential developments and existing or historical flying-fox camps. Identification of degraded sites that may be suitable for long-term rehabilitation for FFs could reduce impacts.	Will not generally mitigate current impacts.	Council may consider including additional buffer zones within their codes in future planning scheme updates if properly documented and justified Appraisal: Investigate further
Property acquisition	All for specific property owners Nil for broader community	$$$			Not required at this location. Appraisal: 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. Appraisal: Disregard
Level 2 options					
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 vegetation as possible and only in vegetation directly affecting residents.	Removing vegetation can also increase visibility into the camp and noise issues for neighbouring residents which may create further conflict. Vegetation removed too quickly could cause inadvertent dispersal.	The camp is buffered by playing fields, roads and a carpark. Furthermore, to keep flying-foxes away from nearby urban areas, roost trees have not been planted along the edges of the creek, instead dense mid-storey

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
				Because the site contains TECs, any works other than assisted regeneration could trigger an impact assessment of significance (Part 5 activities under EP&A Act) and may require a Threatened species licence under Biodiversity Conservation Act 2016.	shrubs have been planted to discourage flying-foxes and provide a sound barrier (FCC 2001). Camp does not require further buffering for sensitive receptors Appraisal: Disregard
Buffers without vegetation removal – visual deterrents, canopy mounted sprinklers	Noise Smell Health/wellbeing Damage to vegetation	$$	Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes from designated buffer zones in Queensland (Ecosure pers comm.). 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 heat stress events, and overuse may impact other environmental values of the site. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. Potentially lead to increase in rubbish in the natural environment.	The camp is buffered by playing fields, roads and a carpark. Camp does not require further buffering for sensitive receptors Appraisal: Disregard
Noise attenuation fencing	Noise Smell Health/wellbeing Property devaluation Lost rental return/income	$$	Standard noise attenuation fencing is intended to alleviate amenity issues for residents. Advice from an acoustic consultant may provide site-specific alternatives	Noise attenuation fencing is costly and can be considered unsightly for property fencing.	Community has not indicated that impacts are being received by roosting flying-foxes so no action required. Appraisal: Disregard
Level 3 options					
Nudging	All	$$–$$$	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.	The site is a Flying-fox Reserve which is not impacting the community and so Level 3

Management options	Relevant impacts	Cost $-$$$ Low-high	Advantages	Disadvantages	Suitability for site
Active dispersal	All at that site but not generally appropriate for amenity impacts only	$$$	If successful can mitigate all impacts at that site.	Dispersal is rarely successful without significant vegetation removal (not appropriate at this location) or ongoing effort and excessive expenditure (e.g. several years and $1M for Sydney Botanic Gardens). Flying-foxes will almost always continue to roost in the area (generally within 600m), and often splinter into several locations nearby (including many remaining at the original site) (e.g. a single camp permanently splintered to numerous sites as a result of dispersal in Maclean, including remaining at the original site).	actions are not required. Appraisal: Disregard

Appendix 6 Flying-fox rescue

Reference documents:

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

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

Purpose

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

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

Requirements

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

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

Human first aid

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

Equipment

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

Work instructions

Case assessment

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

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

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

Rescue instructions

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

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

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

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

Example scenarios

1. Bat low in tree:

   quickly place towel around bat before it can move away

grab hold of feet, toes may curl over rescuers fingers

place in carry basket / transport container.

2. Bat high in tree:

   place pole wrapped in towel in front of bat

   coax bat onto towel

   once on towel, quickly move away from branches and lower to ground

   once on ground, cover with towel and place into carry basket / transport container.

3. A bat caught on barbed wire fence:

   two people only – one to restrain with towel, while the other untangles

   put towels on the wire strands under or around to avoid further entanglement

   if the membrane has dried onto wire, syringe or spray water onto wing

   use pliers or wire cutter if necessary.

