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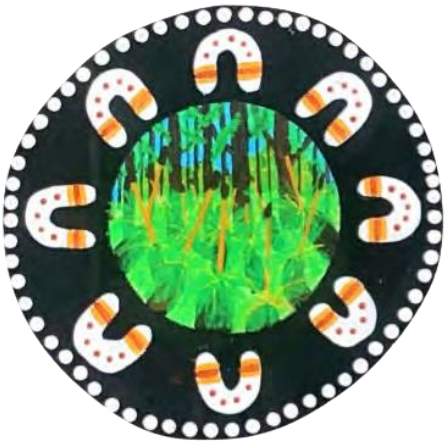
FLYING-FOX ROOST MANAGEMENT PLAN

August 2024

BURDEKIN SHIRE COUNCIL

Acknowledgements

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.



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Acronyms and abbreviations

ABLV	Australian bat lyssavirus
ACP Act	*Animal Care and Protection Act 2001* (Queensland)
BFF	Black flying-fox (*Pteropus alecto*)
CMS	Canopy-mounted sprinklers
Council	Burdekin Shire Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Department of Agriculture and Fisheries (Queensland)
DAWE	Department of Agriculture, Water, and Environment (Commonwealth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DESI	Department of Environment, Science and Innovation (previously Department of Environment and Science (DES)) (Queensland)
DoE	Department of Environment (Commonwealth)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EVNT	Endangered, vulnerable and near threatened
FFRMP	Flying-fox roost management permit
GHFF	Grey-headed flying-fox (*P. poliocephalus*)
HeV	Hendra virus
HSE	Heat stress event
LGA	Local government area
Low Impact COP	Code of Practice – Low impact activities affecting flying-fox roosts (Queensland)
LRFF	Little red flying-fox (*P. scapulatus*)
Management COP	Code of Practice – Ecologically sustainable management of flying-fox roosts (Queensland)
MNES	Matters of national environmental significance
NFFMP	National Flying-Fox Monitoring Program
NAMU	Natural Areas Management Unit
NC Act	*Nature Conservation Act 1992* (Queensland)
NSW	New South Wales
OPW	Operational Works Plan
the Plan	Burdekin Shire Council Flying-fox Roost Management Plan
Planning Act	*Planning Act 2016* (Queensland)
the Planning Regulation	Planning Regulation 2017 (Queensland)
PPE	Personal protective equipment

Qld	Queensland
RE	Regional Ecosystem
the Referral Guideline	Referral Guideline for Management Actions in Grey-headed and Spectacled Flying-fox Camps (Commonwealth)
SEQ	South East Queensland
SFF	Spectacled flying-fox (*P. conspicillatus*)
SoMI	Statement of Management Intent
UFFMA	Urban Flying-fox Management Area
VM Act	*Vegetation Management Act 1999* (Queensland)
WHA	Wildlife Health Australia

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1 Introduction

This Flying-fox Roost Management Plan (the Plan) provides Burdekin Shire Council (Council) with a framework to manage issues associated with flying-fox roosts/camps at Kidby Gully, Lloyd Mann Park, and Arch Dunn Memorial Park in the township of Home Hill, and Plantation Creek in Ayr. Two species of flying-fox have been recorded within the Burdekin Shire LGA: the black flying-fox (*Pteropus alecto*; BFF) and little red flying-fox (*P. scapulatus*; LRFF) (seasonal visitor). Council has implemented various management actions at the roosts within Home Hill. In response, Council has advised that the flying-foxes have moved to "temporary roosts", these new roosts may become established roosts. The Plan includes a range of short- and long-term options to support private landholders, minimise conflict between humans and flying-foxes, improve awareness, and conserve flying-foxes and the critical ecosystem services they provide.

This Plan has been developed in accordance with relevant legislation and considers feedback received from in-person and online stakeholder consultation. The Council acknowledges the impact flying-foxes can have on residents and is committed to implementing management actions that minimise impacts while also encouraging coexistence. The Council intends to manage flying-fox roosts on Council-owned or managed land but may also provide advice and assistance to residents and landowners affected by a flying-fox roost on privately-owned land. Where a roost spans Council-owned and private land, the Council will work cooperatively with landowners to develop joint mitigation actions.

