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NORTHERN BEACHES FLYING-FOX CAMP MANAGEMENT PLAN

DRAFT R2 July 2022

NORTHERN BEACHES COUNCIL

Acronyms and abbreviations

ABLV	Australian bat lyssavirus
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BFF	Black flying-fox (*Pteropus alecto*)
CE	Critically Endangered
CMP	Camp Management Plan
CMS	Canopy-mounted sprinklers
COP	Flying-fox Camp Management Code of Practice 2018
Council	Northern Beaches Council
DAWE	Department of Agriculture, Water and the Environment (Commonwealth)
DCP	Development Control Plan
DPE	Department of Planning and Environment (NSW)
E	Endangered
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FF	Flying-fox
GHFF	Grey-headed flying-fox (*Pteropus poliocephalus*)
GPT	Gross pollutant trap
HeV	Hendra virus
HEV	High Ecological Value
HSE	Heat stress event
LEP	Local Environmental Plan
LGA	Local government area
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)
NSW	New South Wales
ONT	Odour neutralising trial
PMST	Protected Matters Search Tool
PPE	Personal protective equipment
RBGDT	Royal Botanic Gardens Domain Trust
SFF	Spectacled flying-fox
TEC	Threatened Ecological Community
the Policy	Flying-fox Camp Management Policy 2015 (DPE)
V	Vulnerable

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1 Introduction

This Camp Management Plan (CMP) provides Northern Beaches Council (Council[1]) with a five-year plan to manage issues associated with flying-fox camps within the Local Government Area (LGA), whilst ensuring flying-foxes and their ecological services are conserved. The CMP focuses on three camps located on Council-managed land; Balgowlah – Burnt Bridge Creek Reserve (Balgowlah camp), Avalon – Cannes Reserve (Avalon camp), and Warriewood Wetlands (Warriewood camp).

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).

Information regarding flying-fox ecology, species profiles and camp characteristics are provided in Appendix 1. All three species and their habitats are protected under NSW legislation (see Appendix 2). In addition, the GHFF is afforded protection under Commonwealth legislation as a Vulnerable species due to significant population declines in recent decades.

1.1 Flying-foxes in urban areas

Flying-foxes are highly nomadic, moving across their range between a network of camps. Camps may be permanently occupied, seasonal, temporary or sporadic, and numbers can fluctuate significantly on a daily/seasonal basis (Welbergen et al. 2020). Flying-foxes may travel up to 100 km a night in search of food resources (nectar, pollen and fruit), and their occurrence within the LGA is tightly linked to flowering and fruiting of foraging trees. Typically, the abundance of resources within a 20–50 km radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments 2012). However, understanding the availability of foraging resources is difficult because flowering and fruiting are not reliable every year and vary between locations (SEQ Catchments 2012). This highlights the need for a multi-faceted approach to management that is continually adapted as situations change or further research improves our understanding of flying-foxes.

Living near a flying-fox camp can be challenging, with impacts associated with noise, odour, faecal drop, damage to vegetation and concern about potential health risks. There are also challenges associated with management. State approval is required under legislation to manage a camp, and actions which may affect the GHFF must also adhere to Commonwealth policy. Attempts to relocate flying-foxes are extremely costly, and often splinter a camp to multiple undesirable locations that are difficult to predict (Roberts et al. 2021). Flying-foxes will also regularly attempt to recolonise their preferred camp site when resources are available, and it is not appropriate or possible to remove all of the flowering and fruiting trees that attract them to the LGA.

[1] Also used to reference previous Councils Manly, Pittwater and Warringah which were amalgamated in 2016

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

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

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

These drivers mean that flying-foxes are likely to continue occupying the camp into the future. Favourable habitat and food resources within the LGA mean that camps may also establish in new locations.

1.2 Plan objectives

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

The overall objective of this CMP is to guide management, outline potential actions, increase awareness about flying-foxes, promote conservation and reduce negative impacts for communities near camps. Where flying-fox camps occur on or impact private land, private landowners are advised to contact Council to explore management options and the appropriate approval processes for addressing arising issues. Council is limited in how it can assist with the impacts of foraging flying-foxes however will provide support and advice about how landholders can reduce these impacts.

More specifically, the objectives of the CMP are to:

- guide management of the Balgowlah, Avalon and Warriewood flying-fox camps in accordance with the NSW Flying-fox Camp Management Policy
- minimise community impacts and avoid future conflict
- improve community understanding and appreciation of flying-foxes including their ecological role

- conserve flying-foxes and their habitat
- support community resilience to flying-fox impacts
- clearly define roles and responsibilities for management actions
- ensure actions are in accordance with relevant legislation.

1.3 Legislation

Flying-foxes are protected native wildlife that provide a critical ecological role in long-distance seed dispersal and pollination (see Appendix 1). As such, there is a range of legislation and policy that governs how flying-foxes and their habitat can be managed. Key legislation specific to flying-fox camp management is summarised in Table 1, with further detail in Appendix 2.

Table 1 Summary of key legislation

Level	Instrument	Relevance to CMP
Common-wealth	*Environment Protection and Biodiversity Conservation Act 1999*	Approval under the Act may be required for any action likely to impact a Matter of National Environmental Significance (MNES) e.g. nationally threatened species (such as the GHFF) or ecological communities, world heritage sites, wetlands of international importance. The Referral guideline for management actions in GHFF and spectacled flying-fox (SFF) camps (DoE 2015) specifies requirements for camp management, and when referral is required.
State	Flying-fox Camp Management Policy 2015	The Policy specifies which actions are permissible without DPE approval, with actions categorised as Level 1, Level 2 or Level 3. The Policy specifies a hierarchical approach to management based on the principle of using the lowest form of intervention. The CMP is aligned with the Policy.
	Biodiversity Conservation Act 2016 and Flying-fox Camp Management Code of Practice 2018 (COP)	Camp management activities not specified as 'routine camp management' in the Policy require the landholder (Council or private) to obtain a licence under the Act. Managers of public land (e.g. Council) are able to undertake some actions on that land without the need for a licence, provided they are done in accordance with the COP. Private landholders will still require a licence.
	Local Government Act 1993	Provides a framework for local government to act in an effective, efficient, environmentally responsible and open manner, and encourages community participation in Council affairs.
	National Parks and Wildlife Act 1974	Provides for the conservation of nature, objects, places or features of cultural value. Approval may be required if impacts are likely to impact any of these values.
	Prevention of Cruelty to Animals Act 1979	It may be an offence under the Act if there is evidence of animal torment or suffering as a result of management.
	Environmental Planning and Assessment Act 1979	Sets the framework for appropriate management and conservation of resources for the community and environment. Development control plans under the Act should consider appropriate provisions for development near a flying-fox camp, and to protect flying-fox habitat.
	State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017	Landholders require approval under the Act to cut down, fell, root, kill, poison, ringbark, burn or otherwise destroy vegetation, or lop or otherwise remove a substantial part of the vegetation to which the Policy applies.
Local	Northern Beaches Local Environmental Plans (LEPs) and the Development Control Plans (DCPs)	Council is currently developing a single planning framework to replace the current four LEPs and four DEPs. The planning framework will guide planning decisions and manage the way land is used, as well as providing more detailed guidance for local development.

2 Flying-foxes in the Northern Beaches

2.1 Regional context

Three flying-fox camps occur on Council-managed land within the Northern Beaches LGA; the Avalon, Warriewood, and Balgowlah camps (Figure 1). Nearby camps include Woywoy, Everglades to the north, Gordon (nationally important camp) to the west, and Centennial Park (nationally important camp) to the south.

Flying-fox occupancy in certain areas can be influenced by a multitude of factors but is generally driven by resource availability in the local area. Between 2019 and 2020, flying-foxes experienced significant population impacts across the east coast of Australia due to a range of extreme weather events. A prolonged drought period caused a mass food shortage from Coffs Harbour to Gladstone, in which thousands of flying-foxes perished from starvation (Cox 2019, Huntsdale & Millington 2019). Following this, bushfires across the country resulted in the loss of large areas of native forest that provides natural foraging habitat for flying-fox populations. Resource availability and these landscape scale events will influence numbers at Northern Beaches camps.

Figure 2 shows natural flying-fox foraging habitat within 50 km of the Northern Beaches flying-fox camps (mapping by Eby et al. 2019, building on Eby & Law 2008). Further detail about vegetation communities, their value as flying-fox foraging habitat and indicative flowering times can be found in spatial data and literature available from these studies.

Figure 1: Regional context

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

- Nationally important flying-fox camp
- Flying-fox camp
- Local Government Area

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Job number: PR7197
Revision: 0
Author: EK
Date: 20/06/2022

0 0.5 1 2
Kilometers

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

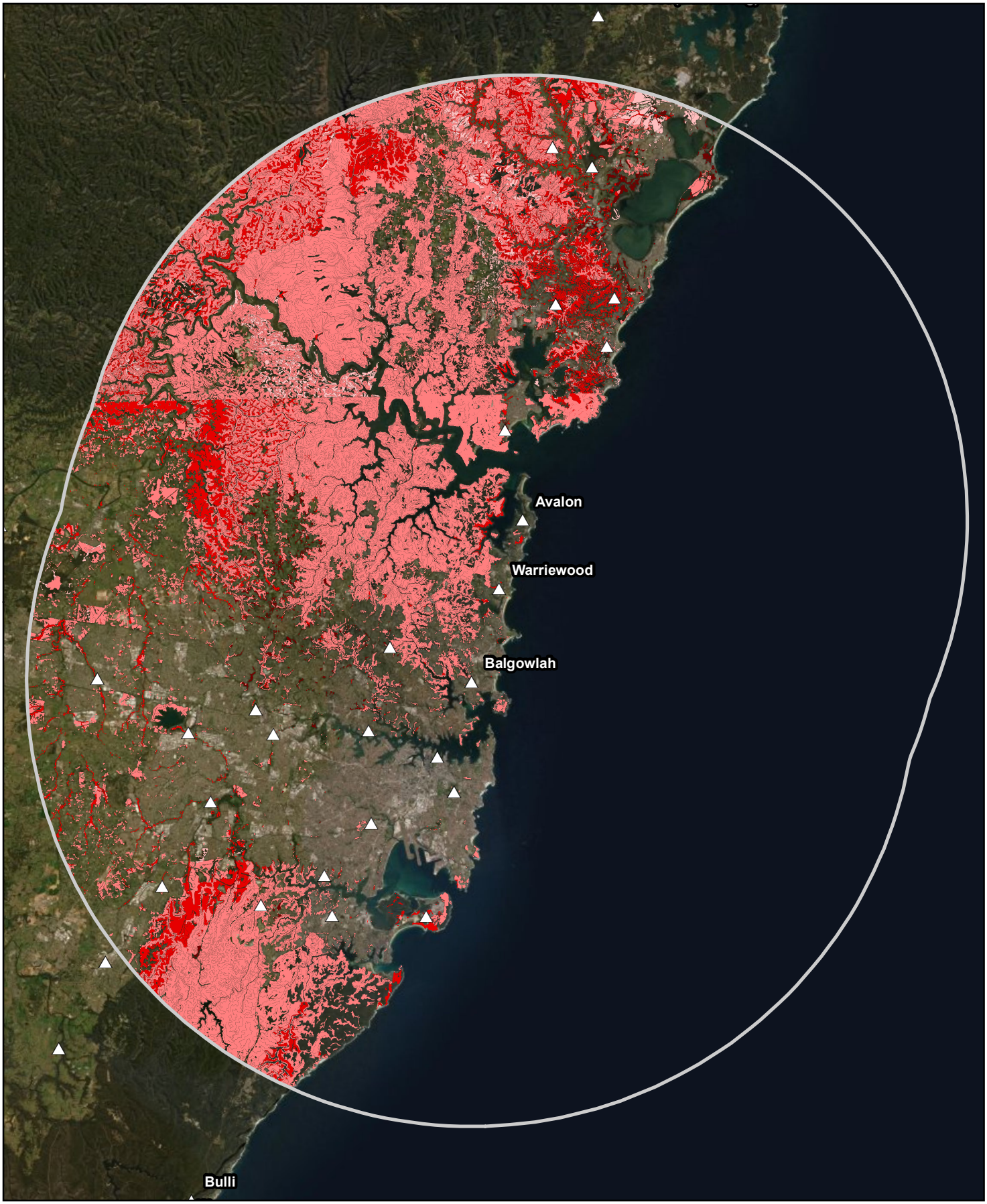

Figure 2: Flying-fox foraging habitat within 50 km of Northern Beaches camps

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

△ Flying-fox camp

50 km buffer

Habitat score *

0.00

0.01 - 0.25

0.26 - 0.50

0.51 - 0.75

0.76 - 1.00

* weighted productivity x reliability scores of flying-fox diet plants (nectar habitat). Data source: Eby et al. 2019

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0 2.5 5 10
Kilometers

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

2.2 Potential impacts from flying-foxes

Flying-foxes in urban areas are commonly the source of conflict with the community. This CMP aims to provide Council with management actions to reduce impacts on residents.

2.2.1 Noise

A highly sociable and vocal animal, the activity heard from flying-foxes at camps includes courting, parenting, and establishing social hierarchy. Noise is often most disturbing pre-dawn, and during the breeding season (e.g. during mating March/April, and pup rearing in spring/summer).

2.2.2 Odour

Flying-foxes use pheromones to communicate with each other, which is the source of the characteristic musky smell around their camps and some foraging trees. There are several factors that affect odour detectability and intensity, such as the number of flying-foxes, time of year, weather conditions, wind direction, and site characteristics.

Odour may be more intense at camps during the breeding and rearing season as female flying-foxes use scent to find their pups after foraging, and males regularly mark their territories (Wagner 2008). Likewise, odour is stronger after rain as males remark branches in their territories.

2.2.3 Faecal drop

Flying-foxes have an extremely fast digestive process with only 12 – 30 minutes between eating and excreting (SEQ Catchments 2012). Given that flying-foxes regularly forage 20 km from their camp (Markus & Hall 2004) and establish new camps within 600 m – 6 km when dispersed (Roberts & Eby 2013, Ecosure 2014), attempting to relocate a camp will not reduce this impact. As such, faecal drop impacts are best managed at an individual property level.

Faecal droppings can cause health concerns, reduced amenity, create a slip hazard, require time and resources to clean, and can damage paint if not promptly removed. Appropriate personal protective equipment (PPE) and hygiene measures are required when cleaning any animal excrement. High-pressure hoses and specific cleaning products are available to assist cleaning. Flying-foxes can be deterred from roosting and foraging around areas of concern. Areas of concern, such as picnic tables and play equipment, could also be covered (e.g. with shade cloth).

2.2.4 Human and animal health

All animals carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species. Flying-foxes may carry pathogens which can be harmful to humans, though there is no known risk of contracting bat-related viruses from contact with faecal drop or urine. As such, flying-fox urine and faeces should be treated like any other animal excrement. Key human and animal health risks associated with flying-foxes are

Australian bat lyssavirus (ABLV) and Hendra virus (HeV); the latter being particularly important for flying-fox camps located in close proximity to horse paddocks. Excluding those people whose occupations require contact with bats, such as wildlife carers and vets, human exposure to ABLV and HeV and frequency of infection is extremely rare. Health risks can be effectively mitigated through education, protocols, PPE, and basic hygiene measures. Further information on flying-foxes and human/animal health is provided in Appendix 3.