Animal first aid

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

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

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

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

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

Transport to veterinarian / wildlife carer

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

Objective

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

Standards

a. The transport container must be tall enough for the flying-fox to hang by its feet without hitting its head on the floor.

b. The container must be designed, set up and secured to prevent injuries to the flying-fox. The sides of the container must prevent the flying-fox from poking its head or wings out.

c. The container must be designed to prevent the flying-fox from escaping.

d. The flying-fox must be allowed to hang by its feet from the top of the container or if it is unable to hang, wrapped in material (e.g. sheet or flannel) and placed in a sling so its feet are higher than its head.

e. The container must be kept at a temperature which is appropriate for the age and condition of the flying-fox. A range of 25–27°C is appropriate for an adult. A temperature of 28°C is appropriate for an orphan. A cool or warm water bottle may be required.

f. The container must be ventilated so air can circulate around the flying-fox.

g. The container must minimise light, noise and vibrations and prevent contact with young children and pets.

h. During transport, a container holding a flying-fox must have a clearly visible warning label that says 'Warning – live bat'.

i. A flying-fox must not be transported in the back of an uncovered utility vehicle or a car boot that is separate from the main cabin.

Guidelines

Flying-fox transport should be the sole purpose of the trip and undertaken in the shortest possible time.

The fauna rehabilitation group's contact details should be written on the transport container in case of an emergency.

Appendix 7 Heat stress event draft response plan

This draft plan aims to assist Council to manage heat stress events (HSE). The following should be read with referral to the OEH heat stress fact sheet. Whilst there is no obligation for Council to mitigate against heat stress impacts at a flying-fox camp, proactively managing these events will:

- minimise potential welfare impacts
- support conservation, including of the threatened GHFF
- minimise flying-fox mortality which will also reduce community amenity and potential health impacts associated with morbidity and mortality
- reduce the likelihood of close interactions with people and flying-foxes which may result in a bite or scratch
- minimise costs and energy expended by reactively managing HSE (i.e. carcass collection and disposal).

It is important to recognise that intervening at an inappropriate time or under certain circumstances can be more detrimental than beneficial. Welbergen (2012) suggests intervention is generally not recommended, unless animals are still unresponsive after temperatures have dropped below ~37°C. As such, a response plan should only be considered when guided by people with extensive experience in managing an HSE. As detailed in the OEH fact sheet, approval is also required to intervene in an HSE (e.g. for example when a response is initiated by a licenced fauna rehabilitation group).

What is heat stress

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).

A flying-fox is considered to be suffering from heat stroke once fanning and shade-seeking is no longer effective and must resort to panting and salivating to reduce body temperature. The point at which heat stroke develops varies with each individual's behaviour and metabolic rate (Bishop 2014). Heat stroke is the cell damage that occurs from enduring the effects of prolonged exposure to heat and the physical effort (exertion) involved to dissipate heat. Exertional heat stroke can lead to myopathy (muscle damage), rhabdomyolysis (breakdown of muscle causing kidney damage) or multi-systemic damage to gastrointestinal tract, renal, circulatory, nervous or respiratory systems as well as death.

The HSE plan consists of three parts:

1. Prediction and preparation
2. Coordination and mobilisation
3. Responding and treatment.

1. Prediction and preparation

Factors that contribute to a HSE vary from colony to colony, depending on geographic location, weather, camp characteristics and demographics (Table 4.4)

Table 7.1 Heat stress event variables

Weather / climate	Roost characteristics	Demographics
< 38ºC (with likely mortality at 42ºC)	Species composition	No. of lactating mothers
No. of consecutive hot days	Size of roost	No. and age of juveniles
Humidity	Understorey vegetation	Birthing season – early or late

The Lab of Animal Ecology (Western Sydney University) has developed the Flying-fox Heat Stress Forecaster to monitor weather conditions at known flying-fox camps and provide alerts when heat stress and heat-related mortality is likely. Those responsible for monitoring should set alerts through the forecaster to ensure they are notified of a potential HSE. When a potential HSE is predicted, weather conditions at the camp should also be monitored to determine the likelihood of a HSE occurring. Those responsible for monitoring will need to contact a HSE Response Coordinator when a HSE is predicted (Figure 7.1).

It is necessary to determine on-ground logistics before conditions for an HSE arise. A Site Response Plan should be prepared that includes:

- access points
- parking
- availability of water
- suitable locations for headquarters and triage tent
- liaising with neighbouring residents and providing information on potential management actions
- health and safety requirements.

The site response plan should identify hazards in and around the camp and the controls to be implemented to reduce risk to response plan participants. Identify the minimum requirements for personal protective equipment (PPE, Table 12) and ensure all participants are adequately provided with this equipment. Clear demarcation must be made for what actions ABLV-vaccinated and non-vaccinated participants can complete.

