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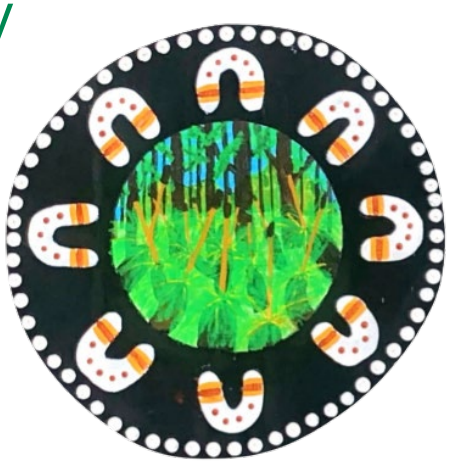
HOODS LAGOON FLYING-FOX MANAGEMENT PLAN

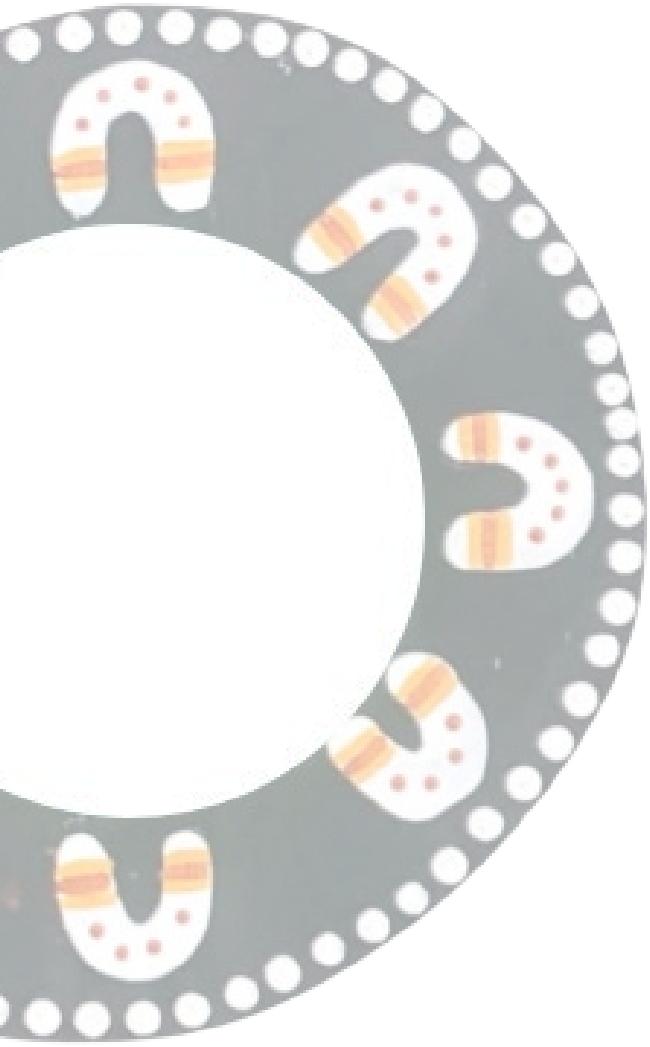
September 2023

ISAAC REGIONAL COUNCIL

Acknowledgement of Country



Ecosure acknowledge the Traditional Custodians of the lands and waters where we work. We pay deep respect to Elders past and present who hold the Songlines and Dreaming of this Country. We honour and support the continuation of educational, cultural and spiritual customs of First Nations peoples.



Acknowledgements

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We would also like to thank the Department of Environment and Science for supplying historical roost data, and the Queensland Herbarium/Department of Environment and Science/CSIRO for sharing information and spatial data on flying-fox foraging resources in the area.

This roost management plan was developed with funding support from the Queensland Government's Local Government Flying-Fox Roost Management Grants Program.

Acronyms and abbreviations

ABLV	Australian bat lyssavirus
ACP Act	*Animal Care and Protection Act 2001* (Queensland)
AIHW	Australian Institute of Health and Wellbeing
ATSB	Australian Transport Safety Bureau
AVA	Australian Veterinary Association
BFF	Black flying-fox (*Pteropus alecto*)
CMS	Canopy mounted sprinkler
Council	Isaac Regional Council
COVID-19	Sudden Acute Respiratory Syndrome SARS-CoV-2
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science (Queensland)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVNT	Endangered, vulnerable and near threatened
FFRMP	Flying-fox Roost Management Permit
HeV	Hendra virus
HSE	Heat Stress Event
LGA	Local government area
Low Impact COP	Code of Practice – Low impact activities affecting flying-fox roosts (DES 2020c)
LRFF	Little red flying-foxes (*P. scapulatus*)
Management COP	*Code of Practice – Ecologically sustainable management of flying-fox roosts* (DES 2020a)
MERS	Middle East Respiratory Syndrome MERS-CoV
MNES	Matters of national environmental significance
NC Act	*Nature Conservation Act 1992* (Queensland)
NSW	New South Wales
the Plan	Hoods Lagoon Flying-fox Roost Management Plan
PPE	Personal Protective Equipment
Qld	Queensland
SARS	Sudden Acute Respiratory Syndrome SARS-CoV-1
SEQ	South-East Queensland
SL	Special least concern species (conservation status of taxon under the *Nature Conservation Act 1992*)
SoMI	Statement of Management Intent
UFFMA	Urban Flying-fox Management Area
VM Act	*Vegetation Management Act 1999* (Queensland)

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1 Introduction

The Hoods Lagoon Flying-fox Management Plan (the Plan) provides Isaac Regional Council (Council) with a framework to manage issues that may be associated with the Hoods Lagoon flying-fox roost in Clermont, whilst ensuring flying-foxes and their ecological services are conserved. The Plan has been developed in line with Council's Statement of Management Intent (SoMI). As outlined in the SoMI, Council recognises the ecological importance of flying-foxes and their critical contribution to the environment. Council also understands living near a flying-fox roost can be challenging and this Plan aims to address community impacts experienced at Hoods Lagoon.

Two species of flying-foxes occur within the Isaac Local Government Area (LGA) at times; black flying-foxes (*Pteropus alecto*; BFF) and little red flying-foxes (*P. scapulatus*; LRFF) (seasonal visitor). Both species have been recorded roosting at Hoods Lagoon, though LRFF are the primary occupants, with BFF only recorded twice in September 2015 and September 2017. The grey-headed flying-fox (*P. poliocephalus*) has not been recorded in the Isaac LGA, and therefore has not been considered in the Plan.

1.1 Objectives

The objectives of the Plan are to:

- minimise impacts experienced by the community at or near Hoods Lagoon
- outline management actions that can be utilised at the Hoods Lagoon roost whilst minimising the risk of flying-foxes dispersing to undesirable areas
- manage public health and safety risks
- contribute to community understanding and appreciation of flying-foxes, including their critical ecological role
- ensure flying-fox welfare and support long-term conservation for flying-foxes.

1.2 Legislation overview

Flying-foxes are protected native wildlife that provide a critical ecological role in long-distance seed dispersal and pollination. As such, there is a range of legislation and policy that governs how flying-foxes and their habitat can be managed in Queensland. Like all native animals, flying-foxes are protected under Queensland's *Nature Conservation Act 1992* (NC Act). Under this legislation, administered by the Department of Environment and Science (DES), it is an offence to harm the animals, or disturb flying-foxes from daytime roosts[1] without approval.

In Queensland, local governments are authorised under the NC Act to manage roosts in areas

[1] There are legislative differences between a 'roost', where breeding has been confirmed, and a daytime camp where breeding has not occurred, as outlined in Appendix 1. Hoods Lagoon is protected as a confirmed 'roost' and this will be the main collective term used throughout.

subject to an urban zoning under a council planning scheme, inclusive of a one-kilometre buffer around such areas. This area of management is known as the Urban Flying-Fox Management Area (UFFMA).

Local governments have an 'as-of-right' authority under the NC Act to manage flying-fox roosts in mapped UFFMAs in accordance with the Code of Practice – Ecologically sustainable management of flying-fox roosts (Management COP) (DES 2020a). The Flying-fox Roost Management Guideline (DES 2020b) has also been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Councils are required to apply for a flying-fox roost management permit (FFRMP) to manage flying-fox roosts outside an UFFMA, or for management actions not specified in the Management COP. It must be noted that this 'as-of-right' authority does not oblige Council to manage flying-fox roosts and does not authorise management under other relevant sections of the NC Act or other legislation (such as the *Vegetation Management Act 1999* [VM Act]).

Anyone other than local government is required to apply for a FFRMP for any management directed at roosting flying-foxes, or likely to disturb roosting flying-foxes. Certain low impact activities (e.g. mowing, minor tree trimming) do not require approval if undertaken in accordance with the Code of Practice – Low impact activities affecting flying-fox roosts (Low Impact COP) (DES 2020c).

The *Animal Care and Protection Act 2001* and *Animal Care and Protection Act 2001* also provides for animal welfare, and any management must comply with this legislation.

Key Commonwealth and State legislation specific to flying-fox management is summarised in further detail in Appendix 1.

1.3 Community concerns

A community survey was conducted to gauge the main areas of concern for residents and community members regarding the Hoods Lagoon flying-fox roost. The most common concerns related to:

- smell
- health concerns, particularly related to the proximity to public areas where children play
- noise
- damage to park infrastructure
- mess
- population numbers
- damage to vegetation and safety issues around branch/tree-fall.

Further discussion on community survey results can be found in Sections 4 and 5. This Plan details measures to mitigate these concerns to reduce negative impacts to residents and community members.

1.4 Stakeholders

Stakeholders with an interest in Hoods Lagoon and/or flying-foxes include:

- recreational parkland users
- nearby residents/businesses
- local and state government bodies (i.e. Council and DES)
- wildlife carers, researchers and conservationists
- Traditional Custodians
- Clermont Business Group.

Feedback has been sought from the community during development of the Plan, and Council will consult with all key stakeholders during the implementation of the Plan.

2 Flying-fox ecology

2.1 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 2015). Some plants, particularly *Corymbia* spp., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton et al. 2004).

Flying-foxes may travel 100 km in a single night with a foraging radius of up to 50 km from their roost (McConkey et al. 2012) and have been recorded travelling over 500 km in two days between roosts (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 2021a). 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 20121).

2.2 Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. In a study of national flying-fox roosts, 55.1% occurred in urban areas and a further 23.5% in agricultural areas (Timmiss 2017). Furthermore, the number of roosts 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 from urban expansion and agriculture

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

In the latest State of the Environment Report key findings (DES 2021b), the Brigalow Belt bioregion, that includes the Isaac region, experienced the highest rates of woody vegetation clearing in 2016-2018 in Queensland. Landscape scale changes such as this are likely to have contributed to flying-foxes becoming more reliant on townships for both roost and foraging habitat, and it is likely that flying-foxes will continue to roost at times within township areas such as Clermont.

2.3 Roost preferences

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

- closed canopy > 5 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)
- ideally greater than one hectare to accommodate and sustain large numbers of flying-foxes and allow the roost to shift its extent so vegetation can recover (note this does not appear to be a strong flying-fox preference, but more a consideration in roost habitat creation/improvement).

Though these are general findings, flying-foxes have been known to roost in a variety of habitats outside the above criteria.

One study, published by CSIRO in 2020, listed the following top five favoured species in known LRFF roosting habitats: *Eucalyptus tereticornis* (forest red gum), *E. camaldulensis* (river red gum), *Melaleuca quinquenervia* (broad-leaved paperbark), *M. leucadendra* (weeping paperbark), and *Rhizophora stylosa* (spotted mangrove) (Macdonald et al. 2020).

2.4 Flying-fox breeding preferences

Flying-foxes reach reproductive maturity in their second or third year of life. Reproductive cycles detailed below and in Table 1 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. Two species (BFF and LRFF) have been present at various times in the Isaac local government area (LGA), therefore the breeding cycles of these two species are outlined below.

Expert assessment is required to accurately determine the phase in the breeding cycle to inform appropriate management timing.

Black flying-foxes

Mating begins in January with peak conception occurring around March to April/May; this mating season represents the period of peak roost 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 & Blackshaw 1991), however out of season breeding is not unusual and births may occur at any time of the year (Ecosure, pers. obs. 2015-2022).

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 roost 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).

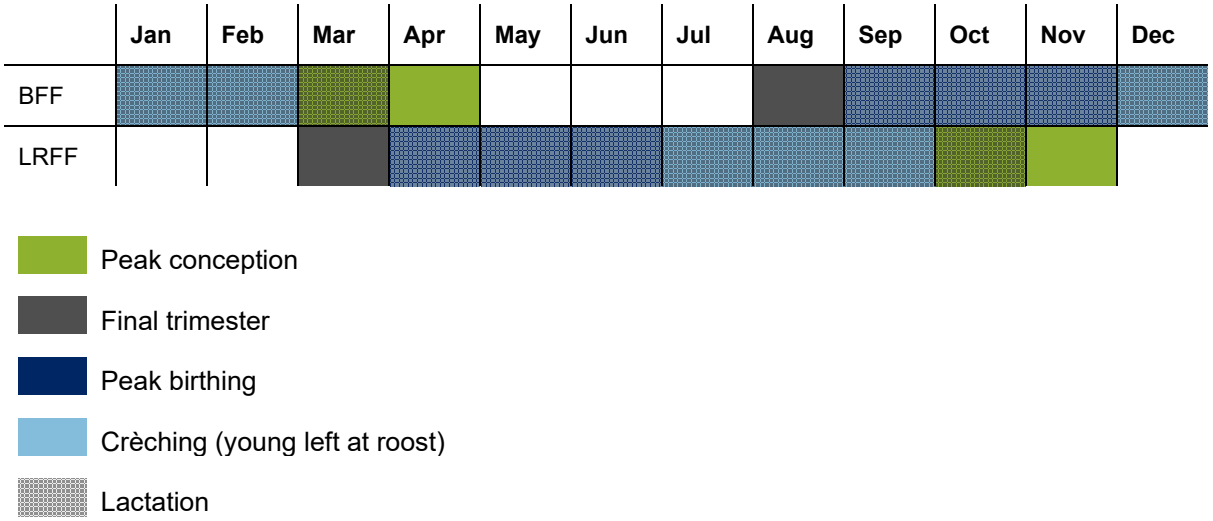
The critical reproductive period for BFF is generally from August/September (when females are in late stages of pregnancy) to the end of peak conception around April/May. Dependent pups (Table 1) are usually present from September/October to February.

Little red flying-fox

The LRFF breeding cycle is approximately six months out of phase with BFF (Table 1). 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 roost 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 during any planned on-ground management actions, rescuers and carers should be on stand-by during cold weather.

Table 1 Indicative flying-fox reproductive cycle



2.5 Local and regional context

Flying-foxes are highly nomadic, moving across their east coast range between a network of roosts. Roosts may be occupied continuously, annually, irregularly or rarely (Roberts 2005), and numbers can fluctuate significantly on a daily (up to 17% daily colony turnover; Welbergen et al. 2020) and seasonal basis. A study by Welbergen et al. (2020) tracked individuals of all three species over a 60-month period and found that BFF and LRFF roosted in an average of 12 and 24 LGAs per year, respectively, within their ranges. Hoods Lagoon forms part of a network of roosts across the species' range (see Appendix 2). There are 14 known current or historical roosts/camps within the Isaac LGA, which are shown in Figure 1.

Typically, the abundance of resources within a 20–50 km radius of a roost site will be a key determinant of the size of a roost (SEQ Catchments 2012). As such, flying-fox roosts are generally temporary and seasonal, tightly tied to the flowering of their preferred food trees. However, understanding the availability of foraging resources is difficult because flowering and fruiting may not occur each year and vary between locations (SEQ Catchments 2012).

A Queensland Government funded study by the Queensland Herbarium and CSIRO incorporated data from a range of sources to rank LRFF diet trees in bioregions across Queensland (Eyre et al. 2020). This was done using the method developed by Eby and Law (2008) by assessing the relative importance of LRFF diet tree species, the abundance of nectar produced during peak flowering periods, and the frequency of substantial flowering by a species, to obtain an overall Diet Plant Nectar score. Figure 2 shows the distribution of overall static nectar scores for remnant vegetation within 50 km of the Hoods Lagoon roost. While this analysis is based on LRFF diet, there is substantial overlap in dietary preferences between LRFF and BFF, and thus this mapping provides insight into flowering that will attract all species into the area.

Between 2019 and 2020, flying-foxes experienced significant population impacts across the east coast of Australia due to extreme weather events. Prolonged drought caused a mass food shortage from Gladstone to Coffs Harbour, peaking around October 2019 (DES 2019), 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. The total number of flying-foxes lost in these events is impossible to quantify but is likely to have been more than 100,000 individuals (M. Mo, pers. comm. 2019).

With these types of events severely impacting natural areas, foraging and roosting resources in and around urban locations become even more important for flying-fox conservation.