Water quality concerns

Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses health risks to humans. Household water tanks can be designed to minimise potential contamination, such as using first flush diverters to divert contaminants before they enter water tanks.

Tanks should be appropriately maintained and flushed, and catchment areas regularly cleaned of potential contaminants. Trimming vegetation overhanging the catchment area for the tank (e.g. flying-fox foraging vegetation overhanging the roof of a house) will also reduce wildlife activity and associated potential contamination. Tanks should also be appropriately maintained and flushed, and catchment areas regularly cleaned to remove potential contaminants. Tanks in urban areas are not for domestic drinking water supply and these areas are supplied with reticulated town water.

Pool maintenance practices (e.g. filtration, chlorination, skimming, vacuuming) should remove general contamination associated with wildlife droppings. Public water supplies are regularly monitored for harmful bacteria and are filtered and disinfected before being distributed. Management plans for community supplies should consider whether any large congregation of animals, including flying-foxes, occurs near the supply or catchment area. Should this occur, increased frequency of monitoring should be considered to facilitate early detection and management of contaminants if required.

There have also been concerns about water quality in artificial or natural waterbodies near a flying-fox camp. In stagnant waterbodies there may be an increase in bacteria and nutrients associated with many animals, including flying-foxes and/or native birds. Water quality monitoring should be considered if this is of concern.

2.2.5 Damage to vegetation

Large numbers of roosting flying-foxes can damage vegetation. While damage can be problematic, most native vegetation is resilient and generally recovers well (e.g. casuarina and eucalypts), and flying-foxes naturally move within a roosting site allowing vegetation to recover. The impact of vegetation damage should be assessed against the potential impact if flying-foxes were not present; specifically, the loss of critical ecological services flying-foxes provide and the associated benefits to other species. If vegetation damage is deemed severe and likely to be permanent, intervention may be required (as a last resort) to protect tree health.

2.2.6 Flying-foxes and aircraft

Flying-foxes are large (~1 kg) animals that transit in large numbers at relatively low altitudes. Consequently, in terminal airspace, where aircraft are also operating at low altitudes, they may present a significant risk to air safety particularly prior to first light and post last light, daily. Between 2008 and 2017, flying-foxes and bats[2] were involved in 1,303 strikes in Australia and accounted for 10% of damaging strikes (ATSB 2019).

The consequence of wildlife strikes with aircraft can be very serious. Worldwide, in civil and military aviation, fatal bird strike incidents have resulted in more than 532 human fatalities and 614 aircraft losses since the beginning of aviation (Shaw et al. 2019). Wildlife strikes cost the commercial civil aviation industry an estimated US$1.2 billion per annum (Allan 2002) and involve more than just the repair of damaged engines and airframes. Even apparently minor strikes which result in no damage can reduce engine performance, cause concern among aircrew and add to airline operating costs.

[2] Due to inconsistent species reporting, species reported to the Australian Transport Safety Bureau (ATSB) include: flying fox, bat, fruit bat, micro bat, freetail bat, eastern freetail bat, mouse-eared bat, and spectacled flying-fox. ATSB reported that it is likely that many of the strikes involving animals reported as 'bats' actually involved flying-foxes.

3 Camp assessments

Camp context, history, ecological values, and sensitive receptors are provided for the three focal flying-fox camps. Sensitive receptors are those locations that host vulnerable people where risks need to be managed, including schools, childcare centres, hospitals with helipads, airports, and equine facilities. Identifying sensitive receptors is necessary with regards to any management actions that could inadvertently cause the camp to splinter to undesirable or sensitive locations surrounding the camp.

Management options for each camp, with consideration to this site-specific detail and legislation, are outlined in Section 4 with planned actions in Section 5.

3.1 Balgowlah camp

3.1.1 Camp description

The Balgowlah camp is located between Burnt Bridge Deviation to the north and Balgowlah Road to the south (Figure 3). The eastern of the extent of the camp is bordered by residential properties on Balgowlah Road and Pitt St, with the western extent of the camp bordered by residential properties along Balgowlah Road. There are 45 residential dwellings (including unit blocks) within 50 m of the camp area.

The camp is located on Lots 7-8 DP776891 (Local Government Authority land) and Lots 1-2 DP1127989 (Freehold land). The land is classified as Public Recreation under the Manly Local Environment Plan 2013 (Table 2).

Table 2 Balgowlah camp context

Criteria	Attribute
Location	-33.789300, 151.262144
Lot and plan	Lot 7 DP 776891 Lot 8 DP 776891 Lot 1 DP 1127989 Lot 2 DP 1127989
Land zone	RE1 Public Recreation
Current land use	Parkland
Maximum confirmed camp extent	1.275 ha
Flying-fox usage	Permanent

Figure 3: Balgowlah flying-fox camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Camp extent May 2022

Maximum camp extent 2018-2022

Property boundary

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Job number: PR7197
Revision: 0
Author: EK
Date: 21/06/2022

0 2.5 5 10
Meters

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

3.1.2 Ecological values

Ecological values within 1 km of the Balgowlah flying-fox camp are shown in Figure 4. Camp habitat is mapped as non-native vegetation, though vegetation bordering the northern boundary of the camp is mapped as Sydney Coastal Sandstone Gully Forest (PCT ID 3595) (DPE 2022). The camp area is also mapped as a High Ecological Value (HEV) waterway (DPE 2019). There are no Threatened Ecological Communities (TEC) mapped within or near the camp extent (DPE 2021). However, a Protected Matters Search Tool (PMST) report listed that the following TECs are likely to or may occur within the camp extent:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and Southeast Queensland ecological community – Endangered (E)
- Coastal Swamp Sclerophyll Forest of NSW and Southeast Queensland – E
- Coastal Upland Swamps in the Sydney Basin Bioregion – E
- Eastern Suburbs Banksia Scrub of the Sydney Region – Critically Endangered (CE)
- River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria – CE.

11 threatened species (including NSW and/or Commonwealth-listed species) have been recorded within 1 km of the camp within the last 20 years (ALA 2022, DPE 2022), including two bird species, one amphibian, one reptile, four mammals, and three plants:

- swift parrot (*Lathamus discolor*) – E (State), CE (Commonwealth)
- powerful owl (*Ninox strenua*) – V (State)
- eastern pygmy-possum (*Cercartetus nanus*) – V (State)
- grey-headed flying-fox – V (State and Commonwealth)
- southern myotis (*Myotis macropus*) – V (State)
- large bent-winged bat (*Miniopteru orianae oceanensis*) – V (State)
- Rosenberg's goanna (*Varanus rosenbergi*) – V (State)
- red-crowned toadlet (*Pseudophryne australis*) – V (State)
- nettled bottle brush (*Callistemon linearifolius*) – V (State)
- magenta lilly pilly (*Syzygium paniculatum*) – E (State), V (Commonwealth)
- Wallangarra white gum (*Eucalyptus scoparia*) – E (State), V (Commonwealth).

Additional threatened species that are likely to or may occur within 1 km of the camp are listed in a separate reference document; PMST Reports for the Northern Beaches Flying-fox CMP. The above list provides a preliminary assessment of threatened species recorded around the camp; however, a flora and fauna assessment should be undertaken to ground truth ecological values before any works occur on site.

The Balgowlah flying-fox camp is not currently listed as a nationally important flying-fox camp (see definition in Appendix 2). However, the camp has been seasonally occupied by 2,500 or more GHFF each consecutive year since 2013. Given that 2022 is the tenth year of this occupation, this camp should be treated as a nationally important camp.

Threatened species (Bionet 2022)

- Eastern Pygmy-possum
- Grey-headed Flying-fox
- Large Bent-winged Bat
- Netted Bottle Brush
- Powerful Owl
- Red-crowned Toadlet
- Southern Myotis
- Swift Parrot

Plant Community Type (PCT)

- Estuarine Swamp Oak Twig-rush Forest
- Southern Sydney Rockplate Heath
- Sydney Coastal Coachwood Gallery Rainforest
- Sydney Coastal Sandstone Bloodwood Shrub Forest
- Sydney Coastal Sandstone Gully Forest
- Woronora Plateau Heath-Mallee
- Not native vegetation

Figure 4: Balgowlah flying-fox camp ecological values

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

- Camp extent May 2022
- 1 km buffer

Job number: PR7197
Revision: 0
Author: EK
Date: 15/07/2022

0 50 100 200
Meters

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

3.1.3 Camp history

Flying-fox occupancy

The Balgowlah camp established in 2010. This site was monitored by the Royal Botanic Gardens and Domain Trust (RBGDT) from 2010 until 2017, and is currently monitored by council staff as part of the quarterly National Flying-fox Census. Historically, numbers fluctuated seasonally between a few hundred to a thousand GHFF, with GHFF typically vacating the camp during winter months (Figure 5). GHFF began permanently roosting at the site in November 2012, with the number of GHFF typically fluctuating between 1,000 and 9,500 GHFF (Figure 5). Small numbers of BFF (up to 150 individuals) are present sporadically at the camp (Figure 5).

Issues & management actions to date

Communication between Council, residents, and the broader community is regular and ongoing regarding flying-fox related issues at the Balgowlah camp. The majority of resident/community enquiries have been regarding impacts experienced due to noise and faecal drop. Negative impacts experienced by residents generally increase when numbers of flying-foxes increase. Vandalism of educational signage is also an issue experienced at this camp.

Council has invested significantly into managing community impacts associated with the Balgowlah flying-fox camp. Some actions include:

- Developing a Camp Management Plan (Manly Council 2016) and obtaining DPE threatened species licences for delivery of the plan's actions.
- Selective removal of trees (including coral trees and she-oaks) to establish buffers on the western and eastern boundaries of the camp to minimise impacts to adjoining residents.
- Removal of invasive and hazardous trees along the creek line to the west of the camp to improve environmental values and public safety.
- Installation of educational signage around the camp.
- Delivery of the Flying-fox Residents Assistance Program to subsidise the purchasing of items and services that will reduce impacts for residents within 50 m of the camp. Subsidised items included air conditioners and purifiers, secondary glazing for windows, car wash services, cleaning equipment, balcony upgrades, and covers for outdoor items. The program received positive feedback from recipients, many of whom reported that the items had helped to reduce impacts.
- Planting advanced roost trees (including casuarinas) within the core camp area to increase habitat away from conflict areas.
- Weed removal and planting of a low-growing vegetative screen within the eastern buffer area.

- Providing information to residents and the broader community about living alongside flying-foxes.
- Delivery of interactive wildlife shows to allow the public to learn about flying-fox ecology.

Construction for the new Beaches Link tunnel (entrance approximately 750 m from the camp) was scheduled to commence in 2023, though this has been delayed indefinitely by Infrastructure NSW (Kidd & Cornish 2022). Should project planning re-commence, construction work is likely to draw water from the camp reserve stream and will likely increase construction noise in the camp, potentially leading to impacts on the camp and increased conflict with nearby residents. Impact avoidance measures will be required as part of this project.

Sensitive receptors

Sensitive receptors within a 1 km radius of the Balgowlah camp are depicted in Figure 6.

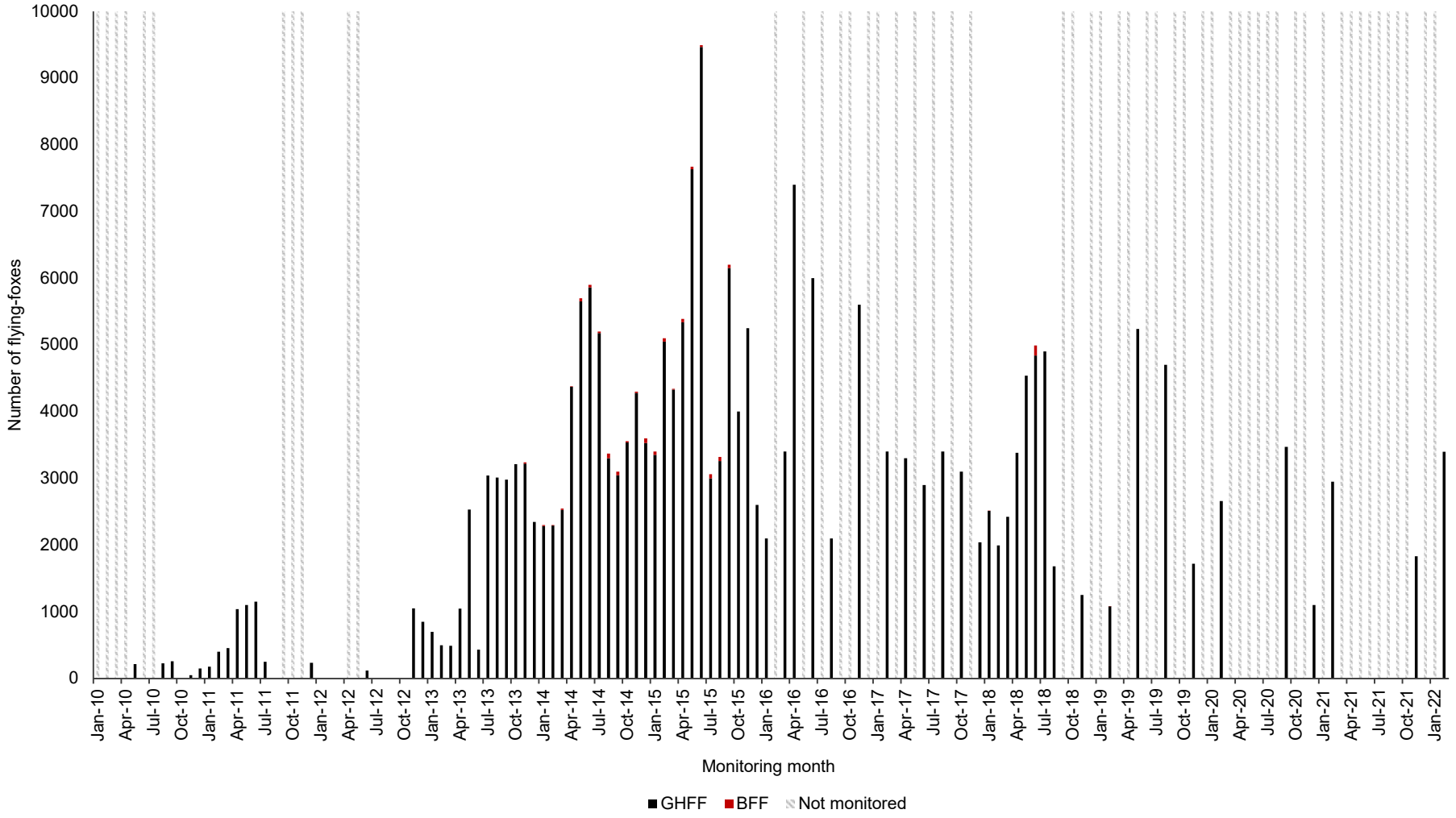

Figure 5 Historical flying-fox camp counts at the Balgowlah camp (Source: Council, Ecosure, RBGDT).

* Note, in months where two counts were undertaken, this graph shows the average count (i.e. Oct 2014, Nov 2015, Oct 2017, Jun 2018).