The site response plan will need to include a list of key personnel and support organisations with contact details. Documents such as sign in sheets and data recording sheets should be

prepared in advance and held at the headquarters (which should be located away from the triage area to minimise activity at the triage tent). While Council is responsible for assisting risk mitigation, the safety plan and induction should identify that Council insurance policies only apply to paid Council staff.

Responding to an HSE is confronting and will be highly stressful for some participants. There is also a risk that people will be physically affected by heat. Preventative measures and support for people experiencing physical or emotional responses to conditions during the HSE should be included in the site health and safety plan.

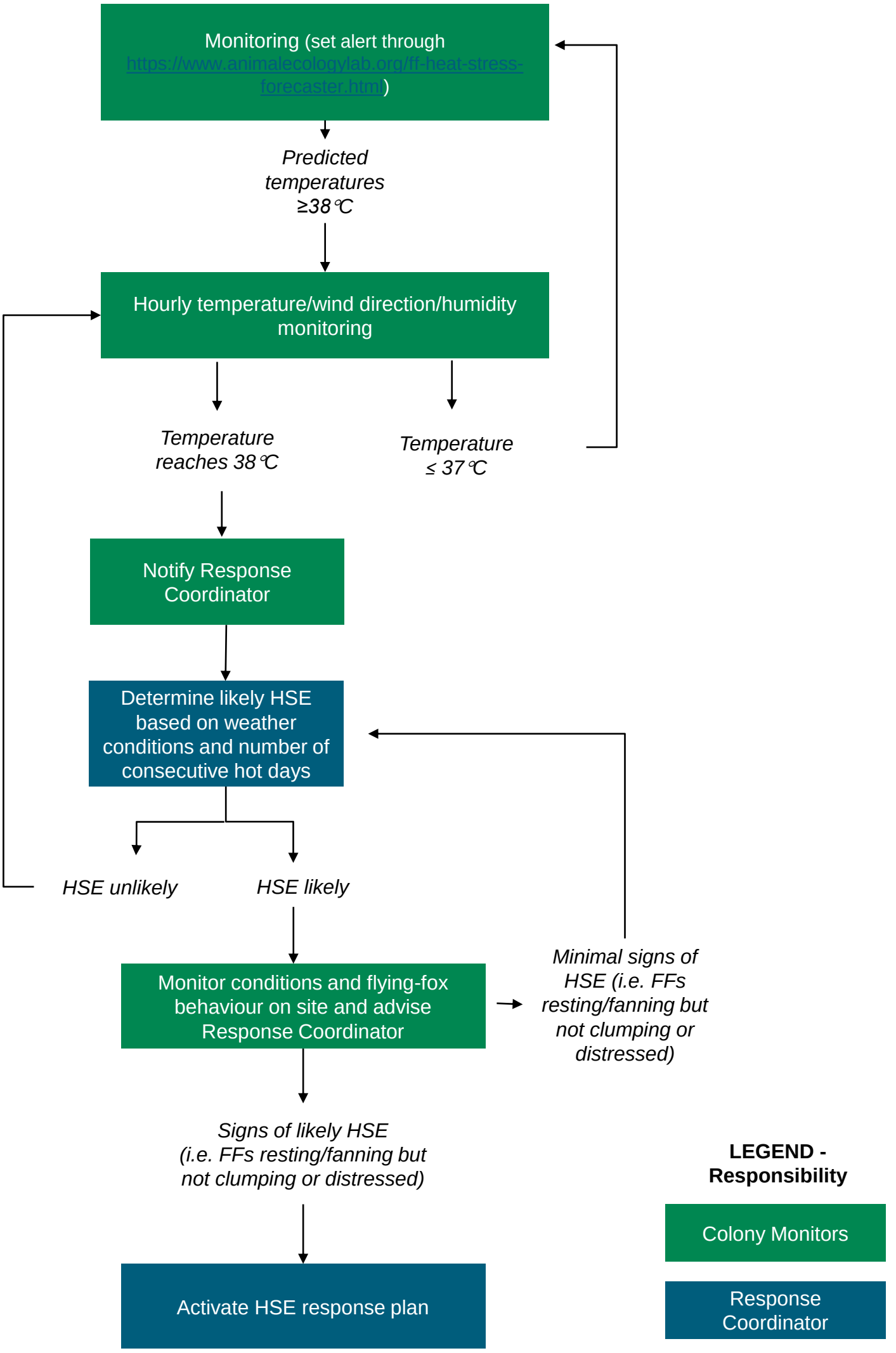


Figure 7.1 HSE response tool

2. Coordination and mobilisation

Equipment required to effectively manage an HSE shown in Table 7.2.1, including who will supply.