Roosts and camps have legislatively different definitions based on historical breeding activity and differing levels of protection, see also Appendix 1. Historical data on flying-fox breeding is not currently available to enable determination of each of the roosting sites in this Plan; as such all sites are collectively referred to as roosts herein, however noting some may actually be camps. This determination should be made by a flying-fox knowledgeable person prior to any management.

1.1 Stakeholders

Stakeholders with an interest in the Home Hill and Ayr roost sites and/or flying-foxes include:

- residents/businesses
- Traditional Custodians - the Juru and Bindal peoples
- Burdekin Shire Council
- Department of Environment, Science and Innovation (DESI)
- conservation groups, researchers, and community groups such as North Queensland Wildlife Care
- community visitors and businesses in/around Home Hill and Ayr.

As part of the development of this plan, Council initiated a community consultation meeting with key stakeholders including business owners and residents living and working close to roosts. In addition, an online survey was open to the general public between March and April 2024. Results from the consultation are included in Section 4 and were considered in the development of the plan.

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 (Qld). As native animals, all flying-foxes and their roost habitat are protected under State legislation. Details of relevant legislation are provided below.

Commonwealth

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the Commonwealth 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 grey-headed flying-fox (*P. poliocephalus*; GHFF) and spectacled flying-fox (*P. conspicillatus*; SFF) are listed as vulnerable and endangered species, respectively. Under the EPBC Act the GHFF and SFF are classified as MNES; the GHFF has been observed in Townsville, as such this species may occur within the camps at Home Hill and/or Ayr.

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

Queensland

All flying-foxes and their roost habitat are protected under the Qld *Nature Conservation Act 1992* (NC Act). Under this legislation, administered by the Department of Environment, Science and Innovation (DESI; formerly Department of Environment and Science (DES)), it is an offence to harm the animals, or disturb flying-foxes from daytime roosts without approval.

In Qld, local governments are authorised under the NC Act to manage roosts in areas 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 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 the 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).

Private land holders are required to apply for a FFRMP for any management directed at roosting flying-foxes, or likely to disturb roosting flying-foxes other than:

- certain low impact activities (e.g. mowing, minor tree trimming) if undertaken in accordance with the Code of Practice – Low impact activities affecting flying-fox roosts (Low Impact COP) (DES 2020c)
- instances where Council is enacting their as-of-right authority.

In addition, the Qld *Animal Care and Protection Act 2001* (ACP Act) applies to all living vertebrate animals; this includes wild animal species. To comply with the ACP Act, flying-fox management actions must not cause mental or physical suffering, pain, or distress.

Native vegetation is also protected under various legislation, including the NC Act, the VM Act and in some cases the *Planning Act 2016* (Planning Act). Clearing of vegetation in core koala habitat and/or a koala priority area is prohibited, with few exemptions (see Schedule 21 and 24 of the Planning Regulation 2017 [the Planning Regulation] for exempt works). Permits/approval may be required for trimming or clearing protected habitat/plants.

Key State legislation specific to flying-fox management is summarised in further detail in Appendix 1. Other legislatively significant ecological values of the sites that need to be considered in management are outlined in Section 3.

Local

The Flying-fox Roost Management Guideline (DES 2020b) has been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Furthermore, councils are required to apply for a FFRMP for management options not specified in the Management COP.

Council endorsed a Statement of Management Intent (SoMI) (Flying-fox Management Policy) in 2022 for Flying-fox Roost Management in Burdekin Shire for the purpose of articulating Council's approach to management of flying-foxes within the Burdekin LGA, specifically within UFFMA. Council's Flying-fox Management Policy aims to reduce conflict between flying-foxes and the community in addition to improving coordination and planning of flying-fox roost management within UFFMA of the Burdekin LGA.

Council will consider appropriate non-lethal management actions, in accordance with the Management COP, to manage flying-foxes occurring on Council owned or controlled lands where their presence significantly impacts residents or the community. Based on a site assessment conducted by Council, flying-fox roost management will be considered on a case-by-case basis. Flying-fox management on land outside of an UFFMA will be referred to DESI for advice.