Figure 6: Sensitive receptors around Balgowlah camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Sensitive receptor

Camp extent May 2022

1 km buffer

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Job number: PR7197
Revision: 0
Author: EK
Date: 22/06/2022

0 50 100 200
Meters

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

3.2 Avalon camp

3.2.1 Camp description

The Avalon camp is located adjacent to residential properties, with Therry Street to the north of the camp, Cannes Drive to the south of the camp, and properties along Therry Street bordering the east and west of the camp (Figure 7). There are 12 residential properties within 50 m of the camp area. Roosting flying-foxes occasionally spill over to the adjoining Gunyah Place Reserve (Lot 4 DP 232257, Figure 7), which is undesirable due to a playground at this location.

The camp is located on Lot 18 DP 236595 (Freehold land) and Lot 2 DP 209493 (Freehold land). The land is classified as Public Recreation under the Pittwater Local Environmental Plan 2014 (Table 3).

Table 3 Avalon camp context

Criteria	Attribute
Location	-33.625430, 151.324546
Lot and plan	Lot 18 DP 236595 Lot 2 DP 209493
Land zone	RE1 Public Recreation
Current land use	Parkland
Maximum confirmed camp extent	0.341 ha
Flying-fox usage	Permanent

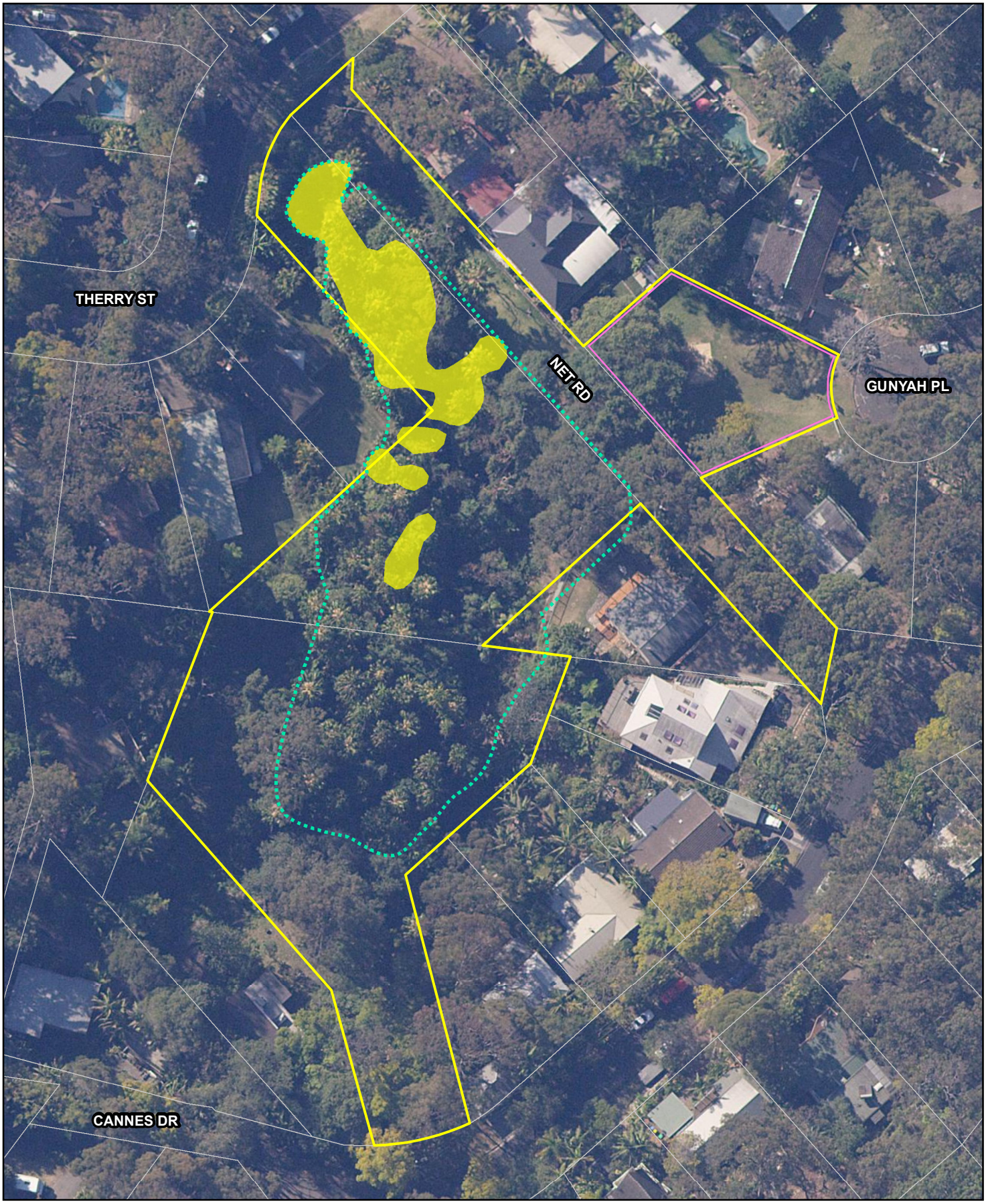

Figure 7: Avalon flying-fox camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Camp extent May 2022
Maximum camp extent
Property boundary
Cannes Reserve
Gunyah Place Reserve parkland

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improving ecosystems

Job number: PR7197
Revision: 0
Author: EK
Date: 24/06/2022

0 2.5 5 10
Meters

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

3.2.2 Ecological values

Ecological values found within 1 km of the Avalon flying-fox camp are depicted in Figure 8. The camp habitat is mapped as Sydney Coastal Lilly Pilly-Palm Gallery Rainforest (PCT ID 3039) and Hunter Coast Lowland Spotted Gum Moist Forest (PCT ID 3234) (DPE 2022). The camp is also mapped as a HEV waterway (DPE 2019). TEC mapping shows the camp habitat consists of two TECs; Coastal Escarpment Littoral Rainforest (E) and Pittwater Spotted Gum Forest (E) (DPE 2021). A PMST report also listed that the following TECs may occur within the camp extent:

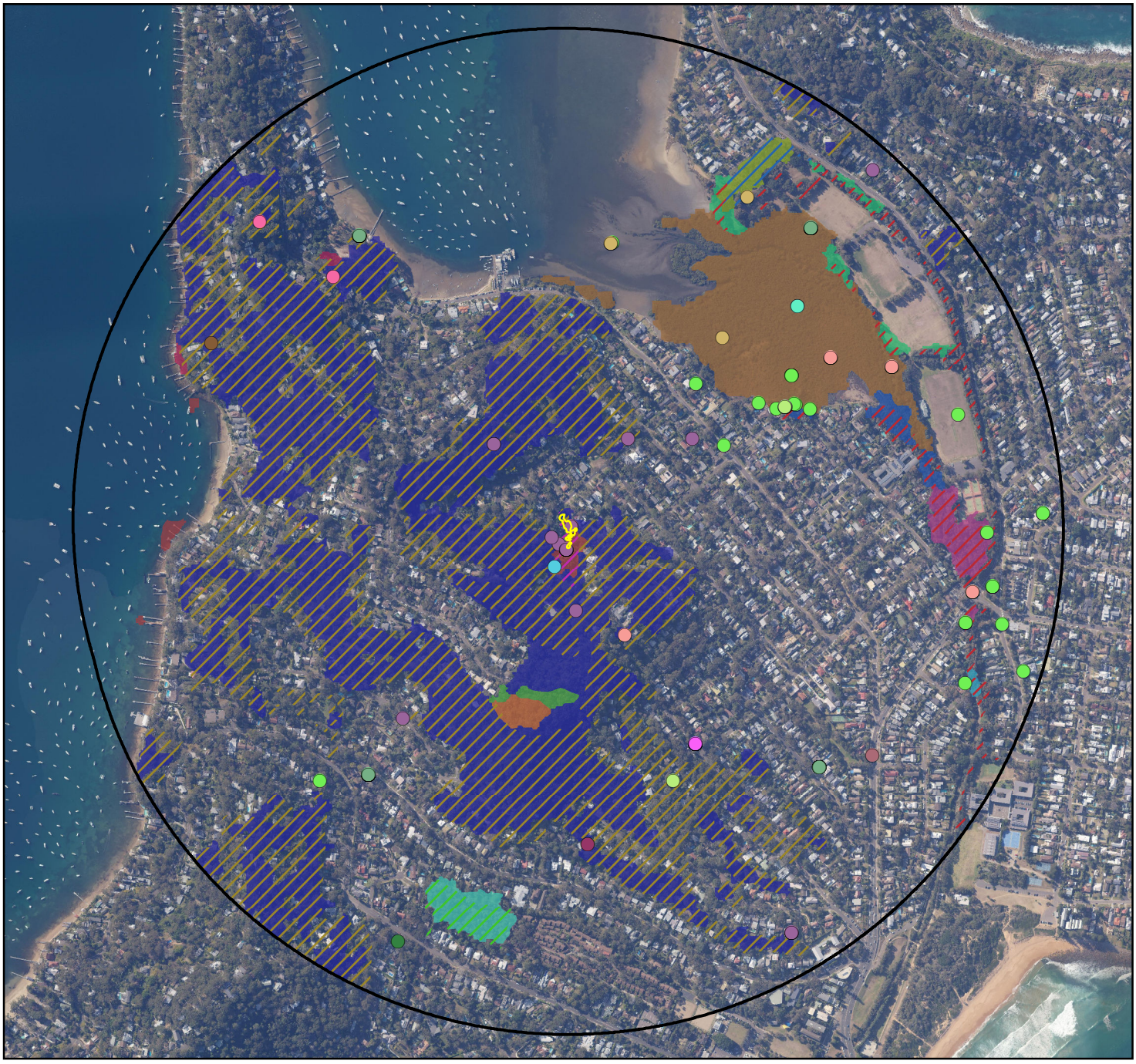
- Coastal Swamp Oak Forest of NSW and Southeast Queensland ecological community (E)
- Coastal Swamp Sclerophyll Forest of NSW and Southeast Queensland – E
- Coastal Upland Swamps in the Sydney Basin Bioregion – E
- Eastern Suburbs Banksia Scrub of the Sydney Region –CE
- River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria – CE.

25 threatened species (including NSW and/or Commonwealth-listed species) have been recorded within 1 km of the camp within the last 20 years (ALA 2022, DPE 2022), including ten bird species, one amphibian, 11 mammals, and three plants:

- beach stone-curlew (*Esacus magnirostris*) – CE (State)
- bush stone-curlew (*Burhinus grallarius*) – E (State)
- eastern curlew (*Numenius madagascariensis*) – CE (Commonwealth)
- masked owl (*Tyto novaehollandiae*) – V (State)
- powerful owl – V (State)
- rose-crowned fruit-dove (*Ptilinopus regina*) – V (State)
- sooty oystercatcher (*Haematopus fuliginosus*) – V (State)
- sooty tern (*Onychoprion fuscata*) – V (State)
- turquoise parrot (*Neophema pulchella*) – V (State)
- white-bellied sea-eagle (*Haliaeetus leucogaster*) – V (State)
- red-crowned toadlet – V (State)
- eastern cave bat (*Vespadelus troughtoni*) – V (State)
- eastern coastal free-tailed bat (*Micronomus norfolkensis*) - V (State)
- eastern pygmy-possum – V (State)
- greater broad-nosed bat (*Scoteanax rueppellii*) – V (State)
- grey-headed flying-fox – V (State and Commonwealth)
- koala (*Phascolarctos cinereus)* – Endangered (E) (State and Commonwealth)

- large bent-winged bat – V (State)
- large-eared pied bat (*Chalinolobus dwyeri*) – V (State and Commonwealth)
- little bent-winged bat (*Miniopterus australis*) – V (State)
- southern myotis – V (State)
- squirrel glider (*Petaurus norfolcensis*) – V (State)
- anthraxon (*Arthraxon hispidus*) – V (State)
- macadamia nut (*Macadamia integrifolia*) – V (Commonwealth)
- magenta lilly pilly (*Syzygium paniculatum*) – E (State), V (Commonwealth).

Note, the 1 km buffer around the camp encompasses marine and coastal ecosystems that provide habitat for some of the species listed above, such as the bush stone-curlew, eastern curlew, sooty oystercatcher, and sooty tern. The Avalon flying-fox camp habitat is not suitable for these species. Additional threatened species that are likely to or may occur within 1 km of the camp are listed in a separate reference document; PMST Reports for the Northern Beaches Flying-fox CMP. The above list provides a preliminary assessment of threatened species recorded around the camp; however, a flora and fauna assessment should be undertaken to ground truth ecological values before any works occur on site. This camp does not meet the criteria to be listed as a nationally important camp (see definition in Appendix 2).



Threatened species (Bionet 2022)

- Beach Stone-curlew
- Bush Stone-curlew
- Eastern Cave Bat
- Eastern Coastal Free-tailed Bat
- Eastern Curlew
- Eastern Pygmy-possum
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Koala
- Large Bent-winged Bat
- Large-eared Pied Bat
- Little Bent-winged Bat
- Macadamia Nut
- Magenta Lilly Pilly
- Powerful Owl
- Red-crowned Toadlet
- Rose-crowned Fruit-Dove
- Sooty Oystercatcher
- Southern Myotis
- Squirrel Glider
- Turquoise Parrot
- White-bellied Sea-Eagle

Threatened Ecological Communities

- Coastal Alluvial Bangalay Forest
- Coastal Flats Swamp Mahogany Forest
- Estuarine Swamp Oak Forest
- S_RF07: Coastal Escarpment Littoral Rainforest
- S_WSF11: Pittwater Spotted Gum Forest

Plant Community Type (PCT)

- Coastal Alluvial Bangalay Forest
- Coastal Sands Littoral Scrub-Forest
- Estuarine Swamp Oak Twig-rush Forest
- Estuarine Swamp Oak-Mangrove Forest
- Grey Mangrove-River Mangrove Forest
- Hunter Coast Foothills Apple Forest
- Hunter Coast Lowland Spotted Gum Moist Forest
- Northern Paperbark-Swamp Mahogany Saw-sedge Forest
- Sydney Coastal Enriched Sandstone Forest
- Sydney Coastal Lilly Pilly-Palm Gallery Rainforest
- Sydney Coastal Sandstone Bloodwood Shrub Forest
- Sydney Coastal Sandstone Foreshores Forest
- Not native vegetation

Figure 8: Avalon flying-fox camp ecological values

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Camp extent May 2022

1 km buffer

Job number: PR7197
Revision: 0
Author: EK
Date: 15/07/2022

0 50 100 200
Meters

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

3.2.3 Camp history

Flying-fox occupancy

The Avalon camp was first recorded around approximately 2004, though relatively consistent occupancy has been recorded since 2011. Numbers typically fluctuate between 180 and 800 GHFF (Figure 9). There have been two unusually large influxes in winter 2013 and winter 2014 which resulted in a peak of more than 3,000. This was likely associated with an uncommon flowering event in the area and may have been spill over from another camp in the area.

Issues & management actions to date

Council has invested significantly into managing community impacts associated with the Avalon camp. Some actions include:

- developing a CMP (Pittwater Council 2015) and obtaining DPE threatened species licenses for delivery of the plan's actions
- facilitating regular community meetings and establishing a resident working group to assist in development of the CMP
- establishing buffers along the reserve boundaries to minimise impacts to adjoining residents, including removal of exotic trees and removal of lower fronds on Cabbage Tree Palms within the buffer ('pineapple pruning')
- replanting of roosting habitat to increase habitat outside of conflict areas
- planting of Bolwarra (*Eupomatia laurina*) as a visual and odour buffer between the camp and impacted residents
- revegetation and removal of weeds and invasive and hazardous trees to improve environmental values and public safety
- delivery of the Flying-fox Residents Assistance Program to subsidise the purchasing of items and services that will reduce impacts for residents within 50 m of the camp
- providing information to residents and the broader community about living alongside flying-foxes
- delivery of interactive wildlife shows to allow the public to learn about flying-fox ecology
- flying-fox dispersal in July 2015 (camp re-established and dispersal disbanded).