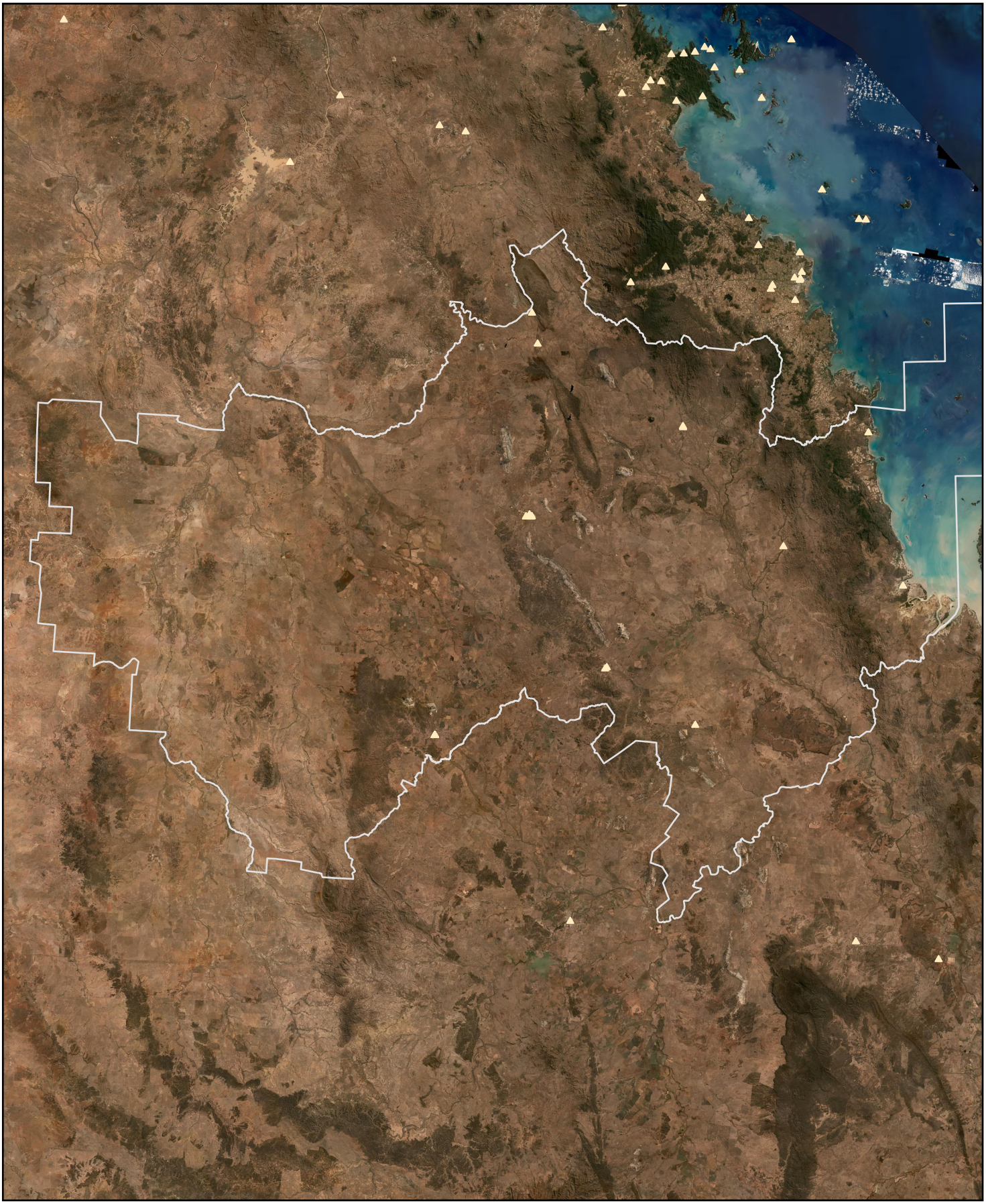


Figure 1: Regional context

Isaac Regional Council

Hoods Lagoon Flying-fox Management Plan

Current/historic flying-fox roosts

Isaac local government area boundary

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0 5 10 20 30 40
Kilometers

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

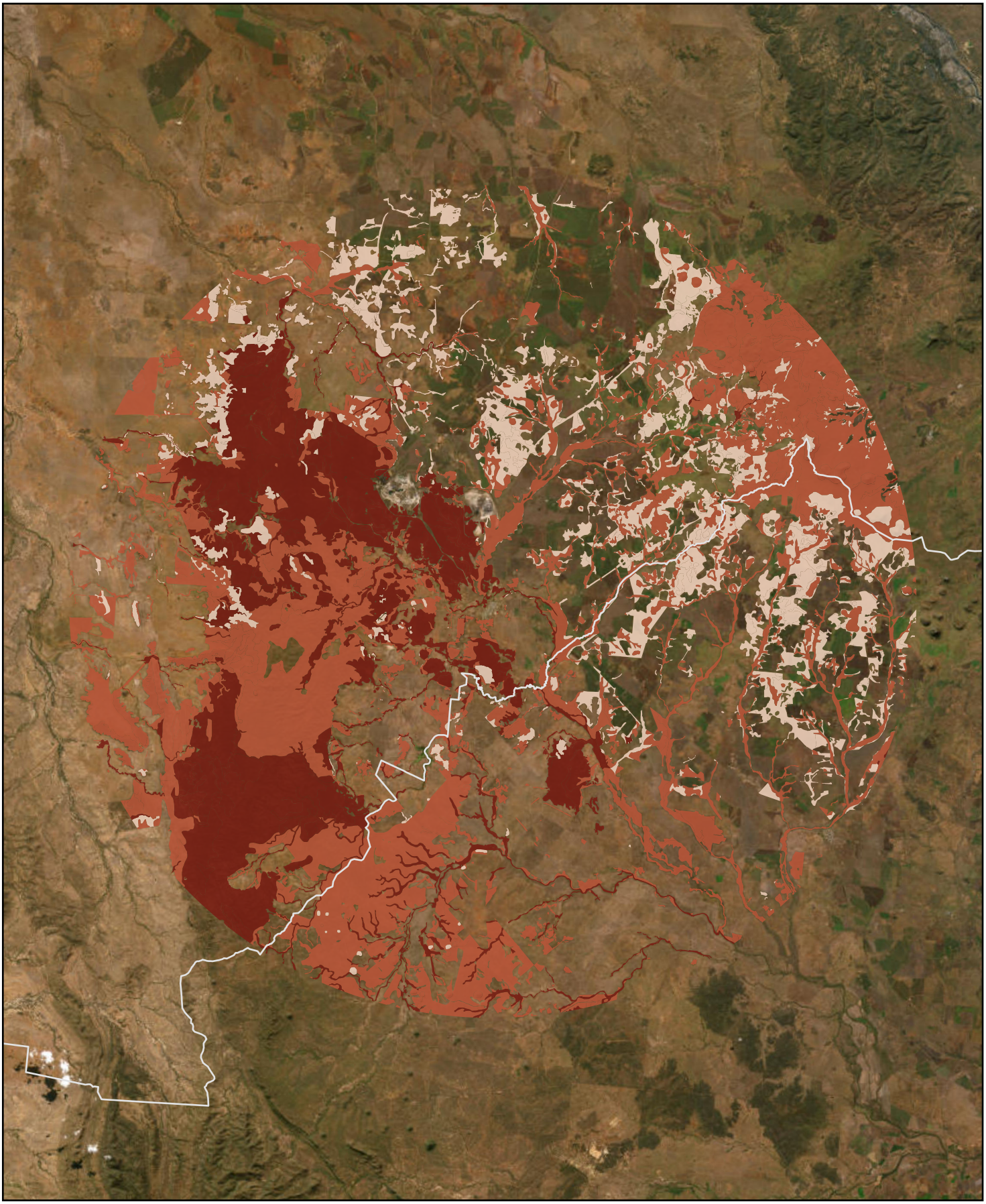

Figure 2: Distribution of the overall static nectar scores for remnant (2015) vegetation within 50 km of Hoods Lagoon

Isaac Regional Council

Hoods Lagoon Flying-fox Management Plan

Overall nectar score (Eyre et al. 2020)

- Low (0 - 6)
- Medium (7 - 15)
- High (16 - 24)

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Kilometers

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3 Site context

3.1 Tenure

The Hoods Lagoon flying-fox roost is located on Council-owned and managed land, on the southern bank of Hoods Lagoon. The core roosting area is located on lot/plan 14C9569, with an overflow roosting area located on lot/plan 8C95142 (Figure 4). Flying-foxes have also roosted on the northern side of the lagoon in Ivan Bettridge Park on lot/plans 32CLM602, 2RP601547, 1RP601547 and 1RP603630, and north of Drummond St on lot/plans 901CLM602, 1RP603626 and 2RP603626 (see Figure 4). Table 2 below summarises the tenure and zoning for each of the lot/plans where flying-foxes have been recorded roosting.

Table 2 Land tenure on which flying-foxes have been known to roost in Hoods Lagoon.

Lot/plan	Tenure	Zoning
14C9569	Reserve	Recreation and Open Space
8C95142	Freehold	Recreation and Open Space
32CLM602	Freehold	Recreation and Open Space
2RP601547	Freehold	Recreation and Open Space
1RP601547	Freehold	Recreation and Open Space
1RP603630	Freehold	Recreation and Open Space
901CLM602	Freehold	Recreation and Open Space
1RP603626	Freehold	Recreation and Open Space
2RP603626	Freehold	Recreation and Open Space

3.2 Flying-fox numbers and roost extent

Flying-foxes have been officially recorded roosting at Hoods Lagoon since 2015 (Figure 3), though anecdotal evidence suggests that flying-foxes have been recorded since 2011 (K. Worsley. pers. comm. 2023). In the community survey, an anonymous resident who has lived in Clermont for 70 years provided a recount of flying-foxes in Clermont when they were a child.

The core roost is located on the corner of Lima and Capella Str in Centennial Park (Figure 4). During large influxes, flying-foxes can also roost in overflow areas along the lagoon between Capella St and Capricorn St, and north of the Lagoon. Flying-foxes have roosted in vegetation to the north of Drummond St, which has been a target site for multiple nudging attempts in the past (Figure 4).

The roost is predominantly occupied by LRFF, with BFF only recorded twice (September 2015 and September 2017). The number of flying-foxes roosting at Hoods Lagoon varies

significantly from year to year. LRFF typically roost at Hoods Lagoon from November to April and vacate over the winter months (K. Worsley. pers. comm. 2022). The number of LRFF can vary between a few hundred individuals up to the highest recorded number of 120,000 individuals (Figure 3). These large influxes typically last for one to two weeks, before reducing significantly (K. Worsley. pers. comm. 2022). Birthing and crèching of LRFF has been recorded in multiple years (K. Worsley. pers. comm. 2022).

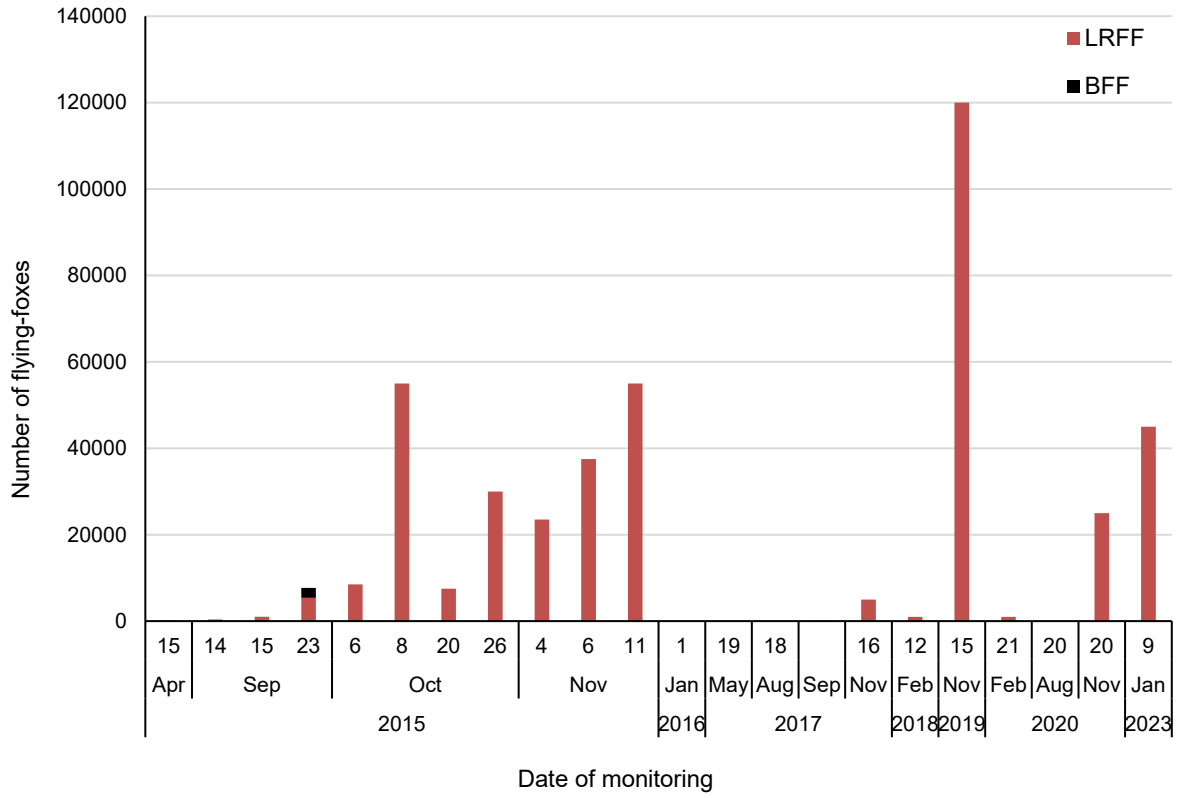

Figure 3 Historical flying-fox counts at Hoods Lagoon (Source: DES Flying Fox Monitoring Program Data. DES Camp ID: 336, Isaac Regional Council).

3.3 Management response to date

Several dispersal/nudging attempts have been made at Hoods Lagoon in 2015, 2016 and 2017 (see Appendix 3). The dispersals successfully relocated LRFF across to north of the lagoon, however LRFF continued to occupy the Hoods Lagoon site in Centennial Park in subsequent years. Council no longer endorses dispersal as a management option due to the intense resource requirements, direct evidence that it does not relocate roosts long term, increased impacts to residents, and welfare impacts on flying-foxes (Isaac Regional Council 2019).

Council is adaptively managing the Hoods Lagoon site by erecting temporary fencing around the roost site to restrict access to the roost, thereby reducing disturbance to flying-foxes and community members, reducing faecal drop impacts to recreational park users, and reducing the risk of strikes from fallen branches. Council temporarily covers multiple public chairs and park benches to protect these assets from faecal drop and reduce impacts to recreational park

users.

Council provides regular media updates about the roost via social media platforms and Council's website, and regularly encourage residents to conduct vegetation trimming on their properties while flying-foxes are vacant which can reduce the likelihood of flying-foxes roosting in backyards.

When flying-foxes are present at Hoods Lagoon, Council conduct weekly monitoring to collect data on the species present, the number of flying-foxes and extent of the roost.

3.4 Other values of the site

Hoods Lagoon is a naturally occurring riverine wetland that provides habitat for many wildlife species and a recreational space for the community to utilise barbecues, walking paths, a playground, and public amenities.

Several memorials have also been established at Hoods Lagoon: memorials for Anzac Day, the 1916 flood and sister Mary Mackillop. The Ivan Bettridge Park has been planted to memorialise World War II veteran Ivan Bettridge. Hoods Lagoon is used regularly as a rest stop by travellers and a location for community events such as the Gold and Coal Festival. The Lagoon is also regularly used as an area for fitness, including community park runs.

Records of threatened and special least concern native fauna within two kilometres of Hoods Lagoon include koala (*Phascolarctos cinereus*), star finch (eastern subspecies *Neochmia ruficauda ruficauda*), Australian painted-snipe (*Rostratula australis*), Dunmall's snake (*Furina dunmalli*) and Latham's snipe (*Gallinago hardwickii*) (WildNet 2022, PMST 2022). Hoods Lagoon is mapped entirely as non-remnant vegetation under Regional Ecosystem mapping. However, the site contains *Casuarina* spp., *Ficus* spp., *Eucalytus* spp. (such as *E. tereticornis*) among may other flora species, and likely provides habitat for a range of aquatic and terrestrial fauna.

Any management undertaken must carefully consider these other values and relevant legislative requirements.

Figure 4: Site context and roost extent

Isaac Regional Council

Hoods Lagoon Flying-fox Management Plan

Overflow roost extent

Core roost extent

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0 5 10 20 30 40
Meters

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

4 Key issues

Key issues associated with flying-foxes roosting at Hoods Lagoon are briefly outlined in Section 1.3 and detailed in more depth below. A large proportion of the community concerns have been raised during times of large influxes of flying-foxes. A community survey was also conducted to gauge community concerns, though the results of this are detailed in Section 5.

4.1 Odour

Flying-foxes use pheromones to communicate with each other, which is the source of the characteristic musky smell around their roosts 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 roosts 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.

A number of community members have voiced concerns regarding the smell of the flying-fox roost at Hoods Lagoon, with community members feeling as though they cannot utilise the park due to the strong smell.

4.2 Health concerns

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, personal protective equipment (PPE), and basic hygiene measures.

Many community members have concerns regarding the risk of disease transmission from flying-foxes to humans. Due to the close proximity of the roost to walking paths, a playground and BBQ facilities, community members have raised concerns regarding disease risk from faecal droppings or scratches to park users and children who utilise the playground. Flying-foxes at Hoods Lagoon often become disturbed and take flight when public walkways are heavily trafficked, which can exacerbate community concerns, as well as welfare concerns for the flying-foxes. Some community members have also raised concerns about potential transmission of HeV to horses.

Further information on flying-foxes and human/animal health is provided in Appendix 4.

4.3 Noise

A highly sociable and vocal animal, the activity heard from flying-foxes at roosts 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).

Some community members feel that they are unable to use the park at all, or as much as they would like, due to increased noise from the Hoods Lagoon roost at times. Some residents close to Hoods Lagoon and in Clermont have experienced negative impacts on their mental health due to a lack of sleep and decreased quality of life due to the impacts associated with living close to a flying-fox roost.

4.4 Faecal droppings/damage to property

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 roost (Markus & Hall 2004) and establish new roosts within 600 m – 6 km when dispersed (Roberts & Eby 2013, Ecosure 2014), attempting to relocate a roost will not reduce this impact. As such, faecal drop impacts are best managed at an individual property level.