Table 7.2.1 Resources required and supply responsibilities. *Note in the event Council is unavailable, responding wildlife carers/veterinarian will need to supply these items.

Resource	Supply		
	Personal	Council*	Carer/veterinarian
PPE			
hat	✓		
long pants	✓		
closed shoes	✓		
puncture-resistant gloves		✓	✓
sunglasses or protective eyewear	✓	✓	✓
water bottle	✓		
insect repellent	✓		
face masks when collecting bodies		✓	
Cooling equipment			
water tankers/trailer/sprinklers		✓	
back pack sprayers/hand-held pumps	✓	✓	✓
hand held sprayer	✓	✓	✓
First aid - human			
first aid kit		✓	
wash station		✓	
drinking water	✓	✓	
flying-fox transport cages			✓
First aid – flying-fox			
triage tent		✓	
towels	✓		✓
syringes			✓
fluids and other veterinary supplies			✓
garbage bags for disposal		✓	✓
folding tables		✓	
Communication			
mobile phones	✓		
safety plan with contact details		✓	

The role of Response Coordinator and Site Coordinators should be undertaken by suitably qualified personnel (Table 7.3.1). Communication lines between personnel are shown in Figure 7.2.1.

Table 7.2.2 Personnel and responsibilities. *Note in the event Council is unavailable, these roles will need to be filled by non-Council personnel.

Role	Responsibilities	Who*	Reports
Response Coordinator	· first point of contact for Colony Temperature Monitors · initiate heat response plan including notifying Site Coordinators and arranging other team members · coordinate data records (i.e. any incidents, numbers/species/status of sick, injured, treated or dead flying-foxes) · coordinate timing, resources (equipment and personnel) · prioritise sites	Council staff member/contractor (1 per heat stress event)	Direct reports: Site Coordinators Reports to: Council
Colony Temperature Monitors	· set alerts through the Flying-fox Heat Stress Forecaster and monitor weather sites for conditions in colony before a potential HSE and notify Response Coordinator if HSE is likely · set up sprinklers under the colony the day before possible heat stress event if requested by Response Coordinator · monitor colonies on site if directed by Response Coordinator, and provide feedback of flying-fox behaviour to inform heat stress response · participate as required in heat stress response	Volunteers (2 prior to heat stress event then 1 per roost during heat stress event)	Direct reports: Nil Reports to: Response Coordinator
Site Coordinator	· initiate and enforce safety protocols (as per site safety plan), including personnel inductions · maintain site communication protocols · delegate roles and position in and around the colony according to Australian Bat Lyssavirus (ABLV) vaccination status · supervise personnel · collect site data records and provide to Response Coordinator · coordinate all activities on site and prioritise site-specific activities · set up triage tent · administer first aid to personnel if required · debrief team · support to all team members · report regularly to Response Coordinator	Volunteer (1 per roost)	Direct reports: Response team Reports to: Response Coordinator
Water truck driver/s	· drive to priority roosts (as advised by Response Coordinator) and operate water trucks/trailers as required. Suitably experienced members of the Response Team are to advise of water pressure, nozzle dimension and water direction.	Council staff (preferably 1 per per roost)	Direct reports: Nil Reports to: Response Coordinator

Role	Responsibilities	Who*	Reports
Response team	· monitor and observe flying-fox behaviour and report to Site Coordinator · spray water as advised by Carers/Veterinarians observe flying-foxes and take records · if vaccinated and trained, rescue flying-foxes as advised by Carers/Veterinarians · if vaccinated collect deceased flying-foxes, checking for attached young. · unvaccinated personnel must not handle flying-foxes in any circumstances. Such volunteers may: observe and collect weather/flying-fox behaviour information, register triaged animals, sign-in/sign-out participants, maintain human and flying-fox supplies.	Volunteers	Direct reports: Nil Reports to: Site Coordinator
Carers and Veterinarians	· provide advice to personnel for cooling/rescuing bats · triage · rehydration and treatment · euthanasia if necessary	Carers/veterinary staff (volunteer capacity)	Direct reports: Nil Reports to: Site Coordinator