Sensitive receptors

Sensitive receptors within 1 km of the Avalon camp are depicted in Figure 10.

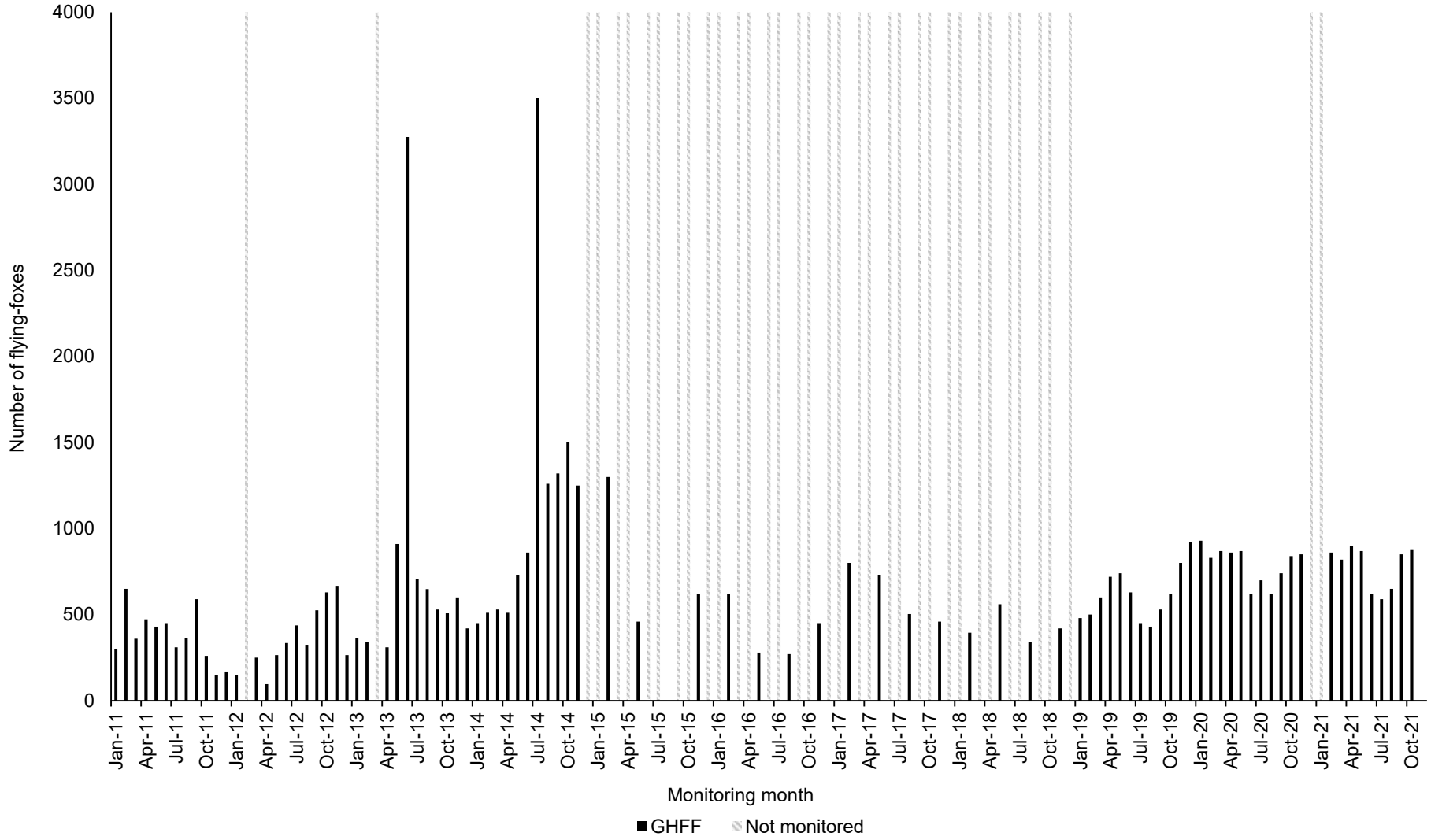


Figure 9 Historical flying-fox camp counts at the Avalon camp (Source: The National Flying-fox Monitoring Program [NFFMP] and Council)

Figure 10: Sensitive receptors around Avalon camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Sensitive receptor

Camp extent May 2022

1 km buffer

ecosure
improving ecosystems

Job number: PR7197
Revision: 0
Author: EK
Date: 22/06/2022

0 50 100 200
Meters

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

3.3 Warriewood camp

3.3.1 Camp description

The Warriewood camp is located in the eastern extent of the Warriewood Wetlands (Figure 11). The camp is adjacent to the north-west of Warriewood Square, along Angus Gordon Walkway. The closest residential properties to this camp are more than 200 m away.

The camp is located on Lot 100 DP 1127710 (Local Government Authority land). The land is classified as Public Recreation under the Pittwater Local Environmental Plan 2014 (Table 4).

Table 4 Warriewood camp context

Criteria	Attribute
Location	-33.694334, 151.295272
Lot and plan	Lot 100 DP 1127710
Land zone	C2 Environmental Conservation
Current land use	Reserve
Maximum confirmed camp extent	0.147 ha
Flying-fox usage	Seasonal

Figure 11: Warriewood flying-fox camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

ecosure
improving ecosystems

Job number: PR7197
Revision: 0
Author: EK
Date: 23/06/2022

0 2.5 5 10
Meters

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

3.3.2 Ecological values

Ecological values found within 1 km of the Warriewood flying-fox camp are depicted in Figure 12. The camp habitat is mapped as Northern Paperbark-Swamp Mahogany Saw-sedge Forest (PCT ID 4006) (DPE 2022), and the Warriewood Wetlands are classed as a HEV waterway (DPE 2019). There are no TECs mapped within the camp extent, though there are three TECs within 100 m of the camp boundary (DPE 2021): Coastal Freshwater Wetland (E), Coastal Swamp Paperbark-Swamp Oak Scrub (E), and Coastal Flats Swamp Mahogany Forest (E) (DPE 2021). A PMST report also listed that the following TECs are likely to or may occur within the camp extent:

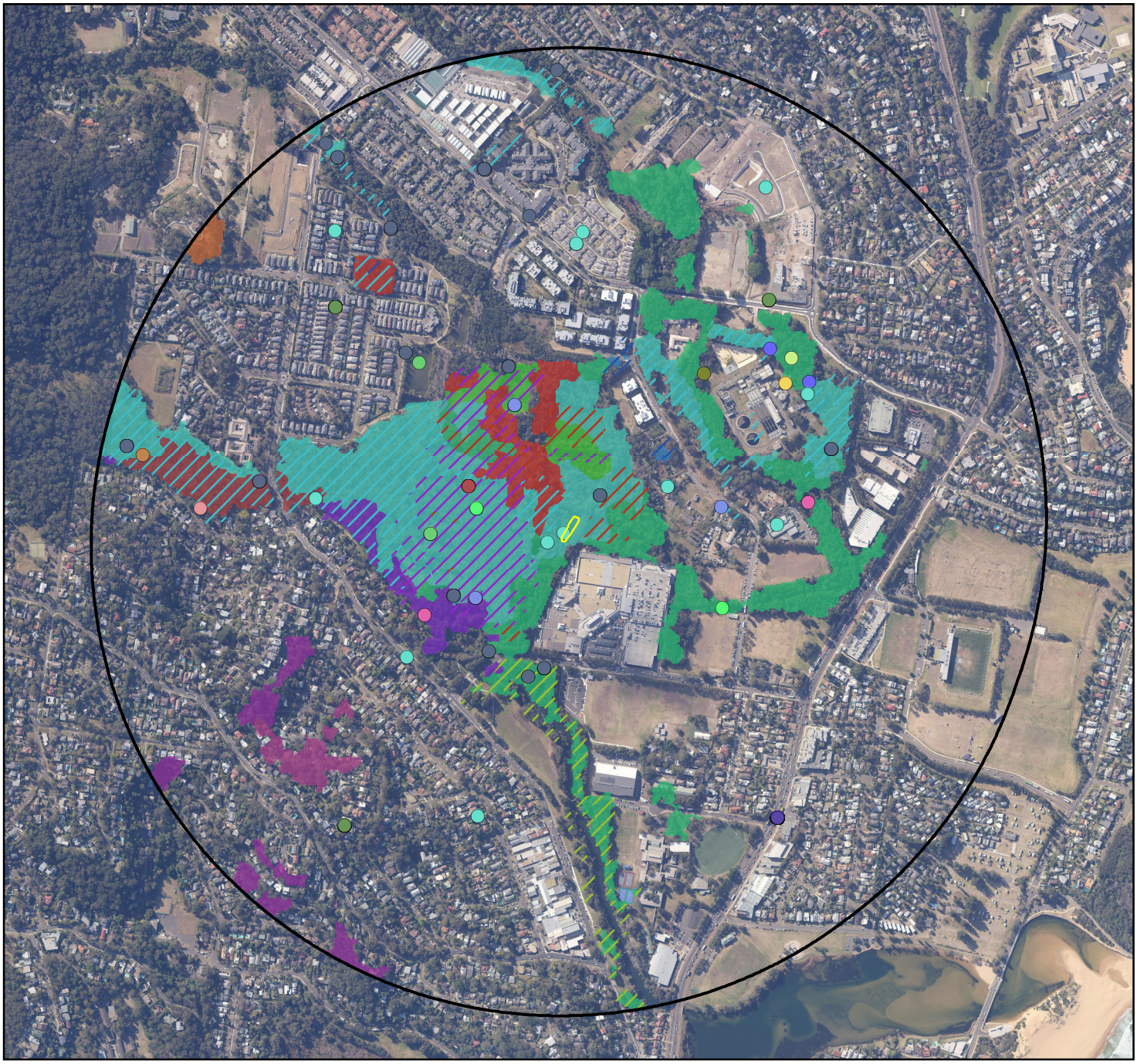
- Coastal Swamp Oak Forest of NSW and Southeast Queensland ecological community - E
- Coastal Upland Swamps in the Sydney Basin Bioregion – E
- Eastern Suburbs Banksia Scrub of the Sydney Region – CE
- River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria – CE.

23 threatened species (including NSW and/or Commonwealth-listed species) have been recorded within 1 km of the camp within the last 20 years (ALA 2022, DPE 2022), including 13 bird species, eight mammals, and two plants:

- superb fruit-dove (*Ptilinopus superbus*) – V (State)
- white-throated needletail (*Hirundapus caudacutus*) – V (Commonwealth)
- black bittern (*Ixobrychus flavicollis*) – V (State)
- white-bellied sea-eagle – V (State)
- eastern osprey – V (State)
- Australian painted snipe (*Rostratula australis*) – E (State and Commonwealth)
- glossy black-cockatoo (*Calyptorhynchus lathami*) – V (State)
- little lorikeet (*Glossopsitta pusilla*) – V (State)
- swift parrot – E (State), Critically Endangered (CE) (Commonwealth)
- barking owl (*Ninox connivens*) – V (State)
- powerful owl – V (State)
- regent honeyeater (*Anthochaera phrygia*) – CE (State and Commonwealth)
- varied sittella (*Daphoenositta chrysoptera*) – V (State)
- squirrel glider – V (State)
- grey-headed flying-fox – V (State and Commonwealth)
- eastern coastal free-tailed bat – V (State)
- large-eared pied bat – V (State and Commonwealth)

- southern myotis – V (State)
- eastern cave bat – V (State)
- little bent-winged bat – V (State)
- large bent-winged bat – V (State)
- Bauer’s midge orchid (*Genoplesium baueri*) – E (State and Commonwealth)
- Angus's onion orchid (*Microtis angusii*) – E (State and Commonwealth).

Additional threatened species that are likely to or may occur within 1 km of the camp are listed in a separate reference document; PMST Reports for the Northern Beaches Flying-fox CMP. The above list provides a preliminary assessment of threatened species recorded around the camp; however, a flora and fauna assessment should be undertaken to ground truth ecological values before any works occur on site. This camp does not meet the criteria to be listed as a nationally important camp (see definition in Appendix 2).



Threatened species (Bionet 2022)

- Angus's Onion Orchid
- Australian Painted Snipe
- Barking Owl
- Bauer's Midge Orchid
- Black Bittern
- Eastern Cave Bat
- Eastern Coastal Free-tailed Bat
- Eastern Osprey
- Glossy Black-Cockatoo
- Grey-headed Flying-fox
- Large Bent-winged Bat
- Large-eared Pied Bat
- Little Bent-winged Bat
- Little Lorikeet
- Powerful Owl
- Regent Honeyeater
- Southern Myotis
- Squirrel Glider
- Superb Fruit-Dove
- Swift Parrot
- Varied Sittella
- White-bellied Sea-Eagle
- White-throated Needletail

Threatened Ecological Communities

- Coastal Flats Swamp Mahogany Forest
- Coastal Freshwater Wetland
- Coastal Swamp Paperbark-Swamp Oak Scrub
- Estuarine Swamp Oak Forest
- S_DSF21: Coastal Sand Bangalay Forest

Plant Community Type (PCT)

- Blue Gum High Forest
- Coastal Sands Swamp Mahogany Rush Forest
- Estuarine Swamp Oak Twig-rush Forest
- Hunter Coast Sandplain Sedge Paperbark Wetland
- Northern Paperbark-Swamp Mahogany Saw-sedge Forest
- South Coast Sands Littoral Scrub
- Sydney Coastal Coachwood Gallery Rainforest
- Sydney Coastal Enriched Sandstone Forest
- Sydney Coastal Lilly Pilly-Palm Gallery Rainforest
- Sydney Coastal Sandstone Foreshores Forest
- Not native vegetation

Figure 12: Warriewood flying-fox camp ecological values

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Camp extent May 2022

1 km buffer

Job number: PR7197
Revision: 0
Author: EK
Date: 15/07/2022

0 50 100 200
Meters

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

3.3.3 Camp history

Flying-fox occupancy

The Warriewood camp was first recorded in November 2012. It has experienced three large influxes in May 2014, 2018, and 2019 (Figure 13). The Warriewood camp typically empties around June (Council pers coms. 2022), likely due to cold winds at this site at this time, with at least some flying-foxes suspected to relocate to Avalon and Balgowlah camps which tend to increase around this time. Notably, flying-foxes remained at the camp in July for the first time in 2021 (Figure 13).

Issues & management actions to date

The Warriewood camp has required less management intervention from Council compared to Avalon and Balgowlah, primarily due to the fact that there are no residents directly adjacent to the camp and it is less frequently occupied. During a heat stress event in 2019, Council closed the walkway under the camp to limit further stress to flying-foxes and prevent direct contact between people and flying-foxes. Some pruning of vegetation above the walkway has been undertaken to limit flying-foxes from roosting in overhanging trees. In addition, Woolworths will soon commence pruning casuarina trees along the road adjacent to the camp. There have been some customer enquiries regarding flying-fox odour inside the Woolworths precinct, likely a result of the air conditioning vent being located adjacent to the flying-fox camp.