Faecal droppings can cause health concerns (see also Section 4.2), reduced amenity, create a slip hazard, requires time and resources to clean, and can damage paint if not promptly removed. This impact has been a concern in Hoods Lagoon, with community members experiencing faecal drop on their cars when visiting the lagoon. Community members have also raised concerns over faecal droppings on their houses, solar panels, in backyards, on clothesline etc.

As Hoods Lagoon is on Council-managed land, Council regularly cleans park assets. Appropriate PPE and hygiene measures are required when cleaning any animal excrement. High-pressure hoses and specific cleaning products are available to assist cleaning for residents. To reduce the amount of faecal drop on areas of concern for residents on private property, shade sails, clothesline covers and vehicle covers can be used/installed.

4.5 Damage to vegetation

Large numbers of roosting flying-foxes can damage vegetation by stripping leaves and breaking branches. The dense roosting behaviour of LRFF in particular can cause significant damage, including broken limbs and tree fall, and poses a serious human safety hazard. 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.

Vegetation damage has been noted in the past at Hoods Lagoon, and may continue to occur

in the future, especially in the trees along the western extent of Centenary Park along Capella St. Some community members have raised concerns with Council regarding the safety of falling branches, due to the dense roosting behaviour of flying-foxes during large influxes. Assuming actions are taken to reduce direct hazards to humans (e.g. emergency branch removal), 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.

4.6 Restricted public access

Flying-foxes have impacted the recreational value of Hoods Lagoon as some community members feel uncomfortable utilising public walkways and equipment during influxes due to smell, noise and potential health and safety concerns. A key aim of the Plan is to avoid/manage these impacts in future.

4.7 Flying-foxes and aircraft

Collisions between wildlife and aircraft (wildlife strikes) are common aviation safety occurrences and cost Australian civil aviation an estimated AU$50M per year (McKee and Shaw 2016). Strikes to aircraft involving large birds or bats and those involving more than one animal (multiple strikes) can be serious, potentially disabling aircraft and resulting in major accidents.

Flying-foxes are large 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. Currently in Australia, flying-foxes are the most common animals struck by aircraft and, depending on aircraft type, 13-20% of these collisions cause damage to the aircraft (ATSB 2017).

For any strike reduction program to be effective it is imperative that wildlife congregations in the vicinity of the aerodrome are identified, monitored and managed. Under international (International Civil Aviation Organisation Annex 14) and national legislation (National Airports Safeguarding Framework C) airport operators are required to identify potential wildlife hazards in the vicinity and convene a local stakeholder group to help reduce the risk of strike associated with those hazards. National guidelines (National Airports Safeguarding Framework C), identify a 13 km radius from airports within which strike risk should be jointly managed by land holders and airport managers. Hoods Lagoon is approximately 5 km from the Clermont Airport.

Airport operators should negotiate with land use planning authorities and land managers on action plans for monitoring and, where necessary, reducing wildlife attraction to areas in the vicinity of airports.

4.8 Protecting flying-foxes and other fauna

4.8.1 Extreme weather impacts

4.8.1.1 Heat

Heatwaves can cause mortality in any fauna, and mass die-offs in a number of species has been reported (e.g. Gordon et al. 1988, Saunders et al. 2011). Flying-foxes are especially susceptible to extreme heat. Temperatures above 38ºC, consecutive hot days, lactation, age and other weather variables such as high humidity contribute to the likelihood of a Heat Stress Event (HSE) (Bishop 2015, Welbergen et al. 2008). Flying-foxes may die of either heat stroke, or dehydration associated with saliva spreading used for evaporative cooling.

Mass mortality commonly occurs when temperatures exceed 42°C (Welbergen et al. 2008, Bishop et al. 2019), however humidity interferes with evaporative cooling, therefore temperatures as low as 40.6ºC have caused HSEs in Queensland (Bishop 2015, Collins 2014).

Thirty-five HSEs have occurred in Australia since 1994 (Lab of Animal Ecology 2020) including the largest on record, 45,500 deaths across 52 SEQ roosts in the summer of 2014 (Welbergen et al. 2014). During this event, consecutive days with temperatures in the high thirties and early forties compounded the effects of heat stress (Table 3).

Table 3 Bureau of Meteorology Daily Maximum Temperature

Dec 2013 29th	Dec 2013 30th	Dec 2013 31st	Jan 2014 1st	Jan 2014 2nd	Jan 2014 3rd	Jan 2014 4th
40.0°C	29.8°C	28.1°C	29.1°C	32.0°C	36.8°C	41.9°C

The Flying-fox Heat Event Response Guidelines SEQ (Bishop et al. 2019) provides information for decision makers during HSEs and should be adopted by Council when responding to HSEs in the Isaac Regional Council LGA.

A range of intervention methods are used by wildlife rescue and carers to reduce mortality in roosts, including direct spraying of affected animals by hand, or using ground-based or canopy-mounted sprinklers/hoses to simulate a rain shower. These methods were reviewed by Mo and Roache (2020) who found that evaluation of the efficacy of heat stress interventions has been largely anecdotal rather than empirical. Intervention also has the potential to exacerbate HSEs through disturbance, or increasing humidity with spraying. To address this lack of empirical data, the NSW government approved a scientific trial of various methods in combination with flying-fox behaviour and temperature monitoring (currently underway).

4.8.1.2 Storms

Wildlife rescue must only occur when it is safe for human access.

Storm events result in tree loss, damage to vegetation, and resulting fauna habitat loss

including roost space for flying-foxes. The loss of tree crowns can open up the canopy, which may result in a hotter, drier climate in areas with limited canopy cover. Increased sunlight and drier soils also favour weed proliferation, which can further degrade the habitat.

Storms can also result in injury and mortality in flying-fox roosts, particularly when flightless young are present (during summer, which coincides with storm season).

Habitat restoration is critical to ensure sufficient recruitment over time to allow such canopy losses to be replaced as soon as possible.

4.8.1.3 Drought

Drought and associated lack of natural food sources for flying-foxes can lead to mass mortality and pup abandonment events. Urban roosts with varied and consistent food sources provided by urban parks, street plantings and residential areas become more important during these times. Continued protection of urban roosts, such as Hoods Lagoon, will be important to limit impacts of more frequent drought under climate change.

4.8.1.4 Bushfires

With the increasing impacts of climate change and more severe bushfire seasons in Australia, evident in the 2019-20 bushfire season, flying-foxes are extremely vulnerable to widescale habitat loss (BCRQ 2019, Baranowski et al. 2021). With large areas of roosting and foraging habitat burnt during bushfires, flying-foxes are forced to relocate and find alternative suitable roosting and foraging habitat (Baranowski et al. 2021). This can disrupt flying-fox breeding cycles and the ability to find adequate food for survival (BCRQ 2019). Significant loss of habitat in areas affected by bushfire can lead to larger influxes of flying-foxes in urban habitats as they attempt to seek adequate roosting and foraging habitat (Baranowski et al. 2021). Flying-foxes are also vulnerable to bushfires, as they are susceptible to smoke inhalation, exposure to extreme heat, habitat loss, starvation, and potential injury or death. Increased risk of bushfires may lead to increased conflict in communities such as Hoods Lagoon, therefore preparedness for influxes in particularly severe bushfire seasons is key.

5 Community engagement

Early and effective community engagement and education has benefits for both communities and land managers. These benefits include increased community understanding and awareness of flying-foxes, their critical ecological role, and factors that need to be considered in developing a management approach. Engaging with the community is equally important to ensure land managers understand impacts associated with a roost to effectively manage community concerns. Council sought to consult with relevant stakeholders (Section 1.4) during the development of the Plan. The community engagement survey results can be seen in detail in Appendix 5, however the key findings are summarised below.

5.1.1 Understanding and opinions of flying-foxes

Most respondents' experiences with flying-foxes at Hoods Lagoon were negative, and most reported using Hoods Lagoon as a recreational area less frequently due to flying-foxes (Appendix 5).

Most respondents were aware that flying-foxes are native animals and that they are protected under legislation. However, 24% of respondents did not know or did not care that flying-foxes were a native animal. Misinformation regarding flying-foxes was also evident, as only 60% of respondents believed that flying-foxes played an important role in the ecosystem. The large majority of respondents believed that flying-foxes were increasing in numbers. Similarly, only 9% of respondents believed that flying-foxes were decreasing in numbers.

The community survey revealed strong misinformation regarding the actual risk of living within flying-foxes. When respondents were asked if flying-foxes carry diseases that easily transmit between humans and animals, 79% believed this to be true, 9% believed this to be false, 9% did not know, and 3% did not care. Similarly, when respondents were asked if they believe that flying-foxes carry diseases in which transmission can be prevented with simple measures, only half of respondents believed this to be true, 27% did not know, 18% believed it to be false, and 5% did not care (Figure 5).

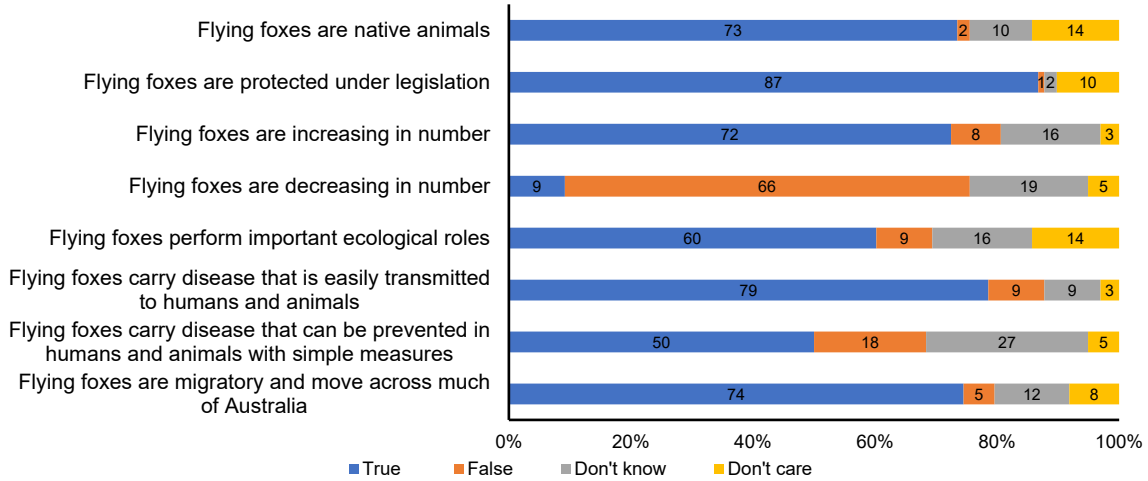

Figure 5 Respondents general understanding of flying-foxes. Note the percentage of responses are shown within bars and have been rounded to the nearest whole number.

When respondents were asked to give their opinions on flying-foxes, most respondents (78%) believed to some extent that flying-foxes are pests and should be managed. Seventy-two percent of respondents did not agree to some extent that flying-foxes could share the urban environment with flying-foxes. However, it was still important to majority of the respondents that Council seek to balance conservation and resident amenity (Appendix 5).

5.1.2 Experienced impacts

When respondents were asked to list their main concerns regarding flying-foxes at Hoods Lagoon, the top three cited concerns was smell, faecal droppings on park infrastructure and reduced use of the park by visitors and residents. Five other concerns that were listed by roughly a third of all respondents were fear of disease, faecal droppings on cars parked in the carpark, damage to public property, damage to vegetation and disruptive noise (Figure 6).

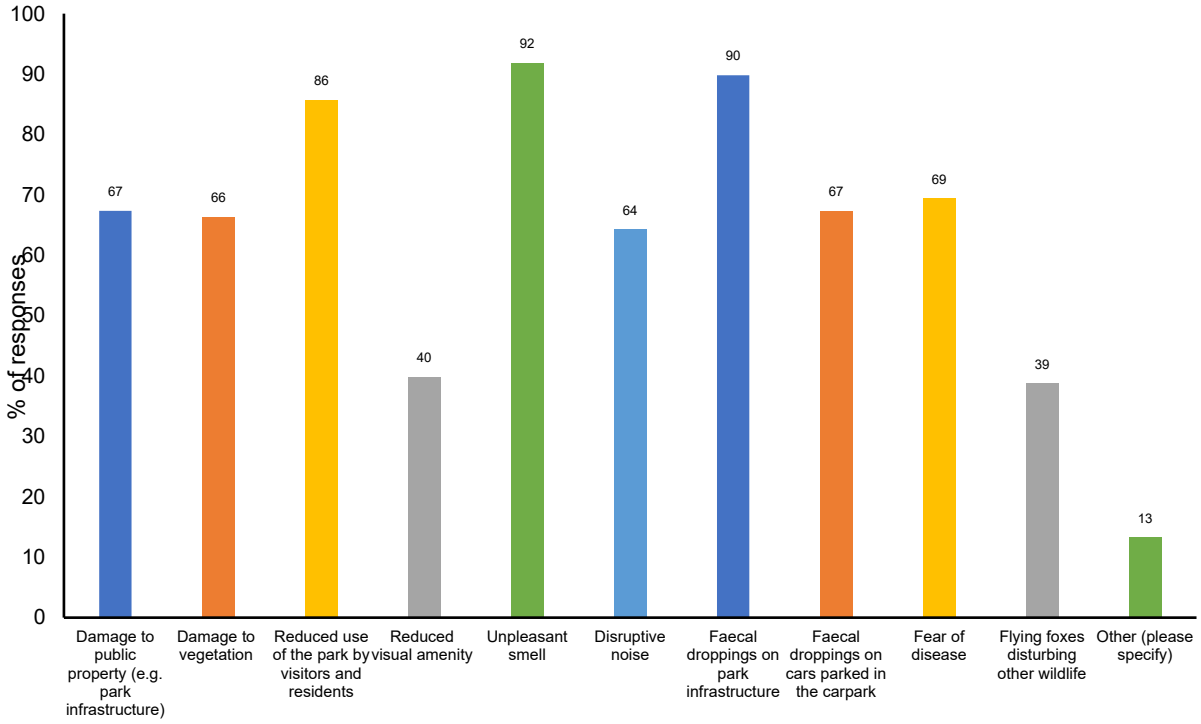

Figure 6 Responses to the prompt 'If your experiences have been negative, what are your main concerns regarding flying-foxes at Hoods Lagoon/Centenary Park?'. Respondents could select multiple answers.

5.1.3 Opinions on management

For the majority of respondents, it was extremely important that Council protects vegetation and other environmental values at Hoods Lagoon/Centenary Park.

When respondents were asked to indicate which management activities they would like to see adopted at Hoods Lagoon, the top two responses were active disturbance to nudge flying-foxes further away from park infrastructure and vegetation management to nudge the flying-fox roost footprint (Figure 7). Other general popular answers were regular routine cleaning of park infrastructure, planting alternative habitat in low conflict areas and vegetation management to reduce the flying-fox roost footprint.

When respondents were asked about preferred locations most respondents preferred the north side of Drummond St in between the softball and cricket fields.

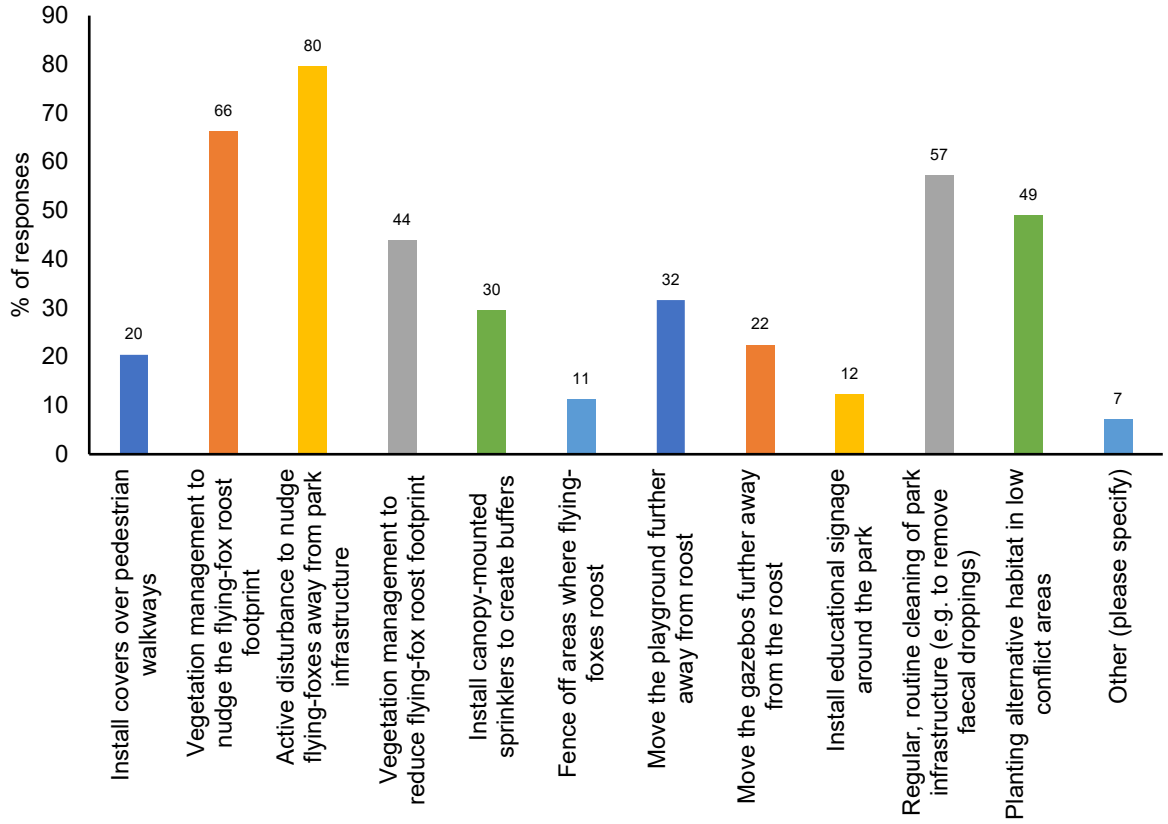

Figure 7 Responses to the prompt 'Which of the following management activities would you like to see adopted at Hoods Lagoon/Centenary Park?'. Respondents could select multiple answers.