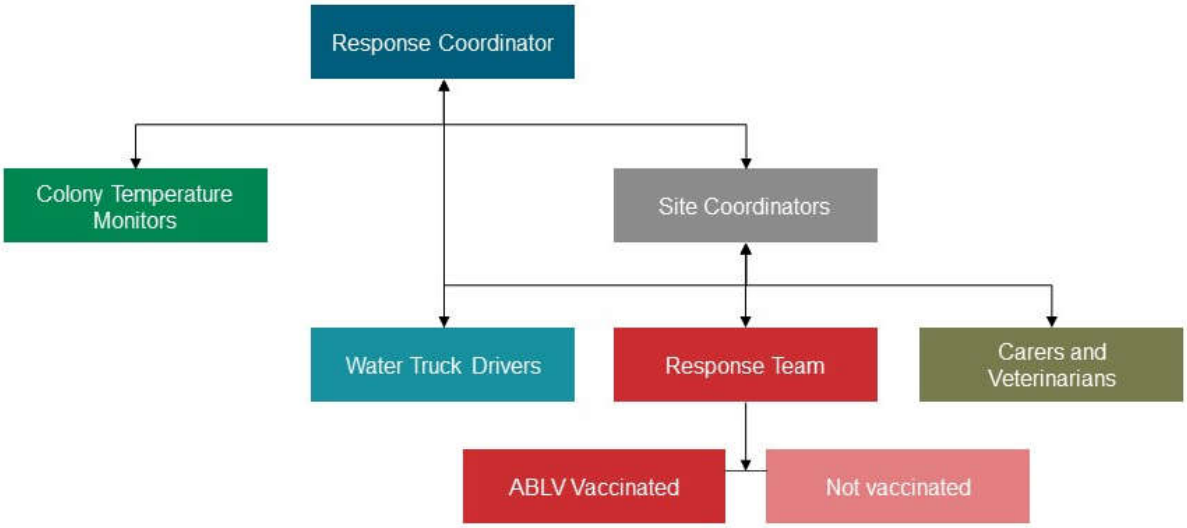


Figure 7.2.1 Communication lines between HSE personnel

3. Responding and treatment

During heat stress events there is a predictable behavioural sequence displayed by both BFF and GHFF:

- wing fanning

- shade seeking
- clustering/clumping
- salivating
- panting
- falling from trees.

While clustering is considered a normal behaviour in little red flying-foxes, clumping is the term used when flying-foxes roost on top of each other in any of the following positions (Stanvic et al 2013):

- shaded side of the tree
- in the understorey
- at base of trees or on the ground
- under logs or in tree hollows.

When flying-foxes begin to suffer from the heat, they fan themselves and move lower down the trees to avoid direct sunlight. Females with young will fan more often than all other demographic groups at high temperatures.

When wing fanning and shade seeking no longer adequately disperse heat, flying-foxes may resort to panting and saliva spreading. Saliva spreading will result in significant loss of body water and should only be used when body temperature has risen close to lethal limits (Licht and Leitner 1967 in Welbergen et al 2012). Table 13 details how personnel assisting the roost should respond to each behavioural response.

Triage should be determined by the Site Coordinator in consultation with the Carer/Veterinarian on site and the Response Coordinator, and vaccinated personnel delegated to collect if required.

Do not touch flying-foxes without appropriate PPE. Only vaccinated and trained people should come into contact with flying-foxes. All bats should be viewed as potentially carrying ABLV. If disposing of a dead flying-fox, do not directly touch it, use a shovel or tongs and place into two plastic bags.

Table 7.3.1 Flying-fox behaviour and appropriate action

Stage	Bat behaviour	Action
Resting	Hanging from perch, wings wrapped around body, eyes closed.	No action required.
Normal clustering	May include fanning.	Do not approach. Continue to observe.