Sensitive receptors

Sensitive receptors within 1 km of the Warriewood camp are depicted in Figure 14.

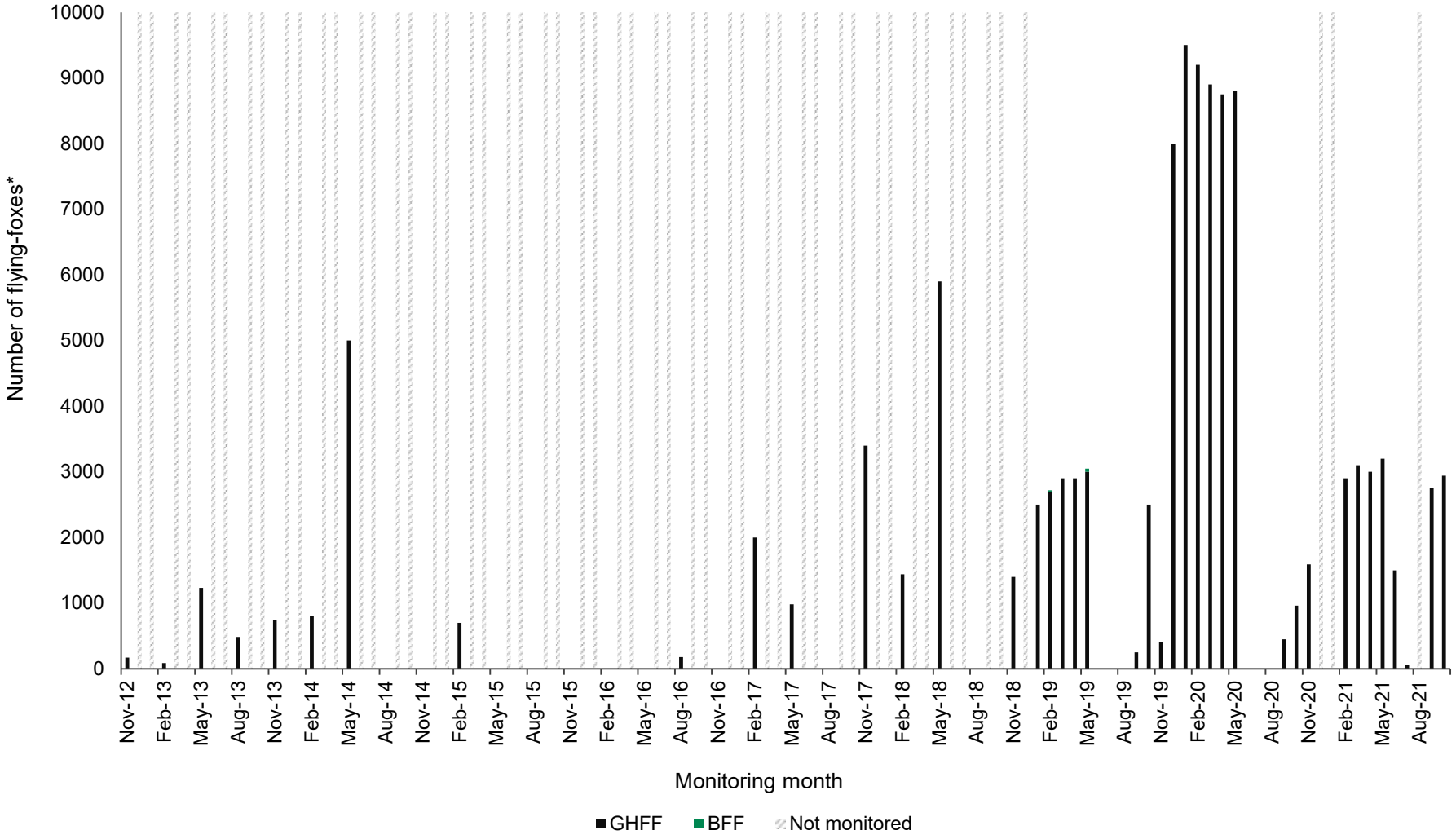


Figure 13 Historical flying-fox camp counts at the Warriewood camp (Source: NFFMP)

* Due to data limitations, two records of BFF (< 500 individuals) in Feb 2018 and Nov 2019 have not been included in this graph as the estimated counts are not available.

Figure 14: Sensitive receptors around Warriewood camp

Northern Beaches Council

Northern Beaches Flying fox Camp Management Plan

Sensitive site

Camp extent May

1 km buffer

ecosure
improving ecosystems

Job number: PR7197
Revision: 0
Author: EK
Date: 22/06/2022

0 50 100 200
Meters

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

4 Camp management options analysis

This section provides an overview of camp management options commonly used across NSW and Australia (detailed in Appendix 4) which have been considered in the development of the CMP. These are categorised as Level 1, 2 or 3 in accordance with the Policy (i.e. Level 1: Routine camp management; Level 2: Creation of buffers; Level 3: Camp disturbance or dispersal). Table 5 provides a site-specific analysis of the camp management options for Northern Beaches.

Table 5 provides an analysis of camp management options and suitability for Northern Beaches. An appraisal, based on this analysis, is provided for options to be either adopted, investigated further or disregarded within this CMP. Planned management actions based on this analysis is provided in Section 5 .

Table 5 Analysis of camp management options

Management options	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Northern Beaches
Level 1 options					
Education and awareness programs	Fear of disease Noise Smell Faecal drop Water contamination	$	Low cost, increasing awareness will help the community understand the ecology of flying-foxes, providing options for landholders to reduce impacts. This is an effective long-term solution, can be undertaken on an ongoing basis and based on community concerns.	Education and advice itself will not mitigate all issues, and on its own would not be acceptable to the community.	Education, advice, and awareness programs are key components of any plan to manage flying-foxes and their camps. Appraisal: Adopt
Property modification / service subsidies	Noise Smell Faecal drop Health/wellbeing Lost rental return	$–$$	Property modification is one of the most effective ways to reduce amenity impacts of a camp, promotes conservation of flying-foxes, is a long-term option, can be undertaken quickly, will not impact on the site and may add value to the property. Property modification, such as glazing windows or installing noise attenuating insulation, will greatly assist with noise impacts inside	May be cost-prohibitive for private landholders, however subsidies would assist.	Council established the Flying-fox Residents Assistance Program and have provided subsidies at Avalon and Balgowlah in the past, including for air conditioners and purifiers, secondary glazing for windows, car wash services, cleaning equipment, balcony upgrades, and covers for outdoor items. Council will investigate expanding this program for communities affected by flying-foxes at the three key camps.

Management options	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Northern Beaches
			residences and businesses. Installing shade sails, car ports or covering other affected areas will reduce the impacts of faecal drop.		Appraisal: Investigate distance-based subsidies program for residents affected by flying-fox camps.
Odour reducing / masking plants	Noise Smell Health/wellbeing	$	Planting dense screens and fragrant plants to assist with odour and noise and trim tall trees to less than 5 metres high and/or use wildlife friendly netting to prevent occupation by flying-foxes.	May take time for plants to provide the desired effect, and unlikely to mitigate odour during large influxes.	Residents could be encouraged to modify properties by planting dense screens and fragrant plants. This information can be provided in an education program. Appraisal: Adopt
Routine camp management	Health/well-being	$	While this action is not aimed at managing flying-foxes, it allows landholders to undertake routine maintenance at or near flying-fox camps (in line with the Policy). Examples of routine camp management actions are provided in the Policy. Weed removal has the potential to reduce roost availability and reduce numbers of roosting FFs.	Will not generally mitigate amenity impacts for nearby landholders.	Protocols should be developed for carrying out operations that may disturb flying-foxes, which can increase impacts such as noise and smell, and create a flying-fox welfare issue. Any weed removal should be staged and mindful of inadvertent dispersal (constituting a Level 3 action) or exacerbating heat stress events. Appraisal: Adopt
Alternative habitat creation	Noise Smell Faecal drop Health/wellbeing	$$-$$$	If successful in attracting FFs away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts and helps FF conservation. Rehabilitation of degraded habitat that is likely to be suitable for FF use could be a more practical and faster approach than habitat creation. Improving potential alternative camp habitat should be part of a medium-long term plan.	Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract FFs to a new site have not been known to succeed.	Council will continue to manage existing camps within Council's bushland reserves and investigate potential habitat which may be improved/restored, or low conflict locations where habitat may be created. Appraisal: Investigate further
Provision of artificial roosting habitat	Noise Smell Faecal drop Health/wellbeing	$-$$	Artificial roosting habitat could be considered to supplement vegetation damaged by large numbers of flying-foxes.	No guarantee that flying-foxes would use artificial habitat, but collaborating with a researcher on varying design options would increase the likelihood of success.	Not enough evidence at this stage to adopt and habitat quality not currently an issue at Northern Beaches camps. Appraisal: Disregard

Management options	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Northern Beaches
Protocols to manage incidents	Health/wellbeing Fear of disease	$	Low cost, will reduce actual risk of negative human/pet–FF interactions, promotes conservation of FFs, can be undertaken quickly.	Will not mitigate amenity impacts, but will reduce fear of disease.	Council to develop standard internal procedures for operations, response to heat stress events and other potential incidents. Appraisal: Adopt
Research	Noise Smell Faecal drop Health/wellbeing	$	Support research that improves understanding and more effectively mitigates impacts. Develop understanding of native flowering events in area.	Generally cannot be undertaken quickly, management trials may require cost input.	Council will stay up-to-date with contemporary research and review this CMP as required. Council also supports relevant research projects, such as drone-monitoring at camps. Appraisal: Adopt
Appropriate land-use planning	Noise Smell Faecal drop Health/wellbeing	$	Suitable planning for future development will reduce potential for future conflict. Identification of degraded sites that may be suitable for long-term rehabilitation for FFs could reduce impacts.	Will not generally mitigate current impacts.	Council may consider applying additional environmental planning controls to flying-fox camps in future DCP/LEP reviews. Appraisal: Investigate further
Property acquisition	All for specific property owners Nil for broader community	$$$	Cost prohibitive and not feasible for Northern Beaches.		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 appropriate. Appraisal: Disregard
Level 2 options					
Buffers through vegetation removal	Noise Smell Health/wellbeing	$–$$	Any vegetation removal should be done using a staged approach, with the aim of removing as little native vegetation as possible and only in vegetation directly affecting residents.	Removing vegetation can also increase visibility into the camp and noise issues for neighbouring residents which may create further conflict. Vegetation removed too quickly could cause inadvertent dispersal.	Management buffers will be maintained for affected residents at Balgowlah and Avalon camps and considered if necessary at Warriewood camp. Appraisal: Adopt
Buffers without	Noise Smell	$$	Successful creation of a buffer will reduce impacts, promotes FF	May impact the site, buffers will not generally eliminate impacts,	Appraisal: Investigate various methods and implement where feasible.

Management options	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Northern Beaches
vegetation removal – visual deterrents, canopy mounted sprinklers	Health/wellbeing Damage to vegetation		conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community.	maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.	
Noise attenuation fencing	Noise Smell Health/wellbeing	$$	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.	Flying-foxes roosting adjacent to 1 – 2 level houses at Balgowlah and Avalon camps are positioned high in canopies, and as such, noise attenuation fencing is unlikely to be effective. Residents in raised apartments at Balgowlah have benefited from subsidised balcony upgrades. Appraisal: Investigate further where site topography makes fencing effective
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 and splintering of the camp if not done at the correct time, frequency or duration.	Not currently suitable but may be considered if Level 1 and 2 management options have been exhausted and risk has not been sufficiently mitigated. Appraisal: Investigate if required
Active dispersal	All at that site but not generally appropriate for amenity impacts only	$$$	If successful can mitigate all impacts at that site. It is important to note that the outcomes of dispersal are generally temporary, and repeat dispersal is likely to be required as flying-foxes attempt to re-establish the camp. This may be seasonally, annually, or more regularly.	Dispersal is rarely successful without significant vegetation removal 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 600 m), and often splinter into several locations nearby (including many remaining at the original site).	This option will only be considered in extreme circumstances, where impacts are severe and cannot be managed through Level 1 or 2 options. Appraisal: Investigate if required

5 Planned management actions

Planned Council actions to reduce impacts associated with flying-foxes in the Northern Beaches are outlined in Table 6. The actions align with legislation (Section 1.3), camp assessments (Section 3), and consultation with Council. Implementation of management actions must be considerate of approvals potentially required, site values, and in accordance with measures to avoid impacts (Appendix 5). Evaluation measures are provided for each action which will be used to evaluate action progress and success. Details of how the Plan and actions below will be implemented are in Section 6 .

Table 6 Planned management actions

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
Level 1 management						
Community engagement and awareness	Ensure clear and up-to-date information available regarding legislation and human and animal health	Ensure the community is aware of legislation around flying-foxes, and that management affecting flying-foxes is illegal without relevant approvals. Education should be delivered in the form of events, online material, hardcopy brochures, or in-situ signage (see below for more detail), and should include up-to-date health information, impact mitigation options available at a property level (e.g. odour-neutralising gel pots and noise attenuation fencing), and legislative responsibilities. One-on-one engagement may be required for primary-affect residents.	LGA-wide	No	Short-term and ongoing	Education program; community informed and engaged.
	Keep community informed of flying-fox numbers, monitoring trials and up-coming management	Engagement platforms including Facebook, websites, media release and digital/hard copy mail (e.g. brochures, fact sheets) will be utilised to maintain awareness and keep the community updated and informed.	LGA-wide	No	Short-term and ongoing	Up-to-date information readily available for the community.
	Provide in-situ flying-fox information at camps	Update/install interpretive signage at publicly accessible camps. Signs will convey key flying-fox information, including basic ecology and behaviour, and should aim to dispel common health misconceptions associated with flying-foxes.	Update signage at Balgowlah camp Install signage at Warriewood	No	Short-term	Flying-fox information available for community in-situ.

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
	Create interpretive QR code walk with platform	Create an interpretive walk along the existing walkway through the Warriewood camp for the community to observe and learn about flying-foxes in an engaging and informative way. QR codes may be provided along the walkway to engage the community and provide key flying-fox information. A viewing platform overlooking the main waterbody below the camp may be built and incorporated into the walk as a way to showcase the flying-fox camp. Platform construction should be timed in winter when the camp is naturally empty.	Warriewood camp	Development approvals may be required for platform construction	Long-term	Community able to engage with the flying-fox camp in a positive manner, while also being provided with up-to-date information.
Impact mitigation	Establish Community Assistance Program and offer property modification /service subsidies	Investigate a Community Assistance Program that offers distance-scaled subsidies program for communities affected by flying-fox camps. Subsidies may cover property modification and/or services to manage impacts associated with flying-foxes (see Appendix 4 for further information). Note, subsidies have previously been offered to residents adjacent to Balgowlah and Avalon, which has assisted in reducing conflict.	Avalon, Balgowlah, and Warriewood camps	No	Long-term and ongoing	Community Assistance Program investigated and implemented. Subsidies offered to residents where feasible.
	Routine camp maintenance	Manage weeds, particularly vines to protect the canopy and woody weeds to ongoing health of mid-storey vegetation This is particularly important in the core areas of habitat to maintain buffers and avoid flying-foxes being forced to edges closer to private properties. All weed control will be done carefully to avoid disturbing flying-foxes, and using a staged approach to avoid impacting habitat values or temporarily reducing heat refugia.	Avalon camp, Balgowlah camp – e.g. controlling *Ipomoea indica*	Authorised under the COP	Ongoing	Reduced weed density and health of canopy and mid-storey vegetation improved and maintained.
	Maintain water flow and quality	Maintain water flow below the camp to allow flying-foxes access to pool areas when rainfall is sufficient to belly-dip during hot weather. Water flow will be maintained by regularly monitoring and removing obstructions, when necessary (e.g. fallen branches and debris following storms), regularly cleaning gross pollutant traps (GPTs) (e.g. at Balgowlah camp), and removing dense wetland weeds (e.g. Salvinia at Warriewood camp). Regular GPT cleaning at Balgowlah camp will be undertaken every 1-2 months (using a truck with a mechanical arm), with a full clean (using truck and vacuum to remove debris) undertaken twice per year (or once every two months when	Balgowlah and Warriewood camp	No	Short-term and ongoing	Water flow maintained below camps.