The most popular of the community engagement options cited were educational signage and fact sheets with up-to-date information regarding flying-foxes (Figure 8). The next most popular answers in decreasing order was a website with links to up to date information, school engagement programs, annual flying-fox night with flying-fox specialists, community and local government, opportunities to meet a flying-fox and promote the flying-fox roost as a natural asset to future residents (Figure 8).

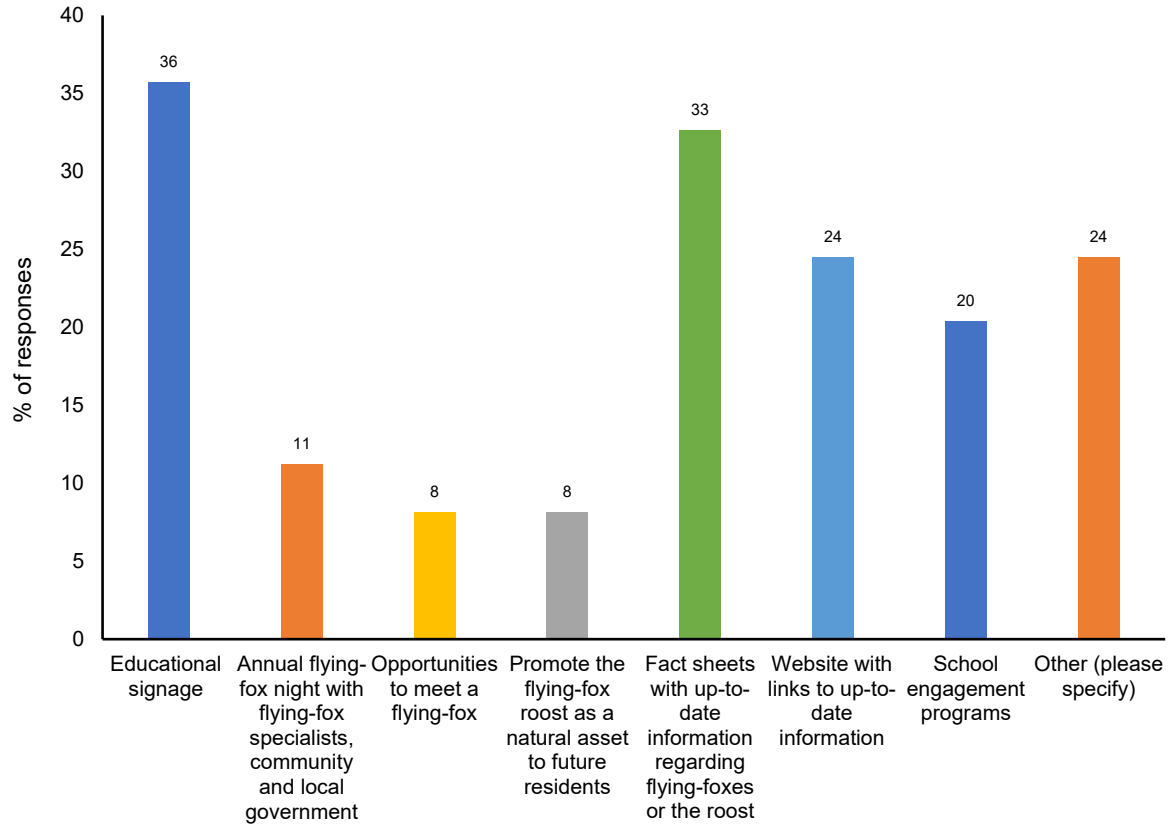

Figure 8 Responses to the prompt 'Which of the following education options appeal to you?'. Respondents could select multiple answers.

6 Management options analysis

Table 4 outlines a site-specific assessment of flying-fox impact management options commonly used across Australia, and their suitability for the Hoods Lagoon roost. Descriptions and examples of management options are provided in Appendix 6.

Table 4 Management options for Hoods Lagoon. Indicative costs are as follows: $ = <$5,000; $$ = $5,000-$20,000; $$$ = $20,000-$50,000, $$$$ = >$50,000.

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
Education and awareness programs	**Advantages:** Low cost compared to active management, promotes conservation of flying-foxes, contributes to attitude change which may reduce general need for roost intervention and reduce anxiety. Increasing awareness and providing options for the community to reduce impacts can be an effective long-term solution, can be undertaken quickly, will not impact on ecological or amenity value of the site. **Disadvantages:** Education and advice itself will not mitigate all issues, and in isolation would not be acceptable to the community.	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. The community survey revealed some misinformation in the community, therefore is important to continue and increase engagement with the community to provide information on human health, ways to coexist with flying-foxes, how to minimise impacts at their homes, and the importance of flying-foxes. Council should consider installing educational signs at Hoods Lagoon outlining information such as flying-fox movements, generally ecology, and the low risk to human health. Council should continue and increase spreading flying-fox information in the community through social media posts, online fact sheets, updates to management actions etc. Continue encouraging private landholders to trim trees on private property while flying-foxes are vacant to reduce likelihood of roosting in backyards. As a long-term strategy, consider the implementation of a school education program and community engagement events.	$ - $$$	No.	Install education signs. Continue and increase community engagement and distribution of information. Consider school education program and community engagement events.
Operational/park modifications	**Advantages:** Increases the buffer between the community and flying-foxes, encourages	Undertaking park modifications to increase the buffer between flying-foxes and the community	$$ - $$$	No	Undertake park modifications to

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
	tolerance of flying-foxes roosting in a public space, reduces the need for vegetation management, reduces disturbance and possible lifting of flying-foxes, improves site amenity. **Disadvantages:** Will not resolve all community conflict, could be cost prohibitive, ongoing costs associated with operational maintenance. May change usage by patrons and therefore the intent of the park.	can minimise the impacts experienced. Council should consider undertaking park modifications as it can be easier to budget for compared to active roost management. Council should consider relocating the playground, gazebo and water fountain- (currently directly adjacent to roost core) further east in Centenary Park (Figure 9). This allows for an increased buffer between the park facilities and the roost, allowing park users to utilise the facilities. Continue to undertake regular cleaning of park facilities, especially following an influx. Council currently already have powerline bundling directly adjacent to the roost, however consider further powerline spacers/bundling near surrounding roost trees.			increase buffer. Continue regular cleaning of park infrastructure at Hoods Lagoon, especially during peak influxes. Investigate further use of powerline spacers/bundling
Subsidy program	**Advantages:** Property-level impact mitigation (e.g. double-glazing, indoor odour-neutralising pots, noise attenuating insulation, car covers, boundary barriers such as dense plantings with fragrant flowers, altering park facilities) is one of the most effective ways to reduce amenity impacts. It provides more certain outcomes compared with attempting to manage flying-foxes or their habitat. It is relatively low cost, can be included in building design and materials, will not impact on the roost and may add value to the property. Service subsidies (e.g. conducting cleaning services in public areas, assistance with cleaning faecal drop on private properties) may encourage tolerance of living near a roost, promotes conservation of flying-foxes, can be undertaken quickly, will not impact on the site, would reduce the need for property modification, or can be used in tandem with property modification to minimise impacts further.	Service subsidies or private property modification subsidies alone would not resolve community conflict at Hoods Lagoon, as impacts are experienced primarily by park users. However as reported in the community survey, residents in Clermont are experiencing impacts at their homes/businesses. Council could consider a subsidy program to assist in alleviating impacts experienced at residents homes, as some residents cited experienced impacts at their home, though this may be cost prohibitive. See Appendix 6 for further information regarding subsidy programs at a private property level.	$ - $$	No.	Investigate subsidies for residents/businesses experiencing impacts at their home/place of business.

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
	Disadvantages: May be cost-prohibitive for private landholders, unlikely to fully mitigate community concerns. Can be costly over a large scale, with service subsidies being an ongoing cost.				
Routine roost management	**Advantages:** Can improve amenity at the site as well as impacts to biodiversity such as weeds on the site and in downstream areas. **Disadvantages:** Will not generally mitigate amenity impacts for nearby landholders. Weed removal and bushfire management has the potential to reduce roost availability and reduce numbers of roosting flying-foxes. Removing weeds also changes the microclimate which can increase roost temperature and therefore susceptibility to HSEs.	Council regularly undertakes maintenance activities at Hoods Lagoon including garden and lawn maintenance. Council should continue maintenance of the parklands through trimming of low hanging branches and regular park maintenance at appropriate times. Residents are able to maintain their properties in accordance with the Low Impact COP. Council should continue to encourage residents to maintain their vegetation when flying-foxes are not present to discourage them from roosting/foraging when they are in town.	$	No permit required for weed management or habitat improvement. No permit or notification required if tree trimming is in compliance with the Low Impact COP (e.g. less than 10% and only conducted during low-risk periods).	Continue in suitable areas and at appropriate times (ideally in the non-breeding season or adapted during the breeding season to be less disruptive).
Alternative habitat creation / habitat improvement	**Advantages:** If successful in attracting flying-foxes away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts and helps flying-fox conservation. Rehabilitation of degraded habitat that is likely to be suitable for flying-fox use could be a more practical and faster approach than habitat creation. **Disadvantages:** Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract flying-foxes to a new site have not been known to succeed.	The site to the north of Drummond St provides a promising location for habitat improvement. Flying-foxes are known to roost here during large influxes. Facilitating habitat improvement at the site may encourage flying-foxes to roost in this area in the future, once plantings are mature and provide a favourable microclimate. This site is lower conflict than the current roost core, and is more preferable than flying-foxes roosting in backyards. Council should undertake habitat improvement at the site north of Drummond St and partner with community groups to facilitate the use of community funding available.	$$ - $$$$	No.	Adopt habitat improvement north of Drummond St and support the community funding for flying-fox habitat restoration.
Provision of artificial roosting habitat	**Advantages:** Artificial roosting habitat (e.g. ropes) could be considered to supplement the canopy if weed removal or roost management effects available roosting space. **Disadvantages:** No guarantee that flying-foxes would use artificial habitat but collaborating with a researcher on varying design options would increase the likelihood of	To date artificial habitat structures have not been effective, however these could be considered to supplement midstorey vegetation at Hoods Lagoon to reduce the pressure on roosting vegetation.	$ - $$$	No.	Investigate if vegetation damage become so severe that it may prevent the current roost trees from recovering.

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
	success.				
Protocols to manage incidents	**Advantages:** Protocols for managing incidents (e.g. HSEs, unauthorised disturbances) can reduce the risk of negative human/pet-flying-fox interactions. Low cost, promotes conservation of flying-foxes, can be undertaken quickly. In some cases, infrastructure problems such as power black-outs from flying-foxes being electrocuted on powerlines may be avoided by proactive management (e.g. adding spacers on powerlines). **Disadvantages:** Will not mitigate amenity impacts.	Council responds to incidents, such as unauthorised disturbance, in accordance with internal protocols and in consultation with relevant agencies (e.g. DES). Council should respond to HSEs as per the Flying-fox Heat Event Response Guideline for south-east Queensland (Bishop et al. 2019) or consider developing a region-specific HSE document. Council should continue to engage with wildlife carers and nearby residents and park users, particularly during potential mass mortality events such as HSEs and post-storm recovery.	$	No.	Continue.
Research	**Advantages:** Support research that improves understanding and more effectively mitigates impacts. **Disadvantages:** Generally, cannot be undertaken quickly, management trials may require cost input.	New research should be reviewed at least annually and incorporated into management where appropriate. Research can be used to identify native flowering events in area and how this can impact flying-fox movements and roosting preferences.	$	Research permit and Animal Ethics Committee approval may be required for some research.	Investigate.
Appropriate land-use planning	**Advantages:** Planning for future land use where possible will reduce potential for future conflict between community and flying-fox roosts. **Disadvantages:** Will not generally mitigate current impacts.	Incorporate planning controls where possible.	$	No.	Investigate.
Property acquisition	**Advantages:** Allows affected landholders to move away from a roost, mitigating all impacts. Supports flying-fox conservation. **Disadvantages:** Costly. Property owners may not want to sell.	Not suitable as impacts are experienced by park users.	$$$$	No.	Not suitable.
Buffers through vegetation removal	**Advantages:** Can provide a buffer between the community and flying-fox roosts which can reduce concerns in some instances. **Disadvantages:** Removing vegetation can reduce buffering benefits of the vegetation to noise, odour and visual impacts, with potential	Due to the risk of colony splintering if nudged/dispersed (potentially into higher conflict areas such as backyards), extremely low efficacy of dispersal/nudging for long term relocation (Appendix 3), and the ability to effectively reduce the experienced impacts to	$-$$	If undertaking vegetation works outside the Low Impact COP, DES notification will be required.	Increase buffer between footpaths and roosting flying-foxes through minimal trimming of low-lying branches in current

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
	to create additional conflict. Vegetation removed may exacerbate the impacts of HSEs. Could deter flying-foxes from roosting at the site.	park users, it is preferable to maintain Hoods Lagoon as a roosting site, at least for the short-medium term until north of Drummond St can be improved to encourage roosting in this lower conflict location. As such, buffers should be limited to trimming of low-lying branches as to avoid making the site unsuitable for roosting. Once the preferred roost site (north of Drummond St) has a matured stock of roosting trees, further trimming may be conducted in the core roosting area to decrease the likelihood of flying-foxes continuing to roost at the current location.			roost trees.
Buffers without vegetation removal – visual deterrents, canopy mounted sprinklers (CMS)	**Advantages:** Canopy-mounted water sprinklers to create buffers have been effective at many roost sites in Queensland with no welfare impacts observed during monitoring. Visual deterrents such as lights, plastic bags, fluoro vests and balloons have shown localised effects (Appendix 6) **Disadvantages:** Can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Misting may increase humidity and exacerbate HSEs, and overuse may impact other environmental values of the site. Water restriction consideration required. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. May appear an eye-sore and lead to increase in rubbish in the natural environment.	Given the preference for maintaining Hoods Lagoon as a roosting site (Appendix 3), and the already limited number of roosting trees available at Hoods Lagoon, the use of deterrents is not considered to be suitable at Hoods Lagoon in the short-term. If flying-foxes begin roosting at an undesirable location at Hoods Lagoon (e.g. Ivan Bettridge Park), deterrents could be considered to nudge flying-foxes back to the core roosting area or to north of Drummond St. Deterrents may be considered once flying-fox habitat planting north of Drummond St is complete and vegetation is mature enough to sustain the flying-fox roost. Temporary fencing to increase the buffer between park users and the roost should be used on an ad hoc basis until park facilities (such as the playground and gazebo) can be appropriately relocated, or until shade covers can be erected over problematic areas along footpaths.	$$	Notification to DES (for options within the Management COP); FFRMP for any outside the Management COP.	Temporary fencing as a buffer to be used as required. Deterrents are not considered suitable in the short-term. Investigate if flying-fox roost at undesirable locations, or once site north of Drummond St is mature.

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
Noise attenuation fencing	**Advantages:** Standard noise attenuation fencing is intended to alleviate amenity issues for residents. Advice from an acoustic consultant may provide site-specific alternatives. **Disadvantages:** Noise attenuation fencing is costly and can be considered unsightly if not cleaned of faecal drop.	Noise-attenuating fencing is likely cost-prohibitive and unlikely to able to be adequately installed to effectively attenuate noise due to the close proximity of the roost to park users. Using screening plants can be used in some circumstances, however given the close proximity of the roost to park facilities, screening plants would not be sufficient to reduce noise, smell or vision of flying-foxes.	$$	No.	Not suitable.
Roost monitoring	**Advantages:** Allows for an understanding of population dynamics over time. Allows for data to be used to determine the effective of some management actions. Relatively inexpensive. **Disadvantages:** Not a direct management action that will minimise impacts.	Council should continue regular monitoring of the Hoods Lagoon roost when flying-foxes are present, ideally weekly. This should include species present, numbers, roost extent, age of flying-foxes present (whether dependent or independent young are present). This monitoring data is important to know when management actions can be implemented and allows for important data to be collected over time to assess the effectiveness of management actions.	$	No.	Continue.
Nudging using low intensity disturbance	**Advantages:** Can encourage flying-foxes to shift away from high conflict areas next to residential areas. **Disadvantages:** May lead to inadvertent dispersal if not done at the correct time, frequency or duration. Resource intensive with flying-foxes quickly returning to their favoured roost trees.	Given the small amount of suitable habitat and the preference for keeping flying-foxes roosting at the current site to prevent roosting in backyards and potential colony splintering, nudging using low intensity disturbance should not be undertaken. Council has attempted nudging using low-intensity disturbance several times in the past, however flying-foxes continue to return to the core roost.	$$ - $$$	Council's as-of-right authority under the Management COP does allow for nudging but should not be during the day to avoid inadvertent dispersal/splintering. DES notification is required prior to nudging activities.	Not suitable (may be reconsidered once north of Drummond St has been improved if required).
Passive dispersal through vegetation removal	**Advantages:** If successful can mitigate all flying-fox impacts at that site. **Disadvantages:** Likely less stressful on flying-foxes if done in a staged way than active dispersal, but risks as per active dispersal with additional impacts of losing native vegetation. May change usage by patrons and therefore the intent of the park.	Given the preference for maintaining Hoods Lagoon as a roosting site and the limited number of roosting trees, passive dispersal through vegetation removal is not suitable.	$$ - $$$$	Vegetation removal under the Management COP will require DES notification prior to works.	Not suitable.