Stage	Bat behaviour	Action
Bats fanning	Movement of wings in steady fanning motion. Note: not to be confused with wings outstretched when males broadcast their scent.	Do not approach. Continue to observe.
Clumping	Individuals moving in close proximity of each other. May appear hyperactive or distressed.	Observe from a distance so as not to disturb unnecessarily. Some clumps may be receptive to mist spraying.
Flying	Flying aimlessly, colliding with trees.	Retreat – flying will exacerbate HSE affects and risks females dropping young.
Moving down from canopy	Clumping in the understorey. Clumping at base of trees or on the ground. Clumping under logs or in tree hollows.	Spray and observe Even when in the understorey and base of trees, bats are capable of responding to spraying and can return to the canopy when conditions cool back down. If flying-foxes attempt to avoid spray, retreat to ensure HSE affects are not exacerbated.
Signs of heat stroke begin		
Panting	Rapid breathing with mouth open.	Spray and observe. If flying-foxes attempt to avoid spray, retreat to ensure HSE affects are not exacerbated.
Licking wrists	Individuals licking wrists or wing membranes.	Spray and observe. If flying-foxes attempt to avoid spray, retreat to ensure HSE affects are not exacerbated.
Bats on ground	Flying-fox on ground, lethargic.	Spray and observe. If flying-foxes attempt to avoid spray, retreat to ensure HSE affects are not exacerbated. Report to flying-fox coordinator/vet. Collect and take to first aid tent.
Falling to the ground	Disorientated.	Leave unconscious bats. If juveniles are attached to deceased mothers, they will need to be removed by carers.
Bats dead	Unresponsive.	Collect if disturbance to remaining camp can be minimised OR Leave and collect at night.

During the HSE, keep record of:

- flying-fox behaviour and time of day
- flying-foxes receiving treatment – species, sex and age (and volunteers who took each animal into triage)

- mortality data – species, sex and age.

Complete the Lab of Animal Ecology (Western Sydney University) Flying-fox Heat Stress Data Form for both affected and unaffected camps to support research into the affects, outcomes and appropriate response to future HSE.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	11/05/2018	Cabramatta Creek Flying-fox Camp Management Plan - draft	Emily Hatfield Senior Wildlife Biologist	Jess Bracks Principal Wildlife Biologist	
01	25/05/2018	Cabramatta Creek Flying-fox Camp Management Plan - draft1	Emily Hatfield Senior Wildlife Biologist	Jess Bracks Principal Wildlife Biologist	
02	24/10/2018	Cabramatta Creek Flying-fox Camp Management Plan - final	Emily Hatfield Senior Wildlife Biologist	Dave Fleming, Manager - SEQ	

Distribution List

Copy #	Date	Type	Issued to	Name
1	11/05/2018	Electronic	Liverpool City Council	Alexi Gilchrist
2	11/05/2018	Electronic	Fairfield City Council	Tim Johnson
3	11/05/2018	Electronic	Ecosure	Administration
4	25/05/2018	Electronic	Liverpool City Council	Alexi Gilchrist
5	25/05/2018	Electronic	Fairfield City Council	Tim Johnson
6	25/05/2018	Electronic	Ecosure	Administration
7	24/10/2018	Electronic	Liverpool City Council	Alexi Gilchrist
8	24/10/2018	Electronic	Ecosure	Administration

Citation: Ecosure (2018), Cabramatta Creek Camp Management Plan, Report to Fairfield City Council and Liverpool City Council Burleigh Heads

Report compiled by Ecosure Pty Ltd

ABN: 63 106 067 976

admin@ecosure.com.au www.ecosure.com.au

PR3277-DE.Cabramatta Creek Camp Management Plan.FI

Adelaide
PO Box 145
Pooraka SA 5095
P 1300 112 021
M 0407 295 766

Brisbane
PO Box 675
Fortitude Valley QLD 4006
P 07 3606 1030

Coffs Harbour
PO Box 4370
Coffs Harbour Jetty NSW 2450
P 02 562 8103

Gladstone
PO Box 5420
Gladstone QLD 4720
P 07 4994 1000

Gold Coast
PO Box 404
West Burleigh QLD 4219
P 07 5508 2046
F 07 5508 2544

Rockhampton
PO Box 235
Rockhampton QLD 4700
P 07 4994 1000