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
		below average rainfall). Standard measures to mitigate impacts to flying-foxes during GPT cleaning are outlined in Appendix 5.				
	Emergency tree removal	In some cases, emergency roost tree removal may be required at short notice to remove dead/damaged trees that are a hazard to humans, flying-foxes, infrastructure and/or adjacent properties. In such cases, wherever possible works will be undertaken at night if the camp is occupied and **after** flying-foxes have vacated the camp. Where emergency removal of a non-roost tree is required, Council should also aim to delay works until flying-foxes have vacated the camp. However, works may be required urgently to ensure human safety, in which case they may be done during the day provided: no flying-foxes are roosting in the tree or within 10 m of the tree being removed (in adjacent vegetation), no risk of heat stress event (> 38°C), minimal signs of stress prior to and during tree works (monitored by ecologist), camp not at full capacity (i.e. to ensure sufficient refugia area for flying-foxes to shift away from tree removal works). Tree removal will be limited to the minimum amount needed to reduce risks. A licenced wildlife carer and/or ecologist will be on site for the duration of the proposed works. Where possible, native habitat trees should be planted to replace the loss of flying-fox roosting habitat.	Primarily Avalon and Balgowlah camps, Warriewood if needed	Authorised under the COP, approvals may be required under other legislation for protected vegetation / other ecological values.	As required	Emergency tree removal undertaken safely to minimise potential impacts to humans, flying-foxes, and properties.
	Track maintenance	Maintain walking/access tracks to flying-fox camps to ensure community amenity values are retained. Track maintenance may involve cleaning tracks with high-pressure hoses, repairing damaged sections, mowing (e.g. at Avalon), and trimming understorey and/or overhanging vegetation.	Avalon, Balgowlah, and Warriewood camps	Authorised under the COP	Short-term and ongoing	Safe access to public areas maintained in/around camps.
	Alternative habitat creation	Protect/improve/restore low conflict roost habitat to avoid future conflict.	LGA-wide	No	Long-term	Low conflict camps protected, alternative habitat locations identified and potential to restore habitat investigated.

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
	Revegetation of existing camp habitat	Restore and protect roosting habitat in low conflict areas of camps (e.g. centre portions of Balgowlah and Avalon camps) to encourage flying-foxes to roost further away from residential dwellings. Plant species will be selected to encourage flying-fox roosting, such as rainforest species that provide dense mid-storey vegetation cover and ground cover to achieve a favourable microclimate. Restoration must consider the need for adequate mid-storey vegetation as heat refugia.	Avalon, Balgowlah, and Warriewood camps	Authorised under the COP	Long-term	Improved camp habitat, resulting in positive conservation and welfare outcomes for flying-foxes and reduced impacts on residents (assuming revegetation encourages flying-foxes to roost away from boundaries).
	Odour reducing / masking plants	Boundaries between flying-fox camps and residents can be densely planted with plants that produce fragrant flowers in order to create an odour barrier/buffer to reduce odour impacts. This option may be currently suitable at Balgowlah and Avalon camps, where residents are negatively impacted by flying-fox odour.	Avalon and Balgowlah camps	No	Long-term	Reduced odour impacts for residents living adjacent to flying-fox camps.
	Camp monitoring	Ensure regular (at least quarterly) monitoring of all active flying-fox camps within the Northern Beaches LGA as part of the NFFMP, including records of camp spatial extents.	Avalon, Balgowlah, and Warriewood camps	No	Ongoing	Regular monitoring undertaken at all Northern Beaches camps as part of the NFFMP and data used to inform conservation and management.
Conservation	Maintain high welfare standards during routine camp maintenance	Ensure all management actions are considerate of flying-fox habitat and welfare requirements, including mid-storey for protection during extreme weather, weed treatment and removal and appropriate mowing regimes when flightless young are present.	Avalon, Balgowlah, and Warriewood camps	Routine camp maintenance authorised under the COP	Ongoing	All camps to have mid-storey vegetation for protection during extreme weather and flying-fox welfare is maintained during works.
Avoiding future conflict,	Protocols to	Collaborate with wildlife rescue and care organisations to monitor potential heat stress events (HSE) during predicted	LGA-wide	No	Short-term and	Heat Stress Response Plan

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
conservation	manage incidents	hot weather. Develop a Heat Stress Response Plan that outlines information on the factors that contribute to HSEs, how to monitor flying-fox stress, the importance of having a camp-specific response plan, personnel roles in attending to HSEs, active spraying of flying-foxes, recovery and response to mortalities, as well as the importance of collecting data on HSEs.			ongoing	developed. Ongoing communication with wildlife rescue and care organisations.
	Support flying-fox carers	Support the ongoing rescue, care, and conservation efforts of local wildlife carers, particularly during flying-fox influxes in the LGA and HSEs.	LGA-wide	No	Ongoing	Strong relationship between flying-fox carers and Council.
	Environmental Impact Statement (EIS) submission for the Beaches Link Tunnel State project	Council will encourage further consideration of potential impacts to flying-foxes and camp habitat associated with the project, and appropriate project mitigation measures.	Balgowlah camp	No	ASAP	Engaged with regulators and project where relevant.
Avoiding future conflict	Support research	Support research, particularly projects which will assist in understanding local flying-fox movements and ways to mitigate impacts on the community. A priority area of research is to better understand foraging resources in the area to allow proactive management and preparation for future influxes.	LGA-wide	No	Long-term and ongoing	Council up-to-date on contemporary research and relevant outcomes used to inform management at the three camps.
	Appropriate land use planning	Measures to avoid future conflict between camps and the community will be considered when assessing development applications. Identify potential buffers areas to zone as flying-fox management areas to mitigate impacts to residents. Consider habitat protection measures (zoning, Biodiversity Agreements) for flying-fox camps.	Avalon, Balgowlah, and Warriewood camps	No	Long-term	Flying-fox camp management areas incorporated into planning instruments.
Level 2 management						
Impact mitigation	Maintain existing buffers through vegetation management (trimming/removal)	Maintain existing buffers between residents and flying-foxes at Balgowlah through selective vegetation management (particularly along eastern and south-eastern boundaries) and Avalon (particularly bordering 29 Therry St and 17 Net Rd). Maintenance works may include trimming trees overhanging buffers, mowing, weed removal, and pineapple	Balgowlah and Avalon camps	Authorised under the COP, approvals may be required under other legislation for protected		Existing buffers are maintained.

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
		pruning (at Avalon camp)		vegetation / other ecological values. Trimming/tree removal to create a buffer of up to 30 m is authorised under the COP, though certain restrictions must be adhered to (see Part 2, Section 6 of COP).		
	Investigate canopy-mounted sprinklers	Investigate installing canopy-mounted sprinklers (CMS) at the Balgowlah camp to potentially increase the buffer between residents and the flying-fox camp as the centre of the camp is restored. Residents should be consulted prior to installation to ensure this management option is suitable, considering operational costs are generally covered by residents.	Balgowlah camp	Approvals required for vegetation works associated with installing CMS.	Investigate and implement if deemed suitable – long-term	Increased buffer between residents and flying-fox camp, resulting in decrease negative impacts/conflict.
	Odour neutralising trial	Investigate potential for outdoor-odour neutralising trial (ONT) at Avalon and Balgowlah to mitigate odour impacts to adjacent residents. Untested and innovative trials may constitute Level 2 actions so licence from DPE required. Advise Warriewood Square management about the potential for odour neutralising technology/filtration on air-conditioning units, or potential for management to relocate intake away from the camp.	Avalon and Balgowlah camp	May require licence under the BC Act	Short-term	If considered feasible, trial undertaken.
Level 3 Management						
Impact mitigation	Nudging	Nudging may be considered if Level 1 and 2 management options have been exhausted and risk has not been sufficiently mitigated. Level 3 management options require state and potentially federal approval, and will be dependent on sufficient Council resources being available.	Not currently suitable at any camp	Requires licence under the BC Act	N/A	N/A
	Dispersal	Dispersal may be considered if Level 1 and 2 management	Not	Requires	N/A	N/A

Strategy	Action	Details	Applicable locations	Approvals required	Timeframe / Progress	Evaluation measure
		options have been exhausted and risk has not been sufficiently mitigated. Level 3 management options require state and potentially federal approval, and will be dependent on sufficient Council resources being available.	currently suitable at any camp	licence under the BC Act		

6 Plan evaluation and review

6.1 Plan administration

The CMP will be reviewed regularly including ongoing evaluation of the strategies in Table 5. The following may also trigger a review of the CMP:

- completion of a significant action (Level 2 or above)
- changes to relevant legislation
- any negative incident associated with roosting or foraging flying-foxes.

6.2 Monitoring

Council will monitor and keep internal records to allow the effectiveness of each management action to be evaluated and inform future planning. Monitoring of the camps will be undertaken on a quarterly basis (in accordance with NFFMP) by Council staff to determine the extent of the camp as well as its size and composition.

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

6.3 Reporting

Reports for Level 1 actions that comply with this CMP are not required to be submitted to DPE. Reports for Level 2 and Level 3 actions will be submitted to DPE one month after commencement of works and then quarterly in periods where works have occurred. Each report is to include:

- results of pre- and post-work population monitoring
- any information on new camps that have formed in the area
- further management actions planned to include a schedule of works
- an assessment of how the community responded to the works, including details on the number and nature of customer enquiries before and after the works
- detail on any compensatory planting
- expenditure and contributors
- outcomes from evaluation and review.

6.4 Responsibilities

Council is responsible for implementation of the CMP once it has been endorsed by DPE.

Council will seek advice from DPE and other flying-fox experts as required during implementation. This CMP does not endorse the community to undertake flying-fox management. Private landholders will need to comply with the NSW Policy or apply to DPE for a licence. If flying-foxes are being unlawfully and intentionally disturbed, please report to NSW's Environment Protection Authority by calling 131 555.

6.5 Avoiding impacts to flying-foxes

Actions outlined in the CMP do not include dispersal. Any on ground works will be undertaken in accordance with standard measures to avoid impacts Appendix 5. This will ensure the welfare of flying-foxes during proposed minor works, and the safety of personnel working in the camp. As such, impacts on flying-foxes are expected to be minimal.

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Appendix 1 Flying-fox ecology and behaviour

Ecological role

Flying-foxes, along with some birds, make a unique contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton et al. 2004). This contributes directly to the reproduction, regeneration, and viability of forest ecosystems (DAWE 2020). It is estimated that a single flying-fox can disperse up to 60,000 seeds in one night (DELWP 2018). 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).

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

Long-distance seed dispersal and pollination make flying-foxes critical to the long-term persistence of many plant communities (Westcott et al. 2008, McConkey et al. 2012), including eucalypt forests, rainforests, woodlands and wetlands (Roberts 2006). Seeds that are able to germinate away from their parent plant have a greater chance of growing into a mature plant (DES 2021). Long-distance dispersal also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones & Augee 1992, Eby 1991, Roberts 2006). This genetic diversity allows species to adapt to environmental change and respond to disease pathogens. Transfer of genetic material between forest patches is particularly important in the context of contemporary fragmented landscapes.

Flying-foxes are considered ‘keystone’ species given their contribution to the health, longevity and diversity among and between vegetation communities. These ecological services ultimately protect the long-term health and biodiversity of Australia’s bushland and wetlands. In turn, native forests act as carbon sinks (Roxburgh et al. 2006), provide habitat for other animals and plants, stabilise river systems and catchments, add value to the production of hardwood timber, honey and fruit (Fujita 1991), and provide recreational and tourism opportunities worth millions of dollars each year (DES 2021).

Camp preferences

- 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 camp in vegetation with at least some of the following general characteristics (SEQ Catchments 2012):
- closed canopy > 5 m high
- dense vegetation with complex structure (upper, mid and understorey layers)

- within 500 m of permanent water source
- within 50 km of the coastline or at an elevation < 65m above sea level
- level topography (< 5° incline)
- greater than one hectare to accommodate and sustain large numbers of flying-foxes.

Proximity to water is a key attribute in camp location (Hall & Richards 2000, Roberts 2005) with one study suggesting that 94% of GHFF camps in NSW were (at that time) located adjacent to or on a waterway or waterbody (Eby & Lunney 2002).

Species profiles

Black flying-fox (*Pteropus alecto*)

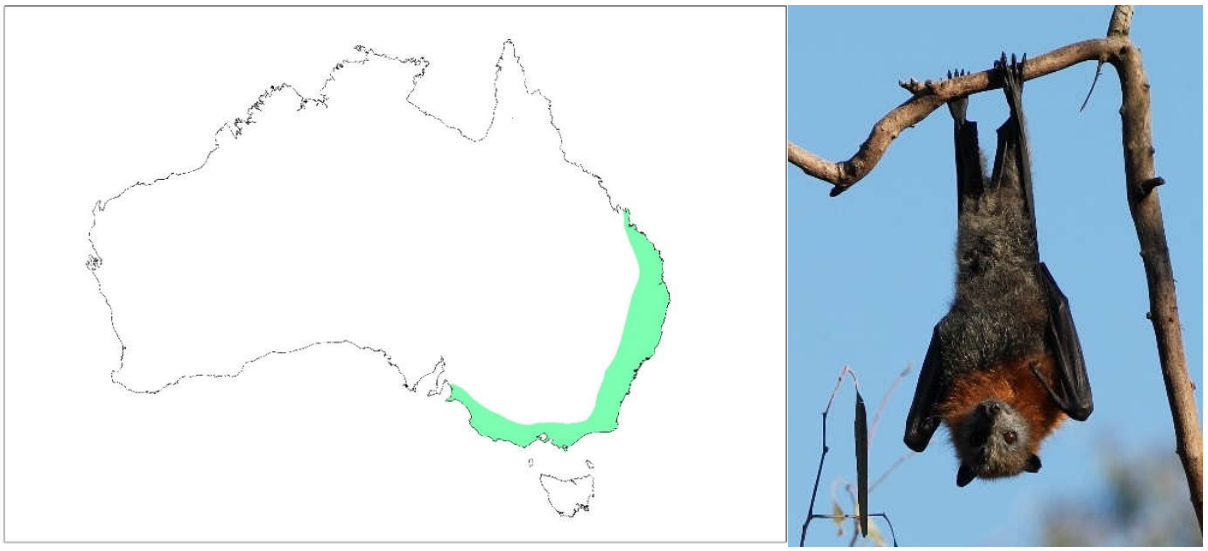
Black flying-fox indicative species distribution (DPE 2020a)

The BFF has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Queensland and into NSW (Churchill 2008). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann 1995). This shift has consequently led to an increase in indirect competition with the threatened GHFF, which appears to be favouring the BFF (DAWE 2020).