Management options	Advantages & disadvantages	Suitability for site	Indicative cost	Permits/DES notification required	Appraisal (see also Section 7)
Active dispersal through disturbance	**Advantages:** If successful can mitigate all flying-fox impacts at that site. **Disadvantages:** Multiple studies show that dispersal is rarely successful, especially without significant vegetation removal (not suitable for this site) or high levels of ongoing effort and significant expenditure (e.g. several years of daily works and over $1M for Sydney Botanic Gardens). Flying-foxes will almost always continue to roost in the area (generally within 600 m, Roberts & Eby 2013), and often splinter into several locations which may result in more widespread impacts. Appendix 3 provides a summary of research conducted on flying-fox dispersals in Australia.	Active dispersal is very costly with highly unpredictable outcomes and can often worsen human-wildlife conflict. For these reasons, as detailed in Council's SoMI (2019), Council does not endorse dispersal. Dispersal will therefore not be considered for this site now or in the future. Further information about the highly low efficacy of dispersal can be found in Appendix 3.	$$$$	Dispersal in accordance with the Management COP is permitted under Council's as-of-right authority with notification to DES.	Not suitable.

7 Management approach

Table 4 outlines management actions for the Hoods Lagoon roost based on site-specific analysis of available flying-fox impact management options (Section 6). An overview of the approach is to use a range of short-term and long-term measures to reduce community conflict through reducing impacts experienced by park users. Actions are summarised in Table 5. Short-term management at the Hoods Lagoon roost will primarily be through:

- installation of educational signs outlining the ecology, behaviour, movement patterns of flying-foxes and health information
- provision of information to the community about flying-foxes and management through informational sheets, media updates, Council's webpage, especially with a focus on the low health risk, and the importance of horse vaccinations
- modifications to Centenary Park including moving the children's playground further east and/or construction of a new playground at another park in town, removing or relocating the gazebo further east, removing or relocating the water fountain further east, installing shade covers in areas of Centenary Park where faecal drop and fallen branches are especially evident (e.g. over the boardwalk under the Eucalypt trees and over the footpath below the fig tree, see Figure 9)
- continuation of cleaning services during flying-fox influxes or an ad hoc basis, including high-pressure cleaning of footpaths, removing leaf litter/stripped bark, covering or cleaning of park benches
- creation of buffers between park users/facilities and core roosting trees through trimming of low-hanging tree branches (not tree removal) and erection of temporary fencing as needed
- continuation of general park maintenance such as weed removal (including Salvinia removal) and lawn maintenance when the roost is vacant, or if activities do not cause lifting.

Long-term management at the Hoods Lagoon roost will primarily be through:

- facilitation of habitat improvement at site north of Drummond St to encourage flying-foxes to roost away from the current core location
- community engagement and education through school educational programs to encourage tolerance and understanding of flying-foxes
- monitoring the roost when flying-foxes are present to collect data on the species present, the number of flying-foxes and the roosting extent. This will be increasingly important once habitat north of Drummond St has matured trees suitable for roosting.

Education will form an important part of the ongoing management of flying-foxes to allay misconceptions and unnecessary fears. Fear of disease was also identified as one of the main issues concerning community members. Educational material should aim to cover key messages in a way that educates and informs, rather than cause alarm, e.g. emphasising that

there is no risk associated with living or playing near a flying-fox roost (Queensland Government 2021) – 'no touch, no risk'. Council should aim to provide regular and easily accessible information, through educational signs, informational sheets, updates on Councils website and school engagement programs. Community engagement will be particularly important during large influxes of flying-foxes.

Though monitoring will not directly reduce conflict in the community, data from regular monitoring is valuable in identifying trends, evaluating management, and to predict influxes and pre-emptively engage with the community.

Active management, including nudging and/or dispersal activities, is not considered to be appropriate for the Hoods Lagoon roost. Due to the limited amount of suitable roosting trees in Clermont, any nudging or dispersal activities may cause colony splintering to areas which are more undesirable (such as backyards, schools etc.). Nudging has been conducted at Hoods Lagoon in the past, and only results in temporary relocation and flying-foxes continue to return each year to the core roosting area. This is extremely resource intensive and can cause more disturbance to residents and park users given the nature of nudging activities. Though many in the community survey indicated the desire to have flying-foxes dispersed from Clermont entirely, flying-foxes are a transient and highly mobile, and resource-intensive attempts to disperse flying-foxes have proved ineffective, often shifting the roost to equally or more problematic locations. Nudging may be reconsidered in the medium-long term when the preferred location north of Drummond St has been improved.

Table 5 Council management actions at the Hoods Lagoon Roost

Management type	Management action	Timeframe
Education and awareness programs	Erect educational signs at Hoods Lagoon (e.g. Figure 9), including the preferred overflow area north of Drummond St, to allow the community access to information such as movement patterns, behaviour, general ecology and the low risk to human health (no touch = no risk).	ASAP.
	Continue education through informational sheets/online content about flying-foxes. For example, posting to Council's website/social media about when residents might expect to experience increased impacts, when they should conduct tree trimming (if on private property), updates on management actions, regularly reiterating the minimal risk of disease transmission to humans, importance of vaccinating horses for HeV etc.	ASAP and ongoing.
	Continue to educate and encourage the community to trim trees while flying-foxes are vacant to reduce the likelihood of roosting in backyards.	ASAP and ongoing.
	As a longer-term strategy, consider a school engagement program to educate children about flying-foxes ecological role, movement patterns, behaviours, minimal risk of disease transmission to humans, the threats that flying-foxes are experiencing, decreasing population numbers etc. to encourage tolerance of living with flying-foxes.	Within 5 years.
	Consider an annual flying-fox night with a flying-fox specialist and an opportunity to meet a flying-fox (however educational signage, information sheets/online content and school education programs were the more population education options outlined in the community survey)	Investigate in near future.
Operational/property modification	Consider modification of park facilities such as moving the children's playground further east away from the current roost, relocating or constructing a new water fountain further away from the flying-fox roost (ideally under cover), erecting cover over a small portion of the boardwalk under the eucalypt tree and over the footpath underneath the fig tree. These costs can be more easily budgeted than for roost management, which is hard to predict.	ASAP.
	Consider developing other parks around Clermont that have fewer facilities compared to Hoods Lagoon. This would provide an alternative public space where the community feel comfortable to use during peak influxes. This was cited multiple times in the community survey as an appealing management action.	Investigate in near future.
	Implement regular cleaning of areas in Hoods Lagoon impacted by faecal drop and leaf litter/shredded bark to improve park amenity, as mess from faecal drop was cited as a main concern for park users. For example, high pressure cleaning of footpaths, covering and cleaning of park tables/chairs, removing debris and broken branches, leaf blowing footpaths etc.	As required.
	Investigate with power suppliers potential for further powerline bundling/spacing, particularly focused near the roost.	Investigate
Subsidy program	Consider service and property modification subsidies on a private property level. e.g. cleaning services, clothesline covers, car coves etc.	Investigate.
Routine roost management	Continue garden maintenance at appropriate times (during the non-breeding season). Lawn maintenance in the immediate vicinity of the roost should be avoided when flying-foxes are present to avoid disturbance, especially during	As required.

Management type	Management action	Timeframe
	the breeding season and on hot days.	
Habitat improvement	As a long-term strategy, undertake habitat improvement on the northern side of Hoods Lagoon between the cricket ground and the softball field. This location was given as the most appealing option in the community as an alternative roosting site (Figure 9). Habitat improvement should include planting additional appealing roost trees and ensuring the grass stays watered to provide a favourable microclimate for flying-foxes. Recent research into roosting habitat preferences of LRFF in Queensland should be used to guide alternative habitat creation (see Section 2.3).	ASAP.
	Work with community members that currently have funding available to improve habitat to facilitate the best use of the funding for this area. If additional measures are required in the site north of Drummond St or other roost habitat improvement sites, such as sprinklers, Council should support these actions,	Within 5 years.
	Continue removing Salvinia to improve the park amenity and allow flying-foxes to belly dip during hot weather to reduce the likelihood of an HSE, and maintain an attractive area to prevent flying-foxes relocating to a less desirable location.	As required.
Research	Support research to investigate flying-fox movements and flowering events in the region.	Investigate.
Appropriate land-use planning	Incorporate appropriate land-use planning controls if approving new structures at or surrounding Hoods Lagoon.	Investigate when required.
Buffers through vegetation removal	Remove low hanging branches in roost trees that are in reaching distance of the park users. This is to avoid flying-fox becoming disturbed when members of the public are walking by and potentially coming into contact when flying-foxes try to take flight. Tree trimming should only be conducted when flying-foxes are not present and should be limited to 10% of the total canopy to avoid detracting them from roosting in the tree. Consider proactively trimming the trees directly adjacent to the toilet block to discourage potential roosting here in the future.	ASAP and ongoing as required.
Buffers without vegetation removal	Consider use of deterrents if flying-foxes begin roosting at an undesirable location at Hoods Lagoon (e.g. Ivan Bettridge Park) to nudge the flying-foxes back to the core roosting area or to north of Drummond St.	Investigate if required.
	Deterrents may be considered once flying-fox habitat planting north of Drummond St is complete and vegetation is mature enough to sustain the flying-fox roost.	Investigate once habitat north of Drummond St is sufficiently mature.
	Continue use of temporary fencing to create separation when required until park facilities (such as the playground and gazebo) can be appropriately relocated, trees trimmed and/or until shade covers can be erected over problematic areas along footpaths.	As required.
Roost monitoring	Continue monitoring the roost weekly when flying-foxes are present.	As required.

Figure 9: Hoods Lagoon management actions

Isaac Regional Council

Hoods Lagoon Flying-fox Management Plan

ecosure
improving ecosystems

Job number: PR7144
Revision: 0
Author: EK
Date: 7/02/2023

0 5 10 20 30 40
Meters

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

8 Plan administration

8.1 Evaluation and review

A review of the Plan should be scheduled annually, with community consultation and expert input sought on an ad hoc basis. The Plan shall remain in force until a revised version is adopted by Council.

The following may trigger an earlier Plan update:

- changes to relevant policy/legislation
- new management techniques becoming available
- outcomes of research that may influence the Plan
- incidents associated with the roost.

Progress and priority of management actions in the Plan will be evaluated annually by Council.

8.2 Reporting

Council will complete the DES evaluation form for actions under its as-of-right authority (excluding activities listed under the Low Impact COP), returned within six weeks of the date of actions being completed, and will comply with any reporting obligations under other permits or approvals obtained to implement the Plan. DES notification requirements are outlined in Table 4.

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Appendix 1 Legislation

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth's *Environmental Protection and Biodiversity Act 1999* (EPBC Act) provides protection for the environment, specifically Matters of National Environmental Significance (MNES). A referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is required under the EPBC Act for any action that is likely to significantly impact on an MNES. The GHFF is listed as a vulnerable species under the EPBC Act, meaning it is an MNES.

State

Nature Conservation Act 1992

As native species, all flying-foxes and their roosting habitat are protected in Queensland under the NC Act. State approval is required to:

a) destroy a flying-fox roost;

b) drive away, or attempt to drive away, a flying-fox from a flying-fox roost ('drive away' is defined to mean "cause the flying-fox to move away from the roost; or if the flying-fox has moved away from the roost, deter the flying-fox from returning to the roost"); and/or

c) disturb a flying-fox in a flying-fox roost.

Note that the definition under Queensland law means that once a flying-fox roost is established, it remains as such even when it is unoccupied. The *Interim policy for determining when a flying-fox congregation is regarded as a flying-fox roost under section 88C of the NC Act* (DES 2021c) has recently been released and is currently in consultation. It is our understanding that the Plan aligns with this roost policy, however amendments can be made to the Plan in consultation with DES if required.

A 'flying-fox roost' is defined under the NC Act as 'a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young'.

Council 'as-of-right' management

Under the NC Act, local governments have an 'as-of-right' authority under the NC Act to manage flying-fox roosts in mapped Urban Flying-fox Management Areas (UFFMAs), without the requirement for a permit, in accordance with the *Code of Practice – Ecologically sustainable management of flying-fox roosts* (Management COP) (DES 2020a).

Councils must however still notify DES of the planned management. Notification is by means of a completed 'flying-fox management notification form' from the DES website submitted at

least two business days prior to commencing any management actions, unless an authorised person from DES provides written advice that these actions can commence earlier. Local governments may also choose to, with the relevant landholder's permission, exercise their as-of-right authority on private land. Notification is valid for all notified management actions within a four-week timeframe.

The *Flying-fox Roost Management Guideline* (DES 2020b) has also been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Councils are required to apply for a FFRMP to manage flying-fox roosts outside an UFFMA, or for management actions not specified in the COP. It must be noted that this 'as-of-right' authority does not oblige Council to manage flying-fox roosts, and does not authorise management under other relevant sections of the NC Act or other legislation (such as the *Vegetation Management Act 1999* [VM Act].

Anyone other than local government is required to apply to DES for a FFRMP for any management directed at roosting flying-foxes, or likely to disturb roosting flying-foxes. Certain low impact activities (e.g. mowing, minor tree trimming) do not require approval if undertaken in accordance with the *Code of Practice – Low impact activities affecting flying-fox roosts* (Low Impact COP) (DES 2020c).

Flying-fox roost management permits

Councils wishing to manage flying-fox roosts located outside an UFFMA or to conduct flying-fox management activities that are not Code-compliant, must apply to DES for a FFRMP. Under the *Nature Conservation (Animals) Regulation 2020*, a FFRMP may only be approved for management of a flying-fox roost where its resident flying-foxes are causing or may cause damage to property; or represent a threat or potential threat to human health or wellbeing.. The Management COP may generally also apply where such a requirement is stated on the FFRMP. Such a permit is valid for a period of one year, or up to three with a DES-approved flying-fox management plan (e.g. this Plan).

Anyone other than local government is required to apply for an FFRMP to conduct flying-fox roost management activities.

Low impact roost management

All landholders – private or public – can undertake low impact activities such as mulching, mowing and weeding near flying-fox roosts, as well as allowing trimming of up to 10% of the total canopy of the roost without a FFRMP if it is done in accordance with the Low Impact COP (DES 2020c). This authorisation is provided these activities not being undertaken with the intention of destroying the roost, or disturbing or driving away the flying-foxes.

Flying-fox management statements and planning

Council has a Statement of Management Intent (SoMI) to articulate the approach that Council will take to the management of flying-fox roosts in the Isaac region. Council's intent is to manage flying-fox roosts on Council-owned or controlled land.

Local councils may also opt to develop a FFMP for the whole of their local government area (LGA). If the FFMP is approved by DES, the local council can be granted three years' approval to manage flying-foxes outside their UFFMAs under an FFRMP.

The *Flying-fox roost management guideline* was developed to provide local councils and other entities wishing to manage flying-fox roosts with additional information that may assist their decision-making, including developing SoMIs and FFMPs (DES 2020b).

Vegetation under the *NC Act 1992*

All plants native to Australia are protected under the NC Act. Prior to any clearing of protected plants, a person must refer to the flora survey trigger map to determine if the clearing is within a high-risk area.

- in a high-risk area, a flora survey must be undertaken and a clearing permit may be required for clearing endangered, vulnerable and near threatened (EVNT) plants and their supporting habitat.
- if a flora survey identifies that EVNT plants are not present or can be avoided by 100 m, the clearing activity may be exempt from a permit. An exempt clearing notification form is required.
- in an area other than a high-risk area, a clearing permit is only required where a person is, or becomes, aware that EVNT plants are present.
- clearing of least concern plants will be exempt from requiring a clearing permit within a low-risk area.

Vegetation under the *Fisheries Act 1994*

All marine plants, including mangroves, seagrass, saltcouch, algae, samphire vegetation and adjacent plants (e.g. melaleuca and casuarina), are protected under Queensland law through provisions of the *Fisheries Act 1994*. Approval must be gained from Fisheries Queensland to destroy, damage, or disturb any marine plant. Under the Fisheries Act, a 'marine plant' includes:

a) a plant (a 'tidal plant') that usually grows on, or adjacent to, tidal land, whether it is living or dead, standing or fallen;
   - The *Fisheries Act* does not define 'adjacent' as it relates to marine plants. In the absence of a definition, the Fish Habitat Management Operational Policy describes the application of 'adjacent' in terms of when a marine plant development permit application would be required for disturbance of plants in or adjacent to the tidal zone.

b) the material of a tidal plant, or other plant material on tidal land;

c) a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.

Vegetation Management Act 1999

The clearing of native vegetation in Queensland is regulated by the VM Act, the *Sustainable Planning Act 2009* and associated policies and codes.

The type of clearing activity allowed, and how it is regulated, depends on:

- the type of vegetation (as indicated on the regulated vegetation management map and supporting maps)
- the tenure of the land (e.g. freehold or Indigenous land)
- the location, extent and purpose of the proposed clearing
- the applicant proposing to do the clearing (e.g. state government body, landholder).

Depending on these factors, clearing activities will either:

- be exempt from any approval or notification process
- require notification and adherence to a self-assessable code
- require notification and adherence to an area management plan
- require a development approval.

VM Act exemptions allow native vegetation to be cleared for a range of routine property management activities without the need for a development approval or notification. A number of VM Act exemptions may apply to clearing vegetation that is flying-fox roosting or foraging habitat. However, specific advice should be obtained from Department of Natural Resources and Mines for each proposed vegetation clearing activity.

No explicit VM Act exemptions for clearing flying-fox roosting or foraging vegetation were in place as of December 2021.

Animal Care and Protection Act 2001

The *Animal Care and Protection Act 2001* (ACP Act) provides for animal welfare. The ACP Act is administered by Biosecurity Queensland within the Department of Agriculture and Fisheries. The ACP Act applies to all living vertebrate animals, including wildlife. To comply with the ACP Act flying-fox management actions must not cause mental or physical suffering, pain or distress.

***Civil Aviation Act 1998* (CA Act)**

The CA Act establishes Australia's Civil Aviation Safety Authority functions in relation to civil aviation, with particular emphasis on safety. Civil Aviation Safety Regulations 1998 Part 139 contains specific requirements for wildlife hazard management.

Council should ensure the Clermont Aerodrome is aware of large influxes to the area so that strike risk can be managed, and Council must ensure this legislation is adhered to when considering events with aircraft.

Appendix 2 Species profiles

Black flying-fox (*Pteropus alecto*)

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

The BFF has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Queensland and into New South Wales (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 grey-headed flying-fox, which appears to be favouring the BFF (DoE 2016).

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 roost site (Markus & Hall 2004).

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

Little red flying-fox (*Pteropus scapulatus*)

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

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 2010). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability of food resources (predominantly the flowering of eucalypt species) (Churchill 2008), which means the duration of their stay in any one place is generally very short.

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

Throughout its range, populations within an area or occupying a roost can fluctuate widely. There is a general migration pattern in LRFF, whereby large congregations of over one million individuals can be found in northern roost 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).

Appendix 3 Dispersal results summary

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

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

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

An overview of findings[3] is summarised below.

- There were attempts to disperse 25 separate roosts in Queensland (compared with nine roosts between 1990 and June 2013 analysed in Roberts and Eby (2013)). Compared with the historical average (less than 0.4 roosts/year) the number of roosts dispersed in the year since the framework was introduced has increased by 6250%.
- Dispersal methods included fog[4], birdfrite, lights, noise, physical deterrents, smoke, extensive vegetation modification, water (including cannons), paintball guns and helicopters.

[2] Local area is defined as the area within a 20-kilometre radius of the original site = typical feeding area of a flying-fox.
[3] This was based on responses to questionnaires sent to councils; some did not respond and some omitted responses to some questions.
[4] Fog refers to artificial smoke or vapours generated by smoke/fog machines. Many chemical substances used to generate smoke/fog in these machines are considered toxic.

- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.
- In nine of the 24 roosts dispersed, dispersal actions did not reduce the number of flying-foxes in the LGA.
- In all cases, it was not possible to predict where new roosts would form.
- When flying-foxes were dispersed, they did not move further than six kilometres away.
- As at November 2014 repeat actions had already been required in 18 cases.
- Conflict for the council and community was resolved in 60% of cases, but with many councils stating they feel this resolution is only temporary.
- The financial costs of all dispersal attempts were considerable, regardless of methods used, ranging from $7500 to more than $400,000 (with costs ongoing).

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

- Of the 48 roost dispersals attempted, only 23% were deemed a success at reducing conflict with communities, and this generally only occurred after extensive destruction of roost 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 roosts were established within one kilometre of the original roost, transferring conflict to neighbouring communities.

Dispersal/nudging attempts in the Isaac region

In the past, Council has conducted several dispersals/nudging activities in Middlemount, Moranbah and Clermont.

Several dispersal attempts have been made in Middlemount. One attempt in 2014 provided successful in relocating flying-foxes less than 200m out of town, and relocated flying-foxes to an area less than 500 m from the Middlemount Airport. Flying-foxes subsequently returned to the roosting site in Middlemount.

Another dispersal attempt was made to relocate flying-foxes from Rosewood Street. Dispersal of the flying-foxes resulted in roosting along Charles Randle Crescent for a few days, when they then returned back to Rosewood Street.

Another dispersal attempt was made in 2016 with the intent to disperse flying-foxes from Alfred Quinn Drive to the west of the town. Flying-foxes splintered and began roosting in backyards of properties along Charles Randle Drive.

A dispersal was conducted in Moranbah, and relocated 120,000 LRFF from Renier Crescent

and Rolfe Street to a location just south of town, however this was into a horse paddock. This resulted in conflict on the property with horses, and increases the risk of transmission of Hendra Virus to horses. An attempt to disperse them away from the property with horses was made, but proved to be unsuccessful in relocating the flying-foxes. Numbers of LRFF did decrease on the property, however due to the conflict at the site, tree removal on the private property was conducted to facilitate dispersal.

Several dispersals have taken place at Hoods Lagoon from 2015 - 2017. These dispersals did prove to be successful in nudging flying-foxes from the corner of Capela St and Lime St (core roost area) to Ivan Bettridge Park just across the lagoon and to the vegetation north of Drummond Street. However, the community do not appreciate flying-foxes roosting in Ivan Bettridge Park, as it is a memorial park for World War II Veteran Ivan Bettridge. As the community does not appreciate flying-foxes roosting in this location, in the short-term, the current roost location should be maintained at Centennial Park with mitigation measures implemented to reduce conflict. As part of the long-term strategy, Council will support facilitation of habitat improvement north of Drummond Street to entice flying-foxes to roost in this area once the trees mature. This area is lower conflict than the current site in Centennial Park, and was the most popular alternative roost habitat site in the community survey. Dispersal will not be considered as a strategy due to the risk of colony splintering into backyards.

Appendix 4 Human and animal health

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

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

These diseases are also easily prevented through vaccination, personal protective equipment, safe flying-fox handling (by trained and vaccinated personnel only) and appropriate horse husbandry. Therefore, despite the fact that human infection with these agents can be fatal, the probability of infection is extremely low, and the overall public health risk is also judged to be low (Qld Health 2016).

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

Disease and flying-fox management

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

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

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

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

- forcing flying-foxes into closer proximity to one another, increasing the probability of disease transfer between individuals and within the population.

- resulting in abortions and/or dropped young if inappropriate management methods are used during critical periods of the breeding cycle. This will increase the likelihood of direct interaction between flying-foxes and the public, and potential for disease exposure.
- adoption of inhumane methods with potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying or deceased flying-foxes.

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

Australian bat lyssavirus

ABLV is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been found in an insectivorous microbat and it is assumed it may be carried by any bat species. The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (Qld Heath 2020) 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 (Qld Health 2020).

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 (Qld Health 2020).

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 (Qld Health 2020, Qld Health 2016).

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

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

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

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

Hendra virus

Flying-foxes are the natural host for 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 (Qld Health 2017). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (AVA 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (DPI 2018).

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

Humans may contract the disease after close contact with an infected horse. HeV infection in humans presents as a serious and often fatal respiratory and/or neurological disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate in horses is greater than 70% (DPI 2018). Since 1994, 81 horses have died, and four of the seven people infected with HeV have lost their lives (DPI 2018, Qld Health 2017).

Previous studies have shown that HeV spillover events have been associated with foraging flying-foxes rather than roost 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 (Qld Health 2017), 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

There is no evidence of Sudden Acute Respiratory Syndrome SARS-CoV-1 (SARS) or SARS-like, Middle East respiratory syndrome (MERS) or MERS-like, 2019-nCOV or 2019-nCoV-like viruses in Australian wildlife (including bats). Novel CoV-2019 (COVID-19) is not closely related to any known Australian bat coronaviruses and there is no suggestion that 2019-nCoV

(COVID-19) is present in Australian wildlife, although further surveillance and studies are recommended. There is no evidence that livestock or pets such as dogs or cats can be infected with 2019-nCoV (COVID-19) and no evidence to suggest that any animals (livestock, pets or wildlife) in Australia might be a source of infection of 2019-nCoV (COVID-19). Regardless, appropriate personal hygiene (e.g., washing hands) is always recommended before and after contact with animals (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. 2020). 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 roosts, 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. 2020). Firstly, bat flies tend to remain very close to flying-fox roosts, 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 roost. The chance of this contact occurring will increase if the roost 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. 2020).

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 roost 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

All animals, including flying-foxes, can 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 and care should be taken when cleaning faeces. 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 5 Online community survey results

The community online survey was advertised via social media and Council marketing and was open for five weeks (6 December 2022 – 12 January 2023). The survey was completed by 96 respondents, with a total of 98 submissions.

Respondent demographics

Majority of respondents identified in the 30-49 year old age category (59%), with 33% identifying as 50-69, 6% as 18-29, and 3% preferring not to answer. Most respondents reported living between 1 km and 5 km from Hoods Lagoon (40%), 24% reporting living less than 500m from Hoods Lagoon, 22% reported living between 500 m and 1km from Hoods Lagoon, and 13% reported living greater than 5 km from Hoods Lagoon. Majority of respondents reporting visiting Hoods Lagoon multiple times per week (49%), 34% reported visiting multiple times per month, 13% reported visiting every two to four months, 4% reported visiting a couple of times a year, and 2% reported that they never visit Hoods Lagoon.

Understanding and opinions of flying-foxes

When respondents were asked questions on their level of understanding of flying-foxes, majority of respondents understood that flying-foxes were native animals (73%), 14% did not care, 10% did not know, and 2% believed that flying-foxes were not native animals.

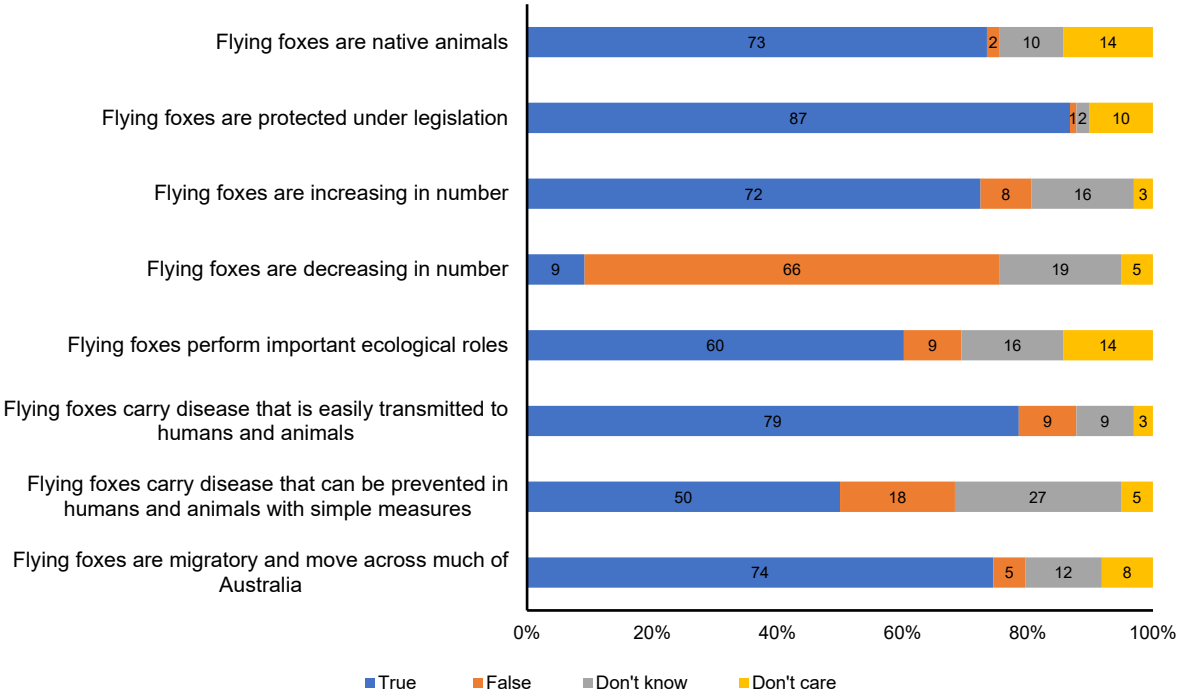
Majority of respondents understood that flying-foxes were protected under legislation (87%), 10% did not care, 2% did not know, and 1% believed that flying-foxes were not protected under legislation.

When respondents were asked if flying-foxes were increasing in number, majority of respondents (72%) believed that flying-foxes are increasing in number, 16% did not know, 8% believed they are not increasing in number, and 3% did not care. Likewise, when respondents were asked if flying-foxes are decreasing in number, majority (66%) believed flying-foxes are not decreasing in number, 19% did not know, 9% believe that flying-foxes are decreasing in number, and 5% did not care.

When respondents were asked if flying-foxes perform important ecological roles, majority (60%) understood that flying-foxes do provide important ecological roles, 9% believed that they did not perform important ecological roles, 9% did not know, and 3% did not care.

Interestingly, when respondents were asked if flying-foxes carry diseases that easily transmit between humans and animals, majority (79%) believed this to be true, 9% believed this to be false, 9% did not know, and 3% did not care. Similarly, when respondents were asked if they believe that flying-foxes carry diseases in which transmission can be prevented with simple measures, half of respondents believed this to be true, 27% did not know, 18% believed it to be false, and 5% did not care.

The majority of respondents (74%) understood that flying-foxes are migratory and move across much of Australia, 12% did not know, 8% did not care, and 5% did not believe this to be true.



Respondents general understanding of flying-foxes

When respondents were asked if they believed flying-foxes are important to the environment and should be protected, most respondents (44%) disagreed to some extent (18% strongly disagreed and 26% disagreed), 33% of respondents were neutral, and 23% agreed to some extent that flying-foxes are important and should be protected (15% agreed and 8% strongly agreed).

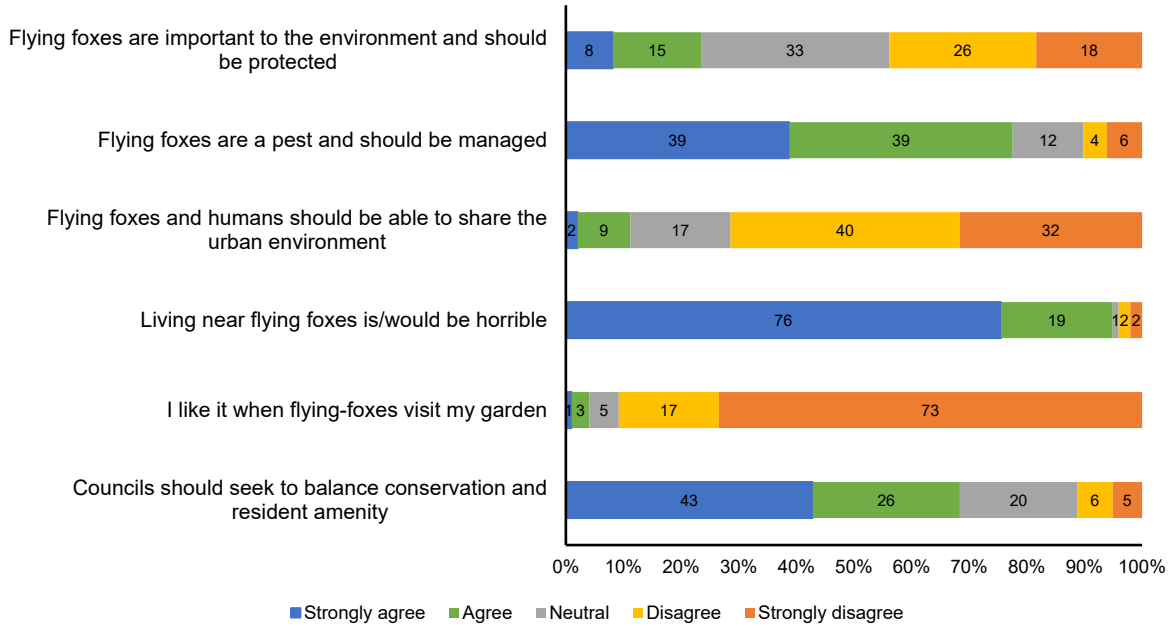
When respondents were asked if they believed flying-foxes were pests and should be managed, the majority of respondents (78%) agreed to some extent (39% strongly agreed and 39% agreed), 12% of respondents were neutral, and 10% disagreed to some extent (6% strongly disagreed and 4% disagreed).

When respondents were asked if humans and flying-foxes should be able to share the urban environment, majority of respondents (72%) were of the opinion that flying-foxes and humans are not able to share the urban environment (40% disagreed and 32% strongly disagreed), 17% were neutral, and 11% believed that the urban environment could be shared (9% agreed and 2% strongly agreed).

The overwhelming majority of respondents (95%) agreed to some extent that living near flying-foxes is/would be horrible (76% strongly agreed and 19% agreed), 1% of respondents were neutral, and 4% disagreed to some extent (2% strongly agreed and 2% agreed).

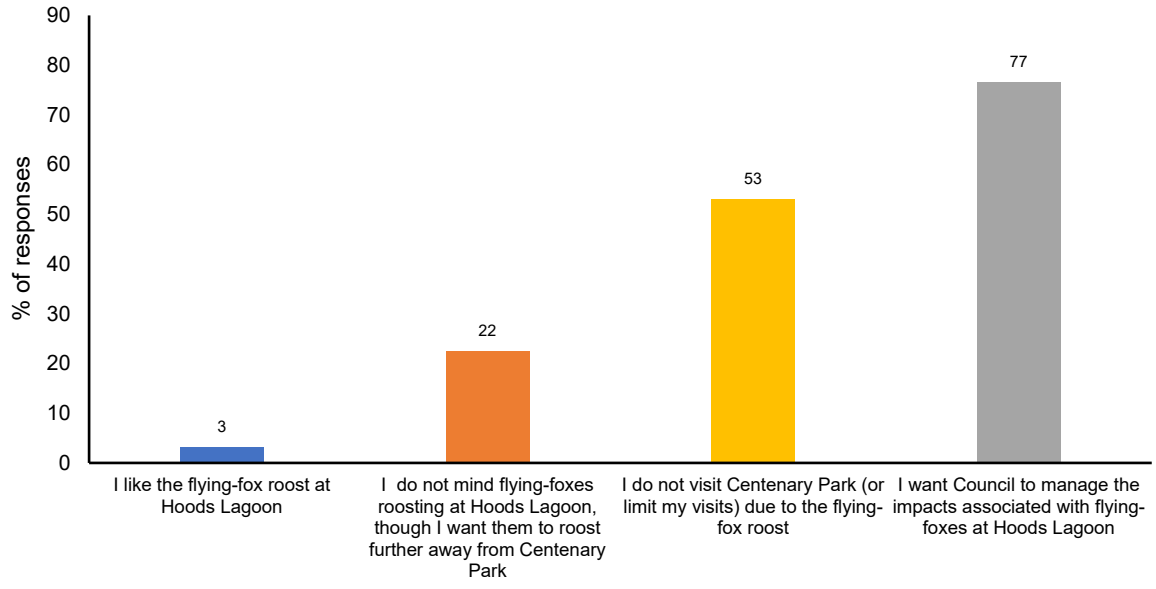
When respondents were asked if they like when flying-foxes visit their garden, the majority (90%) disagreed to some extent (73% strongly disagreed and 17% disagreed), 5% were neutral, and 4% agreed to some extent (3% agreed and 1% strongly agreed).