They forage on the fruit and blossoms of native and introduced plants (Churchill 2008), including orchard species at times. BFF are largely nomadic animals with movement and local distribution influenced by climatic variability and the flowering and fruiting patterns of their preferred food plants. Feeding commonly occurs within 20 km of the camp site (Markus and Hall 2004).

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

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



Grey-headed flying-fox indicative species distribution (DPE 2020a)

The GHFF is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to the north to Melbourne, Victoria (DPE 2020a). This species now ranges into South Australia and individual flying-foxes have been reported on the Bass Islands and mainland Tasmania (Driessen et al. 2011). It requires foraging resources and camp sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will feed in orchards at times, especially when other food is scarce (DPE 2020a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb and Tidemann 1996, DAWE 2021). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012). They have been recorded travelling over 500 kilometres over 48 hours when moving from one camp to another (Roberts et al. 2012). GHFF generally show a high level of fidelity to camp sites, returning year after year to the same site, and have been recorded returning to the same branch of a particular tree (SEQ Catchments 2012). This may be one of the reasons flying-foxes continue to return to small urban bushland blocks that may be remnants of historically used larger tracts of vegetation.

The GHFF population has a generally annual southerly movement in spring and summer, with their return to the coastal forests of north-east NSW and south-east Queensland in winter (Ratcliffe 1932, Eby 1991, Parry-Jones & Augee 1992, Roberts et al. 2012). This results in large fluctuations in the number of GHFF in New South Wales, ranging from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby 2000). They are widespread throughout their range during summer, but in spring and winter are uncommon in the south. In autumn they occupy primarily coastal lowland camps and are uncommon inland and on the south coast of New South Wales (DECCW 2009).

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

2000, Richards 2000 cited in DPE 2019). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, culling in orchards, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, and power line electrocution) and competition and hybridisation with the BFF (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation.

Little red flying-fox (*Pteropus scapulatus*)

Little red flying-fox indicative species distribution (DPE 2020a)

The LRFF 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 2020). 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 (Australian Museum 2020). 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 camp 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).

Flying-fox breeding cycle

Flying-foxes reach reproductive maturity in their second or third year of life. Reproductive cycles detailed below are indicative and can vary by several weeks between regions, are annually influenced by climatic variables, and births can occur at any time of the year. Expert assessment is required to accurately determine the phase in the breeding cycle to inform appropriate management timing.

Black and grey-headed flying-foxes

Mating begins 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 depending on species (Churchill 2008). The birthing season becomes progressively earlier, albeit by a few weeks, in more northerly populations (McGuckin and Blackshaw 1991), however out of season breeding is not unusual and births may occur at any time of the year (Ecosure pers. obs. 2015-2021).

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 an average life expectancy of 5-7 years (Divljan et al. 2006, Fox et al. 2008). Individuals have been recorded to live to 18 years of age in the wild (Tidemann & Nelson 2011).

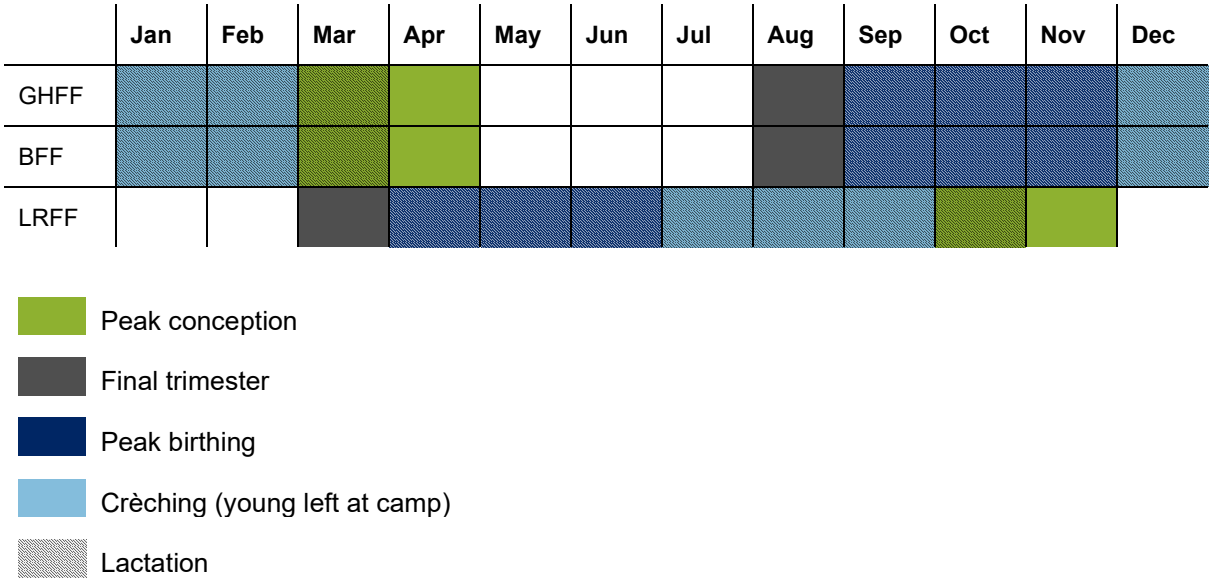
The critical reproductive period for BFF and GHFF is generally from August/September (when females are in late stages of pregnancy) to the end of peak conception around April/May. Dependent pups are usually present from September/October to February.

Little red flying-fox

The LRFF breeding cycle is approximately six months out of phase with BFF and GHFF. Conception occurs around October to November, with peak birthing in April-June (McGuckin & Blackshaw 1991, Churchill 2008). 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 pups are particularly vulnerable to cold weather and can suffer hypothermia and fall from their crèche trees. If LRFF pups are present, rescuers and carers should be on stand-by during cold weather.

Indicative flying-fox reproductive cycle



Appendix 2 Legislation

State

Flying-fox Camp Management Policy 2015

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

Flying-fox Camp Management Code of Practice 2018

DPE has prepared a Code of Practice under the Biodiversity Conservation Regulation 2017 authorising camp management actions on public land. The code defines standards for effective and humane management of flying-fox camps.

Camp management actions can only be implemented under the Code in accordance with a Camp Management Plan endorsed by the Environment Agency Head (i.e. DPE).

The objective of the code is to enable camp managers to act quickly if flying-fox camps are causing a concern on public land. If camp management actions are consistent with the code, a Biodiversity Conservation licence will not be required.

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) replaced the Threatened Species Conservation Act 1995 on 25 August 2017.

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

The grey-headed flying-fox is listed as threatened under the BC Act (DPE 2020b).

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

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

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

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

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

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

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

Local Government Act 1993

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

National Parks and Wildlife Act 1974

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

Prevention of Cruelty to Animals Act 1979

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

Environmental Planning and Assessment Act 1979

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

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

Environment. Development control plans under the EP&A Act should consider flying-fox camps so that planning, design and construction of future land uses is appropriate to avoid future conflict. Development under Part 4 of the Act does not require licensing under the BC Act, however it must be assessed and undertaken in accordance with the provisions of the BC Act.

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

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

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

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

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

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

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

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

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

The GHFF is listed as a vulnerable species under the EPBC Act, meaning it is an MNES. It is also considered to have a single national population. DAWE has developed the Referral guideline for management actions in GHFF and 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, DAWE 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 DAWE will be required.

Mitigation standards:

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

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

Appendix 3 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 ABLV and HeV. 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 and HeV, 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 (Queensland Health 2020).

Below is current information at the time of writing. Please refer regularly to NSW Health for up-to-date information on bats and health.

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 (WHA 2019) 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 (WHA 2019).

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 (WHA 2019).

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 (Queensland Health 2020).

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. 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 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 (WHA 2021). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (NSW Health 2020). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (WHA 2021).

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 (WHA 2021).

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 estimated to be 90% (WHA 2021). Since 1994, over 100 horses have died, and four of the seven people infected with HeV have lost their lives (WHA 2021, Australian Government 2022).

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 (WHA 2021), 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.

Coronaviruses

Coronaviruses are found in bats, birds and other wildlife worldwide. While SARS-CoV-1 (SARS), MERS-CoV (MERS) and SARS-CoV-2 (COVID-19) have caused serious disease in humans, coronaviruses isolated from Australian bats are not closely related to these and no human health implications have been identified (WHA 2020).

Ectoparasites

Bat flies are highly specialised ectoparasites that feed on the blood of bats. There are two families of bat flies; *Nycteribiidae* and *Streblidae*, though only species belonging to *Nycteribiidae* have been observed on flying-foxes in Australia (WHA Bat Focus Group members, pers. comm. 2020). They are generally considered to be highly host-specific and are usually only found on or near bats. This is predominantly due to them being obligate parasites, meaning they need regular blood meals to remain viable (WHA Bat Focus Group members, pers. comm.). There is limited available literature on the relationship between bat flies and flying-foxes in Australia. However, ectoparasite loads appear to be higher in little-red flying-fox camps, perhaps due to their very close roosting style/structure (Ecosure pers. obs.).

To date, there has been limited research on the effect of bat fly bites on humans, though the risk of transmitting diseases to humans is considered low (WHA Bat Focus Group members, pers. comm.). Firstly, bat flies tend to remain very close to flying-fox camps, and rarely remain after flying-foxes have left. As such, the only opportunity for contact between bat flies and humans would be if someone were to walk directly underneath a camp. The chance of this contact occurring will increase if the camp contains LRFF, is large, or if the flying-foxes are highly mobile (Ecosure pers. obs.) but is generally considered low. While bat flies generally do not cause issues for humans and they do not burrow into the skin the way a tick does, some people can react to bites (Dick & Patterson 2006).

There is no evidence to show that bat flies can transmit diseases that Australian flying-foxes may carry. A study by Vidgen et al. (2016) investigated the ability of bat flies in the *Cyclopodia* genus to carry Hendra virus. The study found no evidence of any bat fly carrying the virus, even those found feeding on virus positive black flying-foxes (Vidgen et al. 2016). There is some evidence to suggest that bat flies may be vectors for *Bartonella spp*. overseas (Kamani et al. 2014, Dietrich et al. 2016, Moskaluk et al. 2018). There appears to be no reports of zoonotic pathogens in Australian bat flies, indicating either a lack of presence or very low prevalence.

Overall, the risk of disease transmission from bat fly to human is considered very low as it relies on three infrequent factors; a bat fly carrying a zoonotic pathogen, contact between a

bat fly and human, and the bat fly burrowing sufficiently into the skin to transfer the pathogen (WHA Bat Focus Group members, pers. comm.).

Measures to avoid bat fly bites are:

- Avoid walking directly under dense groups of roosting flying-foxes.
- If possible, postpone manual cleaning of fallen vegetation and debris under a camp for 1-2 weeks after it has emptied at which time flies without a bat host should have died. If this is not possible, consider machine clean-up options.
- Follow protective measures used to avoid tick bites, such as applying insect repellent, long pants and sleeves, and double-sided tape around wrists and ankles to trap biting insects.
- If bitten and a reaction occurs, seek medical advice.

General health considerations

Flying-foxes, like all animals, carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species.

Bat urine and faeces should be treated like any other animal excrement. Viruses are not transferred to humans from bat urine or faeces. As with any accumulation of animal faeces (bird, bat, domestic animals), fungi or bacteria may be present in bat droppings or urine. While considered very unlikely, there is a risk of contracting histoplasmosis and leptospirosis through direct contact with flying-fox droppings and urine, i.e. ingestion of fungal spores from bat droppings (histoplasmosis) and contact of infected urine with open cuts/eyes/mouth/nose (leptospirosis). As such, care should be taken when cleaning bat faeces or urine. This includes wetting dried faeces before cleaning or mowing, wearing appropriate PPE and maintaining appropriate hygiene. If disturbing dried bird or bat droppings, particulate respirators should be worn to prevent inhalation of dust and aerosols. See ‘Work with bird and bat droppings’ for detail.

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

Public water supplies are regularly monitored for harmful microorganisms and are filtered and disinfected before being distributed. Management plans for community supplies should consider whether any large congregation of animals, including flying-foxes, occurs near the supply or catchment area. Where they do occur, increased frequency of monitoring should be considered to ensure early detection and management of contaminants.

Appendix 4 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.

Level 1 actions: routine camp management

Education and awareness programs

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

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

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

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

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

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

An education program may include components shown below.

Property modification

The managers of land on which a flying-fox camp is located could 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. Actions may include:

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. BBQs and tables) within close proximity to a camp or foraging tree to avoid contamination by flying-foxes.

- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Turn off lighting at night which may assist flying-fox navigation and increase fly-over impacts.
- Consider removable covers for swimming pools and ensure working filter and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase camp noise.

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

Odour neutralising trial

Odour neutralising systems (which modify odour-causing chemicals at the molecular level rather than just masking them) are commonly used in contexts such as waste management, food processing, and water treatment. They have the potential to be a powerful tool for managing odour impacts associated with flying-foxes. Two trials have been undertaken that utilised two different odour-neutralising systems. The indoor system uses a Hostogel™ pot containing a gel-based formula for neutralising indoor odour. These are inexpensive, only require replacement every few months, and may be sufficient to mitigate odour impacts in houses affected by flying-fox camps. Initial results suggest there may be a positive localised effect in reducing flying-fox odour within homes. This option may be useful for affected residents (particularly those directly adjacent to the camp), as residents could choose whether or not they wish to have a gel-pot in their living space and can simply put the lid back on the pot when the odour is not impacting on them.

The outdoor system consists of a Vapourgard™ unit that dispenses an odour-neutralising vapour through diffuser pipes that are installed on boundary fences. A world-first trial was undertaken in April – June 2021 with the participation of residents living near a flying-fox camp at Porter Park, Sunshine Coast. The system followed a predetermined schedule (alternating on / off cycles) for 9 weeks and residents were asked to rate the flying-fox odour every day throughout the trial.

The trial identified that the odour-neutralising technique has the potential to be effective. However, objective results were difficult to obtain due to the significant negative experience of residents as a consequence of the large influxes of flying-fox numbers during the trial. If future trials confirm this technique is effective, the odour-neutralising system could be installed at the Regents Park camp.

Subsidy programs

Subsidy programs provide Council with an opportunity to support impacted residents living near flying-fox camps. There are a number of factors to consider when establishing a subsidy program, including who to offer subsidies to (e.g. who is eligible and how is this determined), what subsidies to offer (e.g. service-based or property-based), how subsidies should be offered (e.g. reimbursements for purchases or upfront funding), and how the program will be evaluated to determine effectiveness for reducing flying-fox impacts to residents. A recent report published by the NSW Department of Planning, Industry & Environment (Mo & Roache 2020) summarised the implementation and efficacy of subsidy programs across six councils in NSW: Eurobodalla, Ku-ring-gai, Cessnock, Tamworth, and Sutherland councils. This report provides insight into the aforementioned factors for Council's consideration, if a subsidy program is to be adopted/continued at the Balgowlah and Avalon camps.