When respondents were asked if Council should balance conservation and resident amenity, majority (69%) agreed to some extent (43% strongly agreed and 26% agreed), 20% of respondents were neutral, and 11% disagreed to some extent (6% disagreed and 5% strongly disagreed).



Respondents general opinions of flying-foxes

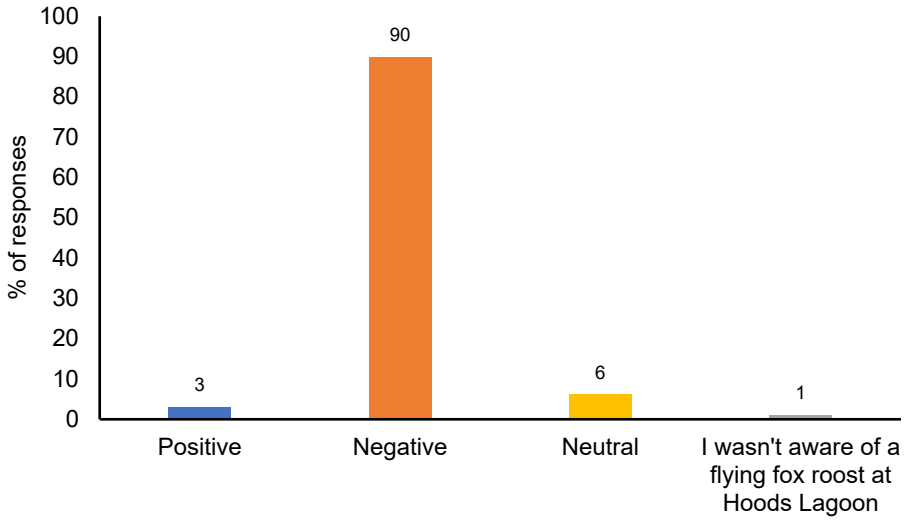
When respondents were asked identify which statements they agreed with, 77% responded that they want Council to manage impacts associated with flying-foxes at Hoods Lagoon, 53% responded that they do not visit Centenary Park (or limit their visits) due to the flying-fox roost, 22% responded that they do not mind flying-foxes at Hoods Lagoon, however they want them to roost further away from Centenary Park, and 3% responded that they like the flying-fox roost at Hoods Lagoon.



Responses to the prompt 'Please tick any of the following statements that are true for you'. Respondents could select multiple answers.

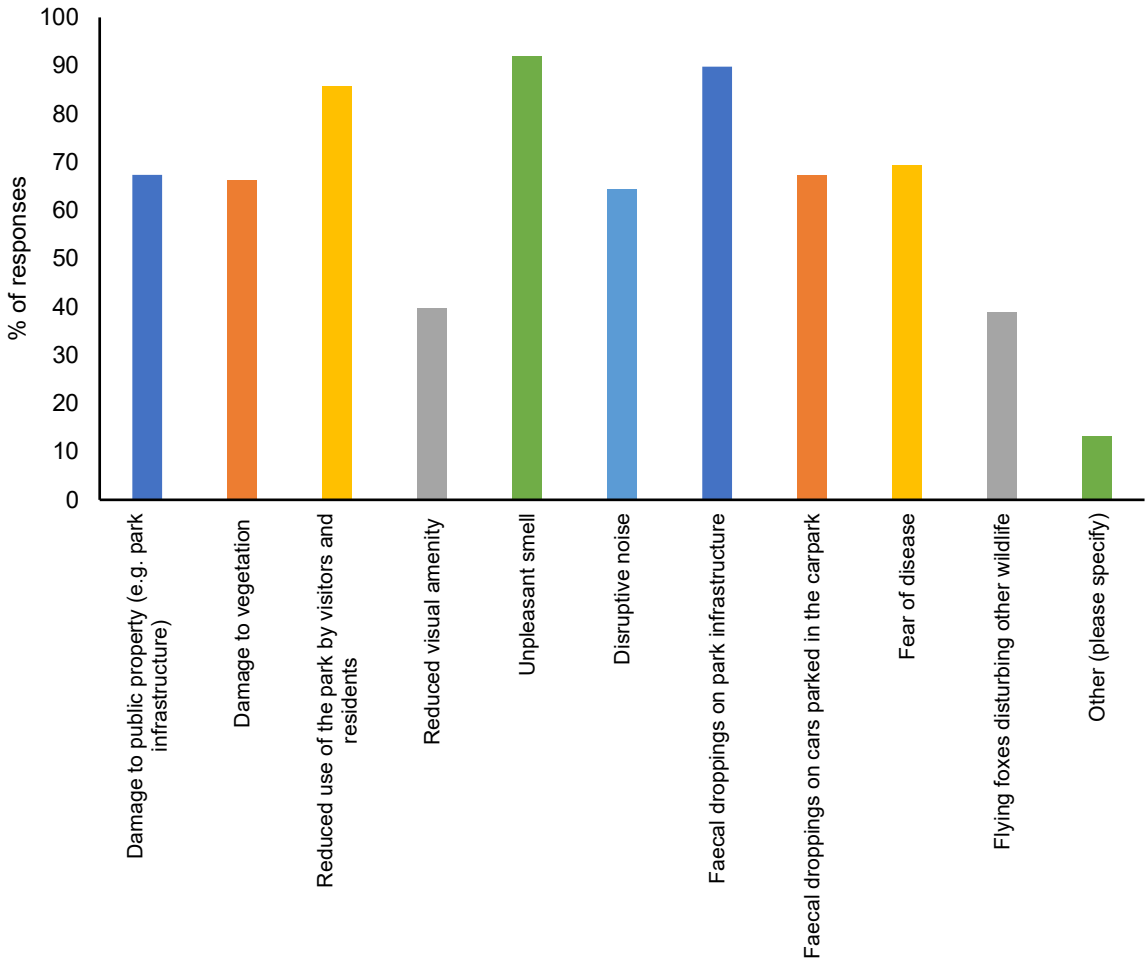
Experienced impacts

When respondents were asked about their relationship with the Hoods Lagoon roost, majority of respondents had a negative relationship (90%), 6% of respondents have a neutral relationship, 3% had a positive relationship, and 1% was not aware there was a roost at Hoods Lagoon.



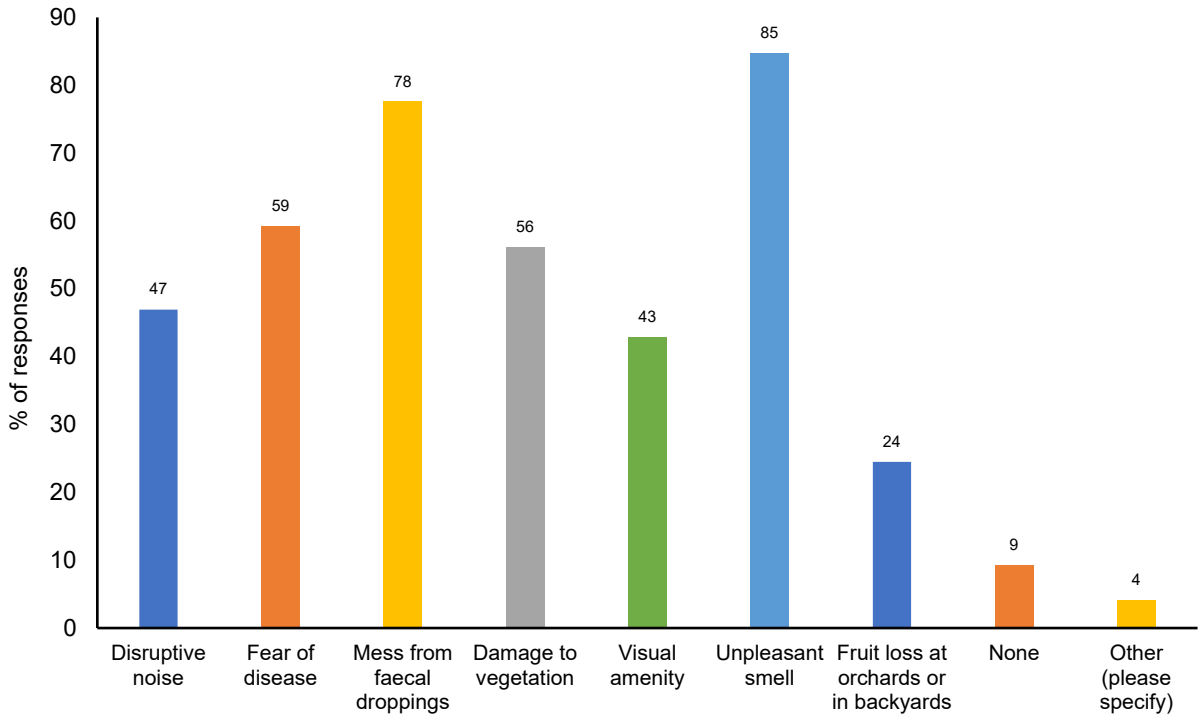
Responses to the prompt 'What best describes your relationship with the Hoods Lagoon flying-fox roost?'

When respondents were asked to list their main concerns regarding flying-foxes at Hoods Lagoon, the top three cited concerns was the unpleasant smell (92%), faecal droppings on park infrastructure (90%) and reduced use of the park by visitors and residents (86%). Five other concerns that were listed by roughly a third of all respondents were fear of disease (69%), faecal droppings on cars parked in the carpark (67%), damage to public property (67%), damage to vegetation (66%) and disruptive noise (64%). Some lesser cited concerns were reduced visual amenity (40%) and flying-foxes disturbing other wildlife (39%). 13% of respondents also answered ‘other’, which reiterate concerns of not being able to use the walking tracks, fear of disease and a few mentions of impacts to their residential dwellings.



Responses to the prompt 'If your experiences have been negative, what are your main concerns regarding flying-foxes at Hoods Lagoon/Centenary Park?'. Respondents could select multiple answers.

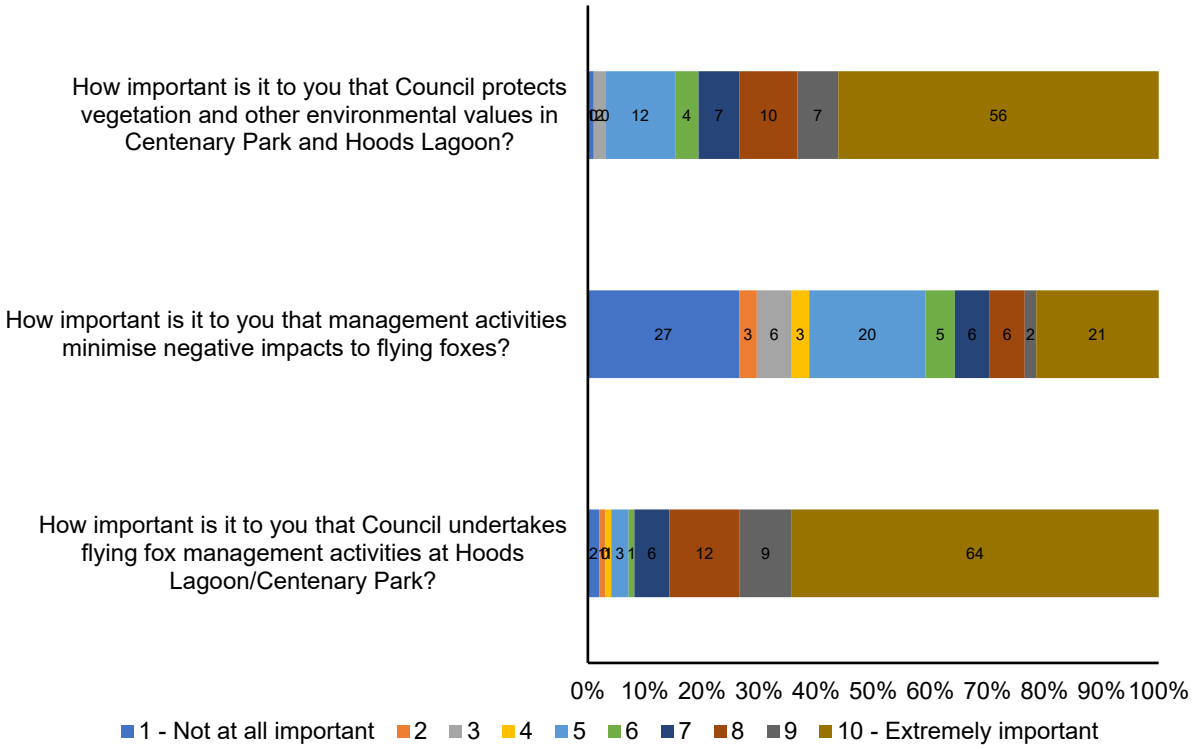
When respondents were asked what their main concerns were regarding flying-foxes at Hoods Lagoon if they are an affected resident or business owner, most respondents cited unpleasant smell (85%) and mess from faecal droppings (78%) as their top two concerns. Majority of respondents were also concerned about disease (59%) and damage to vegetation (56%). Some lesser cited concerns were disruptive noise (47%), visual amenity (43%), fruit loss at orchards or in backyards (24%). Nine percent of respondents reported no concerns. Four percent of respondents who answered other included reiterating concerns of faecal droppings, impacts at residential dwellings, impacts to their sleep and not being able to utilise the park.



Responses to the prompt 'If you are a resident or business owner affected by the Hoods Lagoon flying fox roost, what are your main concerns?'. Respondents could select multiple answers.

When respondents were asked where, if at all, they experienced flying-fox related impacts other than at Centenary Park, respondents cited experiencing impacts at their home (40%), in their garden (36%), in public spaces other than Hoods Lagoon (18%), local business e.g. bowls club (5%), and their own place of business (1%). Thirty-four respondents cited no negative impacts in areas other than Hoods Lagoon. Most answers from respondents who answered ‘other’ were reiterating impacts experienced at their homes. Some other locations mentioned by one respondent per location was Moranbah, Theresa Creek dam and a nearby school in Clermont. Opinions on management.

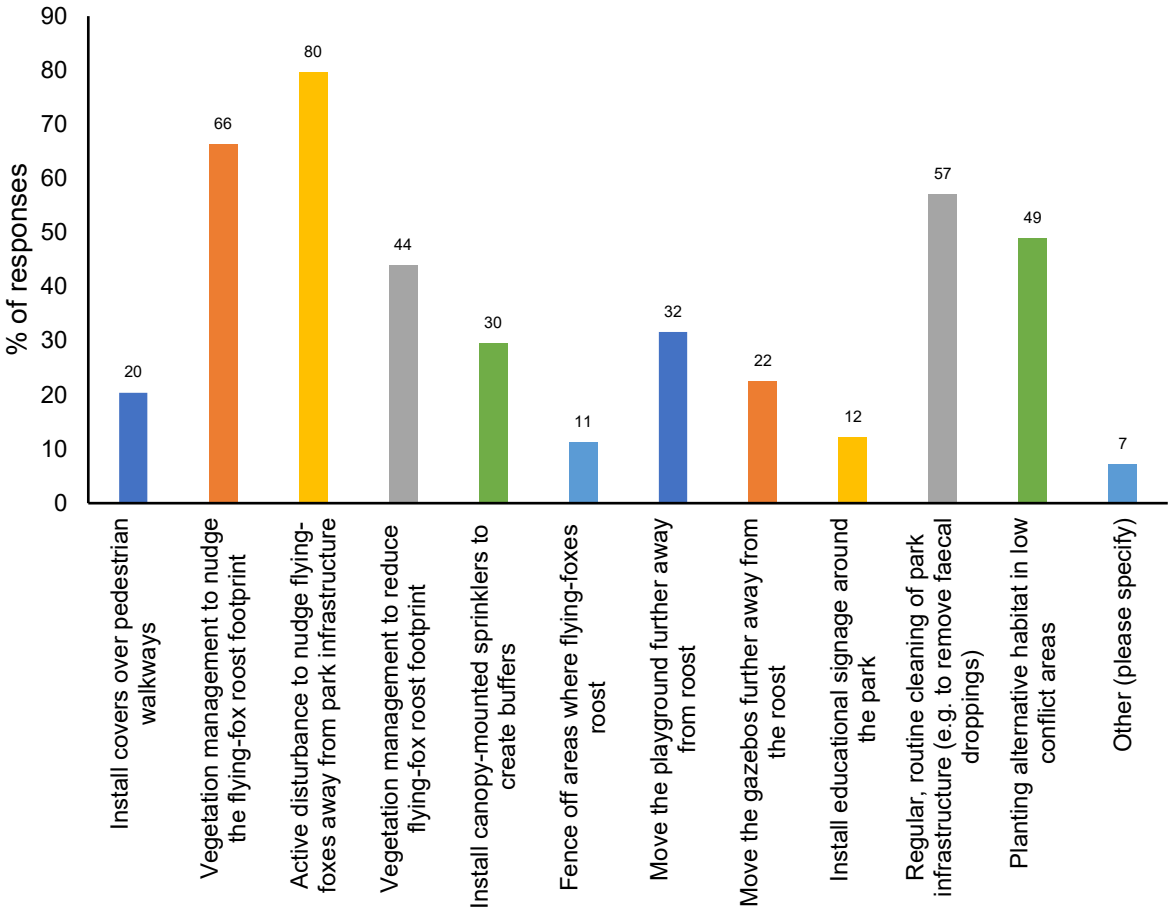
For majority of respondents (56%), it was extremely important that Council protects vegetation and other environmental values at Hoods Lagoon/Centenary Park. When respondents were asked to rate the importance of minimising negative impacts of management activities to flying-foxes, answers were relatively evenly spread across categories. Twenty-seven percent of respondent do not believe it is important at all to minimise negative impacts to flying foxes, 21% believe that it is extremely important, 20% were neutral, 18% believe it is somewhat important (ranking of 6-9), and 12% believe that it is not that important (ranking of 2-4).