Government initiatives that provide financial assistance commonly assess residents' eligibility based on a number of variables, including property distance from a camp, and deliver subsidies as partial or full reimbursements for purchases. It is important to consider that the popularity of certain subsidies likely varies across different communities, so affected residents should be consulted in the process of establishing an effective subsidy program. The NSW subsidy study (Mo & Roache 2020) found managers who design programs that best meet community needs have an increased probability of alleviating human-wildlife conflicts. Critical thresholds of flying-fox numbers at a camp and distance to a camp may also be used to determine when subsidies would apply. However, distance measures must be used with care as the extent to which a resident feels impacted is not a simple function of how close they live, as shown in a large-scale survey of 8,000 residents where there was no correlation between distance and level of bother within 300 m of a flying-fox camp (Lentini et al. 2020).

While subsidies have the potential to alleviate flying-fox impacts within a community, they can be negatively received if residents believe there are broader issues associated with flying-foxes that are not being addressed (Mo & Roache 2020). As such, it is important (as with any community-based program) to assess the needs of residents and have open, ongoing communication throughout the program to ensure the subsidies are effectively reducing impacts, and if not, how the program can be adapted to address these needs.

A brief description and examples of property and service-based subsidies is provided below.

<u>Property modification/item subsidies</u>

Fully funding or providing subsidies to property owners for property modifications can be used to manage the impacts of the flying-foxes. Providing subsidies to install infrastructure may improve the value of the property, which may also offset concerns regarding perceived or actual property value or rental return losses. Focusing funds towards manipulating the existing built environment also reduces the need for modification and removal of vegetation. Examples of property modification subsidies include vehicle covers, carports, clothesline covers, clothes dryers, pool/spa covers, shade cloths, rainwater first-flush diverters, high-pressure water cleaners, air conditioners, fragrance dispensers or deodorisers, double-glazing of windows, door seals, screen planting, tree netting, and lighting (to discourage flying-foxes). Of these,

vehicle and clothesline covers and high-pressure water cleaners were the most common subsidies taken by residents (Mo & Roache 2020).

When offered, double-glazing windows was popular amongst residents and was able to achieve a 65% reduction in flying-fox noise (Mo & Roache 2020). Furthermore, in a study by Pearson and Cheng (2018), it was found using infrastructure such as double-glazing windows significantly reduced the external noise level measured inside a house adjacent to a camp. This finding was supported by post-subsidy surveys undertaken by Port Macquarie Hastings Council that showed that double-glazed windows were rated as being more effective in mitigating impacts than any other subsidised option (e.g. high pressure cleaners, clothesline covers, shade cloths etc.) (Reynolds 2021).

Sunshine Coast Council (Queensland) undertook several rounds of a private property grant trial in 2021-2022. The trial was used to facilitate property improvement or impact reduction infrastructure on eligible private properties. Feedback from this round confirmed that residents that have lived nearby a camp long-term are more likely to participate in the trial and experience more positive outcomes. It is acknowledged that residents that have only experienced short-term impacts may not be ready yet for this intervention. Sunshine Coast Council is currently implementing Round 2 of the grant trial where a one-off grant would be provided to eligible residents, which would be supported by ongoing camp management, education, research and monitoring.

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, solar panel cleaning, car washing, removing exotic trees, or contributing to water/electricity bills. The NSW subsidy study showed that while many property modification subsidies proved popular amongst residents (e.g. high-pressure cleaners, air conditioners), many raised concerns over the increase in water/electricity bills. Increases in bills can be difficult to quantify and justify, and has not yet been effectively offered by a council in a subsidy program.

Northern Beaches Flying-fox Residents Assistance Program

Council has previously provided affected residents at the Balgowlah and Avalon camps with grant-funded subsidies to manage the impacts of flying-foxes. To date, the program has provided $42,378 worth of item- and service-based subsidies to residents at these camps. Items/services provided to residents include:

- works to balconies to improve ease of cleaning
- pressure washers
- cleaning equipment
- outdoor furniture covers
- air purifiers and insulating window furnishings

- window and glass door upgrades, including secondary window glazing, window seals, and other window furnishings
- vehicle cleaning packages and vouchers
- clothes dryers
- protective awning.

The feedback from the Residents Assistance Program has been broadly positive, with residents reporting reduced impacts as a result of many services and items provided.

Given the success of this program in reducing impacts to residents, Council should continue to liaise with residents and provide subsidies through this initiative where appropriate.

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 removal of environmental weeds and Priority weeds under the *Biosecurity Act 2015*
- trimming of understorey vegetation
- the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals
- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or
- removal of leaf litter or other material on the ground.

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

Revegetation and land management to create alternative habitat

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

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

the transient and less selective LRFF). Supporting further research into flying-fox camp preferences may improve the potential to create new flying-fox habitat.

Foraging trees planted amongst and surrounding camp 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.

Provision of artificial roosting habitat

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

Protocols to manage incidents

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

Participation in research

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

Appropriate land-use planning

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

Property acquisition

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

Do nothing

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

Level 2 actions: in-situ management

Buffers

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

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

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

Buffers through vegetation removal

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

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

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

Suitable experts should be consulted to assist selective vegetation trimming/removal to minimise vegetation loss and associated impacts. The importance of under- and mid-storey vegetation in the buffer area for flying-foxes during 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 roosting 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 short-term 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. Further information regarding canopy-mounted sprinklers is detailed below.

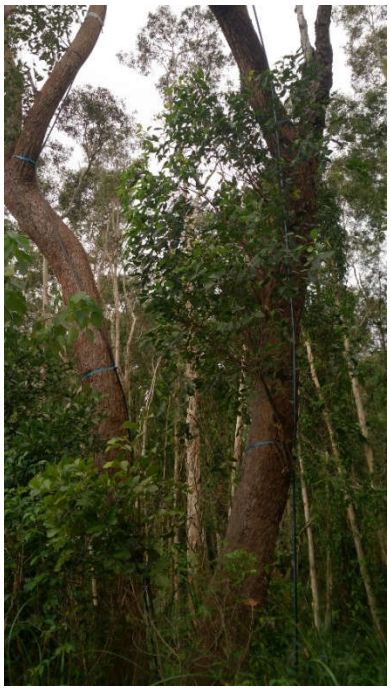
- Screening plants – A ‘screen’ can be created by planting a row of trees along the edge of a camp, with the aim of reducing visual impacts associated with flying-foxes. This technique can be particularly useful in cases where residents can suffer extreme reactions triggered by the mere sight of flying-foxes.

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

Canopy-mounted sprinklers

Installing canopy-mounted sprinklers (CMS) can be used to deter flying-foxes from a buffer. CMS can be installed either:

- without any camp tree trimming/removal or
- accompanied by selective camp tree trimming/removal.



Canopy mounted sprinklers installed by Sunshine Coast Council (source: National Flying-fox Forum 2016, Ecosure).

As CMS are operated by residents, clear guidelines on sprinkler use will need to be established with residents. To date, CMS have been successful at other locations at discouraging flying-foxes from roosting in the buffer zone and enabling residents to have more control over flying-foxes near their properties.

Canopy-mounted sprinklers can be installed and effectively operated without the need for any vegetation removal, as long as the vegetation is not so thick as to restrict the extent of water spray. If vegetation thinning is required to allow sprinklers to operate effectively in some areas, approval may be required under relevant legislation.

Water pressure must be firm so it is sufficient to deter flying-foxes, however, must not risk

injuring flying-foxes (or other fauna) or knocking an animal from the tree. Water misting should be minimised as this is unlikely to deter flying-foxes and could exacerbate heat stress event effects. Flying-fox heat stroke generally occurs when the temperature reaches 42°C, however, can occur at lower temperatures in more humid conditions (Bishop 2015). Given that humidity is likely to increase with water in the environment, sprinklers may need to be turned off in higher temperatures (e.g. >30°C) to avoid exacerbating heat stress (N.B. A NSW government-funded trial through Western Sydney University is currently underway to determine if sprinklers increase humidity and potential heat stress impacts; results should be considered for sprinkler usage).

Sprinklers should release a jet of air prior to water, as an additional deterrent and to cue animals to move prior to water being released. The intention of the sprinklers is to make the buffer unattractive, and effectively 'train' individuals to stay out of the buffer area. If installed, sprinklers should be programmed to operate on a random schedule and in a staggered manner (i.e. not all sprinklers operating at the same time, to avoid excessive disturbance). Each activation should be for approximately 30-45 seconds per sprinkler. Each sprinkler should be activated up to five times between 0630 and 1600 avoiding critical fly-in or fly-out periods. To avoid flying-foxes habituating to the stimuli, sprinklers should only be operated by residents when flying-foxes are within range. Sprinkler settings would also need to account for seasonal changes (e.g. not in the heat of the day during summer when they may be an attractant, and/or could increase humidity and exacerbate heat events). Individual sprinklers may also need to be temporarily turned off depending on location of creching young, or if it appears likely that animals will be displaced to undesirable locations.

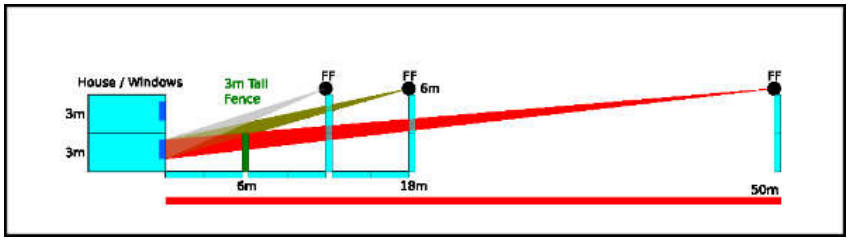
Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in a publicly accessible area.

Noise attenuation fencing

Noise attenuation fencing aims to reduce noise and potentially odour where the camp is close to residents.

Example of noise attenuation fencing (source: http://www.slimwall.com.au/gallery)

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. If flying-fox camps are located directly adjacent (or very close) to residential properties, fencing may need to be relatively tall, as indicated below.



Indicative scaled distances to achieve shielding for bats approximately 6 m elevated, to a typical window height (Air Noise Environment 2019). Image is indicative only with further investigation required.

To avoid the high costs associated with permanent acoustic fencing, and where flying-fox presence is transient, temporary fencing can be erected in property backyards (below). Residents/businesses can have the ability to fold down the acoustic fence when there are no flying-foxes present and erect it when flying-foxes return to the site (highly likely during melaleuca flowering periods).

Sound Block Acoustic Barrier (source: https://fortressfencing.com.au/sound-block-acoustic-barrier-noise-barrier)

Level 3 actions: disturbance or dispersal

Nudging

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

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

Dispersal

Dispersal aims to encourage a flying-fox camp to move to another location. Dispersing flying-foxes may be achieved in two ways:

- actively disturbing the camp pre-dawn as flying-foxes attempt to return from nightly foraging
- passively, by removal of all roosting habitat.

Dispersal via disturbance has been shown to reduce concerns and improve amenity in the short term, however, camps are usually recolonised, and the conflict remains (Roberts & Eby 2013, Currey et al. 2018, Roberts et al. 2021). Data from these and more recent studies show that in 95% of cases, dispersal did not reduce the number of flying-foxes from the local area (Roberts et al. 2021).

A review of dispersal attempts between 1990 and 2013 found that flying-foxes only moved within 600 m of the original site in 63% of cases (Roberts & Eby 2013). Similarly, another review of 69 dispersal attempts undertaken between 1992 and 2020 found that in 88% of dispersals, new camps established within 1 kilometre and resulted in new conflict sites (Roberts et al. 2021). In addition, a review of 25 dispersal attempts in Queensland between November 2013 and November 2014 found that when flying-foxes were dispersed, they did not move further than 6 km away for the original camp site (Ecosure 2014). Ultimately, these results indicate that, when dispersed, flying-foxes generally relocate within 600 m – 1 km of the original camp site, and do not travel further than 6 km away.

Newly published research investigating the effectiveness of dispersal attempts (Roberts et al. 2021) has shown similar findings which are summarised below.

- Of the 48 camp dispersals attempted, only 23% were deemed a success at reducing conflict with communities, and this generally only occurred after extensive destruction of camp habitat.
- No project with a budget less than A$250,000 was deemed successful.
- Repeat actions were required in 58% of cases, some for months and years following the initial activities.
- In 88% of cases, replacement camps were established within one kilometre of the original camp, transferring conflict to neighbouring communities.

Driving flying-foxes away from an established camp is challenging and resource intensive. There is a range of risks associated with camp dispersal. These include:

- shifting or splintering the camp into other locations that are equally or more problematic
- impacts on animal welfare and flying-fox conservation
- impacts on the flying-fox population including disease status and associated public health risk

- impacts to the community associated with ongoing dispersal attempts
- increased aircraft strike risk associated with changed flying-fox movement patterns
- high initial and/or ongoing resource requirement and financial investment
- negative public perception from some community members and conservationists opposed to dispersal.

Despite these risks, there are some situations where camp dispersal may be considered. 'Passive' or 'active' is described further 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/midstorey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important camps (Appendix 2), sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

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

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

Active dispersal through disturbance

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

wind direction for smoke drums).

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

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

Early dispersal before a camp is established at a new location

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

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

Maintenance dispersal

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

Unlawful activities

Culling

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

Appendix 5 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 a camp.

- All personnel will be appropriately experienced, trained and inducted. Induction will include each person's responsibilities under this CMP.
- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and DPE consulted in accordance with the 'stop work triggers' section of the CMP (below).
- 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.).
- DPE 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, or after fly-out if there are no creching young within the camp. 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 DPE fact sheet on Responding to heat stress in flying-fox camps.
- Any proposed variations to works detailed in the CMP will be approved, in writing, by DPE before any new works occur.
- DPE 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.

GPT cleaning, maintenance and/or repairs

- GPT maintenance works will be undertaken during the day outside of the birthing and pup-rearing season and while flying-foxes are not carrying pups.
- Any GPT works required while flying-foxes are carrying pups will be undertaken at/after fly-out, unless there are crèching pups within the camp.
- No GPT works will be undertaken when there are crèching pups within the camp.
- A suitably qualified person will be on site monitoring flying-fox behaviour during any GPT maintenance works to stop work if required.

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 camp 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. Any proposal to remove threatened vegetation will require a threatened species license to be obtained from DPE. The licence application will include provisions for replacement plantings in more appropriate locations at a 2:1 ratio, and undertaken as a condition of the licence.

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.
- 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 camp tree management in the future.

Stop work triggers

Management activities in or near Northern Beaches camps will cease and will not recommence without consulting DPE if:

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

Planned action for potential impacts during any works under or near the camp. A person with experience in flying-fox behaviour 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 have abandoned camp.	Works to cease immediately and DPE 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.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed & approved by
00	24/06/2022	Northern Beaches Flying-fox Camp Management Plan - DRAFT	Ellie Kirke, Wildlife Biologist Tegan Dinsdale, Graduate Wildlife Biologist	Jess Bracks, Principal Wildlife Biologist
01	20/07/2022	Northern Beaches Flying-fox Camp Management Plan – DRAFT R1	Northern Beaches Council	Ellie Kirke, Wildlife Biologist Jess Bracks, Principal Wildlife Biologist
02	27/07/2022	Northern Beaches Flying-fox Camp Management Plan – DRAFT R2	Northern Beaches Council	Ellie Kirke, Wildlife Biologist

Distribution List

Copy #	Date	Type	Issued to	Name
1	27/07/2022	Electronic	Northern Beaches Council	Kristie King
2	27/07/2022	Electronic	Ecosure	Administration

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PR7197-RE.Northern Beaches Flying-fox Camp Management Plan R2

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