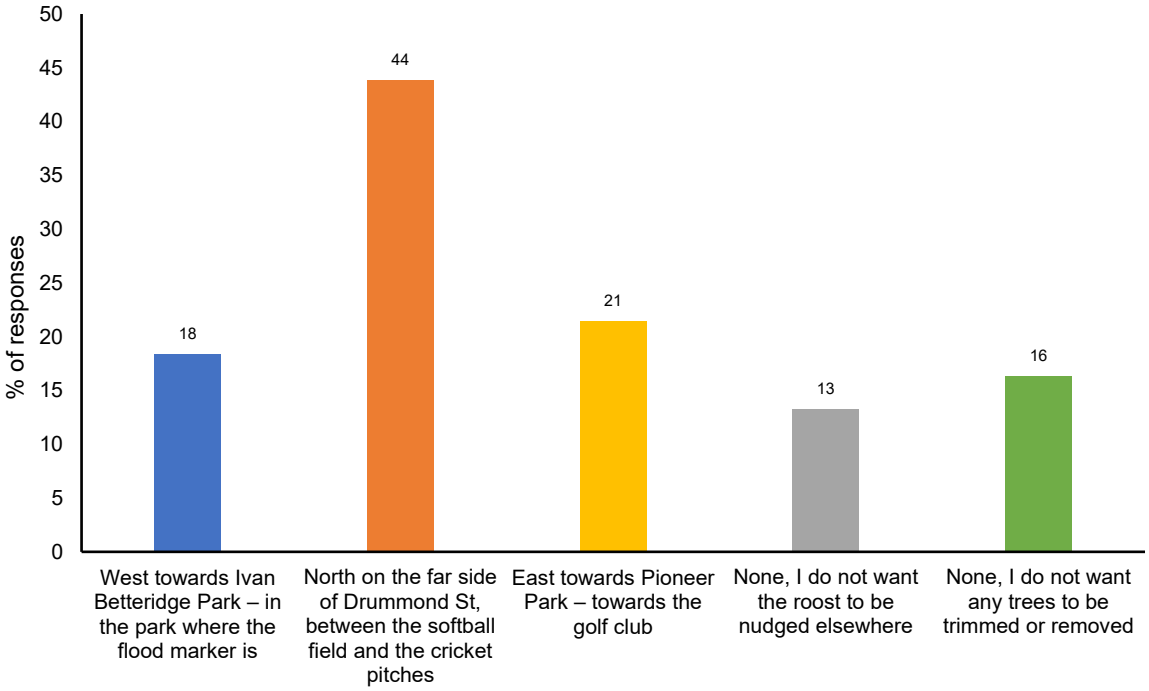
Responses to the degree of importance for respondents regarding management at Hoods Lagoon.

When respondents were asked to indicate which management activities they would like to see adopted at Hoods Lagoon, the top two responses were active disturbance to nudge flying-foxes further away from park infrastructure (80%) and vegetation management to nudge the flying-fox roost footprint (66%). Other general popular answers were regular routine cleaning of park infrastructure (57%), planting alternative habitat in low conflict areas (49%) and vegetation management to reduce the flying-fox roost footprint (44%). Some lesser cited answers were moving the playground further from the roost (32%), installation of canopy mounted sprinklers to increase buffer (30%), moving the gazebo further from the roost (22%), install covers over walkways (20%), installing education signage (12%) and fencing off areas where flying-foxes are roosting (11%). Of the 7% of 'other' responses, all mentioned wanting to completely move flying-foxes out of town. One 'other' response also mentioned building up infrastructure are other parks in town where flying-foxes do not roost.

When respondents were asked about preferred locations if flying-foxes were discourages from roosting at Hoods Lagoon via vegetation management (and via planting at a lower conflict site to provide alternative roosting habitat), most respondents preferred the north side of Drummond St in between the softball and cricket fields (44%). Twenty-one percent preferred east towards Pioneer Park, 18% preferred west towards Ivan Bettridge Park, 16% preferred no trees to be removed or trimmed, and 13% preferred that the roost was not nudged at all.

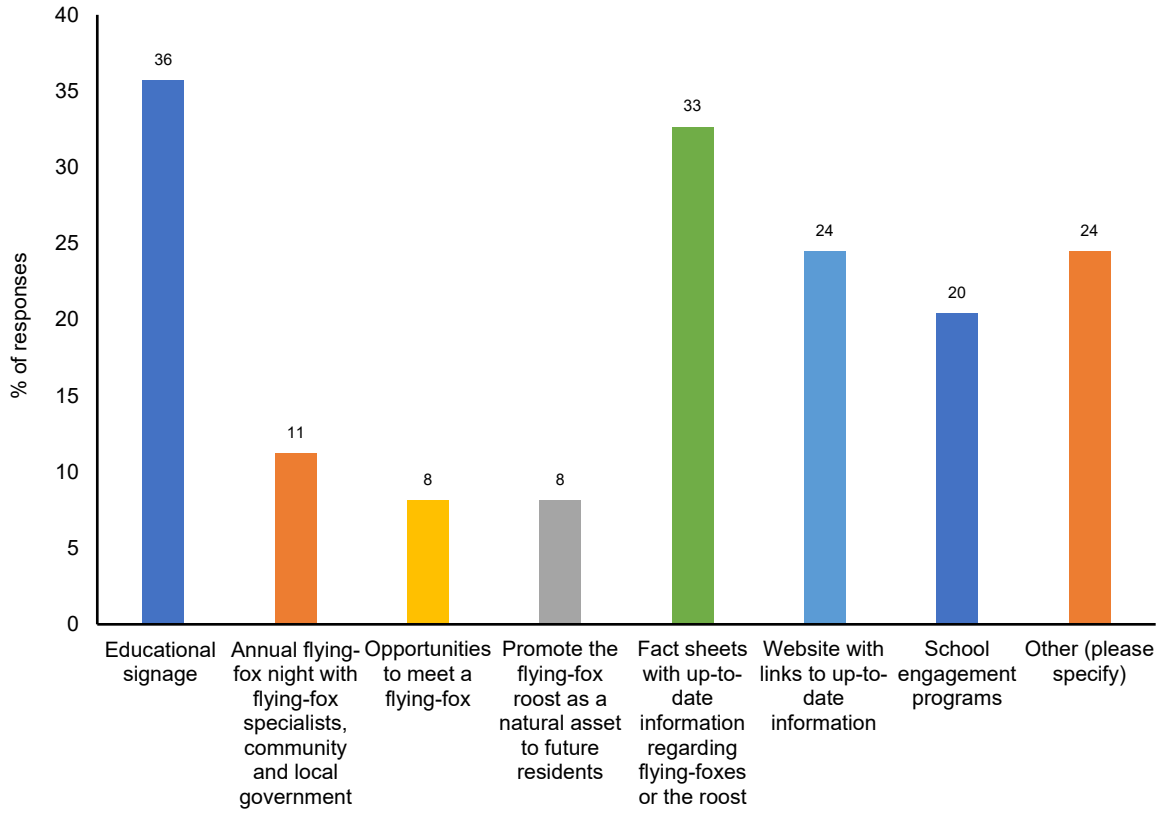


Responses to the prompt 'Which of the following management activities would you like to see adopted at Hoods Lagoon/Centenary Park?'. Respondents could select multiple answers.



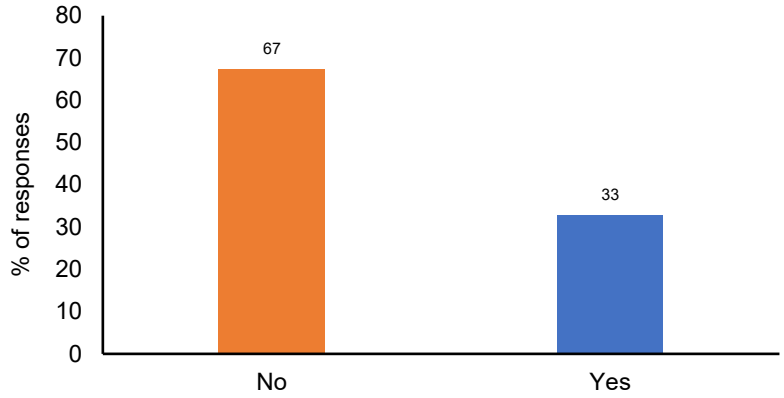
Responses to the prompt 'Vegetation management can potentially be used to nudge flying foxes away from undesirable locations (e.g. through tree trimming) and encourage roosting in more suitable areas (e.g. through planting). If Council were to undertake vegetation management at Hoods Lagoon, where would you like to see flying foxes nudge?'.

When respondents were asked to list educations options that were appealing, most respondents answered educational signage (37%) and fact sheets with up to date information regarding flying-foxes (33%). The next most popular answers in decreasing order was a website with links to up to date information (24%), school engagement programs (20%), annual flying-fox night with flying-fox specialists, community and local government (11%), opportunities to meet a flying-fox (8%), and promote the flying-fox roost as a natural asset to future residents. Of the 24% of respondents who answered 'other' all but 1% of responses believed that no education options were appealing, with one response believing that the flying-fox roost could provide an opportunity for eco-tourism.



Responses to the prompt 'Which of the following education options appeal to you?'. Respondents could select multiple answers.

When respondents were asked if receiving funding subsidies (e.g. to contribute to double-lazing, car covers etc.) would help in reducing flying-fox impacts on their property, 67% responded no, and 33% responded yes.



If you live near Hoods Lagoon or own a business that is impacted by the Hoods Lagoon roost, would receiving funding subsidies (e.g. to contribute to double glazing, car covers) help in reducing flying fox impacts on your property?

Appendix 6 Management options

Below is an overview of management options commonly used across Queensland and Australia which were considered in the development of the Plan.

Low impact options

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 roost, and information about flying-fox numbers and flying-fox behaviour at the roost.

Residents should also be made aware that faecal drop and noise at night is mainly associated with plants that provide food, independent of roost 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 roost is located would promote or encourage the adoption of certain actions on properties adjacent to or near the roost to minimise impacts from roosting and foraging flying-foxes:

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 metres). Vegetation that produces fragrant flowers can assist in masking roost 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 roost 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 roost.
- 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 roost 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 roost.

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 roosts. 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 roost), 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 roost 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 along the boundary of residential properties bordering the flying-fox roost.

Subsidy programs

Subsidy programs provide Council with an opportunity to support impacted residents living near flying-fox roosts. There are a number of factors to consider when establishing a subsidy program, including who to offer subsidies to (i.e. who is eligible, generally based on proximity to roost), 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 2019) 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.

Government initiatives that provide financial assistance commonly assess residents' eligibility based on a number of variables, including property distance from a roost, 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 2019) 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 roost and distance to a roost may also be used to determine when subsidies would apply.

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 2019). 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 may be considered to manage the impacts of the flying-foxes. Providing subsidies to install infrastructure may improve the value of the property, which may also offset concerns regarding perceived or actual property value or rental return losses. Focusing funds towards manipulating the existing built environment also reduces the need for modification and removal of vegetation. Examples of property modification subsidies (as offered by NSW councils) 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 2019).

When offered, double-glazing windows was popular amongst residents and was able to achieve a 65% reduction in flying-fox noise (Mo & Roache 2019). 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 roost. 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 undertook Round 1 of a private property grant trial in July 2021. 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 roost 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. 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 roost 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.

Routine roost maintenance and operational activities

All persons are authorised to undertake low impact activities at roosts in accordance with the Code of practice—Low impact activities affecting flying-fox roosts. Low impact activities include weeding, mulching, mowing or minor tree trimming (not in a tree where flying-foxes are roosting).

Protocols should be developed for carrying out operations that may disturb flying-foxes, which can result in excess roost 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 roost 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 roosts 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 roost sites would be dedicated as a flying-fox reserve. However, if a staged and long-term approach is used to make unsuitable current roosts 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 roost preferences may improve the potential to create new flying-fox habitat.

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

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

Potential habitat mapping using roost 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 roost 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 roosts. Such protocols may include monitoring at sites within the vicinity of aged care or child care facilities, management of compatible uses such as dog walking or sites susceptible to heat stress incidents (when the roost 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 roosts.

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 roosts. 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 roost and leaving the situation and site in its current state.

Buffers

Buffers can be created through vegetation removal, revegetation of non-flying-fox attractant vegetation and/or the installation of permanent/semi-permanent deterrents.

Creating buffers may involve planting low-growing, spiky, non-flowering plants between residents or other conflict areas and the flying-fox roost. Such plantings can create a physical and/or visual buffer between the roost and residences or make areas of the roost 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 roost 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 roost 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 roost. The amount required to be removed varies between sites and roosts, 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 roost and noise issues for neighbouring residents which may create further conflict.

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

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

Buffers without vegetation removal

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

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

- Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012) and balloons (Ecosure, pers. comm.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. Potential for litter pollution should be considered and managed when selecting the type and placement of visual deterrents. In the absence of effective maintenance, this option could potentially lead to an increase in rubbish in the natural environment.
- Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. This is also likely to be disruptive to nearby residents.
- Smell deterrents – For example, bagged python excrement hung in trees has previously had a 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 roost, 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.

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 roost tree trimming/removal or
- accompanied by selective roost 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 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 will be required under the VM Act as exemptions do not exist for this purpose (see Appendix 1).

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.

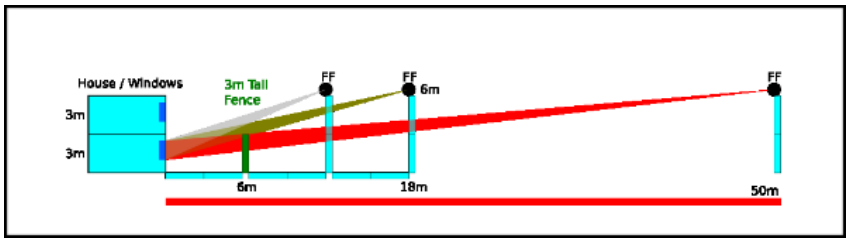
Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in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

Noise attenuation fencing

Noise attenuation fencing aims to reduce noise and potentially odour where the roost 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.



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

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

Disturbance or dispersal

Nudging

Noise and other low intensity active disturbance restricted to certain areas of the roost 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 roost site.

Unless the area of the roost 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 roost 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 roost to move to another location. Dispersing flying-foxes may be achieved in two ways:

- actively disturbing the roost 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, roosts are usually recolonised, and the conflict remains (Roberts & Eby 2013, Currey et al. 2018). 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 roost site (Ecosure 2014). Ultimately, these results indicate that, when dispersed, flying-foxes generally relocate within 600 m – 1 km of the original roost site, and do not travel further than 6 km away.

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

- shifting or splintering the roost 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 roost 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 roost, 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 roost 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 roost or to prevent roost re-establishment. For example, flying-foxes abandoned a roost in Bundall, Queensland once 70% of the canopy/mid-storey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important roosts, 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 roosts 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 roost 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 roost to be abandoned is unknown. It would also likely only be effective where there are no alternative water sources in the vicinity of the roost.

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 roost, 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 roost 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 roost 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 roost. 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 roost. It may also avoid considerable issues and management effort required should the roost 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 roost.

Maintenance dispersal

Maintenance dispersal refers to active disturbance following a successful dispersal to prevent the roost 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 conservation legislation will not be permitted as a method to manage flying-fox roosts.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	10/02/2023	PR7144 Hoods Lagoon Flying-fox Management Plan DRAFT	Tegan Dinsdale, Fauna Ecologist	Ellie Kirke, Fauna Ecologist	Jess Bracks, Principal Wildlife Biologist
01	07/07/2023	PR7144 Hoods Lagoon Flying-fox Management Plan DRAFT R1	Tegan Dinsdale, Fauna Ecologist	Jess Bracks, Principal Wildlife Biologist	
02	29/09/2023	PR7144 Hoods Lagoon Flying-fox Management Plan	Tegan Dinsdale, Fauna Ecologist	Jason Ray, Wildlife Operations Manager	

Distribution List

Copy #	Date	Type	Issued to	Name
1	29/09/2023	Electronic	Isaac Regional Council	Kent Worsley
2	29/09/2023	Electronic	Ecosure	Administration

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Report compiled by Ecosure Pty Ltd

ABN: 63 106 067 976

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

PR7144-RE.Hoods Lagoon FFMP

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

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

Coffs Harbour
PO Box 4370
Coffs Harbour Jetty NSW 2450
P 02 5621 8103

Gladstone
PO Box 5420
Gladstone QLD 4720
P 07 4994 1000

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

Rockhampton
PO Box 235
Rockhampton QLD 4700
P 07 4994 1000

Sunshine Coast
PO Box 1457
Noosaville QLD 4566
P 07 5357 6019

Sydney
PO Box 880
Surry Hills NSW 2010
P 1300 112 021

Townsville
PO Box 2335
Townsville QLD 4810
P 1300 112 021