2 Flying-fox ecology and impacts

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, DES 2020d). This contributes directly to reproduction, regeneration, and viability of forest ecosystems (DAWE 2021). 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 300 km in a single night with a foraging radius of up to 50 km from their roost (Welbergen et al. 2020) 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 can germinate away from their parent plant have a greater chance of growing into a mature plant (Ruxton & Schaefer 2012). Long-distance dispersal also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones & Augee 1992, Eby 1991, Roberts 2006). This genetic diversity allows species to adapt to environmental change and respond to disease pathogens. Transfer of genetic material between forest patches is particularly important in the context of contemporary fragmented landscapes.

Flying-foxes are considered ‘keystone’ species given their contribution to the health, longevity and diversity among and between vegetation communities. These ecological services ultimately protect the long-term health and biodiversity of Australia’s bushland and wetlands. In turn, native forests act as carbon sinks (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 (NSW Wildlife Council 2010), and provide recreational and tourism opportunities worth millions of dollars each year (DES 2020d).

2.2 Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. In a recent study of 654 known national flying-fox roosts, 55.1% occurred in urban areas and a further 23.5% in agricultural areas (Timmiss et al. 2020). Furthermore, the number of roosts increased with increasing human population densities (up to ~4,000 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 habitat or ease of navigation due to landmarks and lighting.

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).

Recently, specific research into the roost habitat preferences of LRFF revealed that roosts were most often associated with the following attributes (MacDonald et al. 2021):

- marginally taller canopy; mean height of canopy trees was 19.9 m (± 8.9 m) and of subcanopy trees was 9.9 m ± 4.8 m
- greater canopy and subcanopy cover/complexity
- marginally taller shrub layer with greater cover
- shorter, less dense ground cover layer
- preference for ten tree species (accounting for 68% of roost habitats), including *Eucalyptus*, *Melaleuca*, *Rhizophora*, *Avicennia*, *Corymbia*, and *Tamarandus* species
- generally located within 200 m of watercourse (50% of roosts).

Proximity to water is a key attribute in roost location (Hall & Richards 2000, Roberts 2005, MacDonald et al. 2021) with one study suggesting that 94% of GHFF roosts in New South Wales (NSW) were (at that time) located adjacent to or on a waterway or waterbody (Eby & Lunney 2002).

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

2.4 Flying-fox breeding cycle

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

Black and grey-headed flying-foxes

Mating begins in January with peak conception occurring around March to April/May; this mating season represents the period of peak 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 and Blackshaw 1991), however out of season breeding is not unusual and births may occur at any time of the year (Ecosure pers. obs. 2015-2023).

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

Little red flying-fox

The LRFF breeding cycle is approximately six months out of phase with BFF and GHFF. Conception occurs around October to November, with peak birthing in April-June (McGuckin & Blackshaw 1991, Churchill 2008). Young are carried by their mother for approximately one month then left at the 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, rescuers and carers should be on stand-by during cold weather.

Table 1 Indicative flying-fox reproductive cycle

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BFF, GHFF and SFF												
LRFF												

Peak conception
Mid-pregnancy
Final trimester
Peak birthing
Crèching (young left at roost)
Lactation

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 (Vanderduys et al. 2024). The number of flying-foxes at a roost can fluctuate significantly each day, seasonally, and between years. An estimate based on satellite tracking found that up to 17% of a colony can turnover each day (Welbergen et al. 2020). 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. The Burdekin Shire roosts form part of a network of roosts across the species' range (see Appendix 2).

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 study compiled a range of data sources to rank LRFF diet trees in bioregions across Qld (Eyre et al. 2020). This followed 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. The static nectar score for remnant vegetation within Burdekin LGA indicates extensive foraging habitat to the south-west (Figure 2). 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. Importantly, this data does not assess urban and agricultural nectar (or fruit) resources, this is a knowledge gap that warrants assessment across the LGA and Qld.

Between 2019 and 2020, flying-foxes experienced significant population impacts across the east coast of Australia due to extreme weather events (predominantly South East Qld, NSW, and Victoria). Prolonged drought caused a mass food shortage from Gladstone (Qld) to Coffs Harbour (NSW), peaking around October 2019 (Mo et al. 2021), 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 2019, pers. comm.).

Significant events including fires, cyclones, floods, and drought can severely impact foraging and roosting resources in natural areas. Consequently, foraging and roosting resources in and around urban areas become even more important for flying-fox conservation.

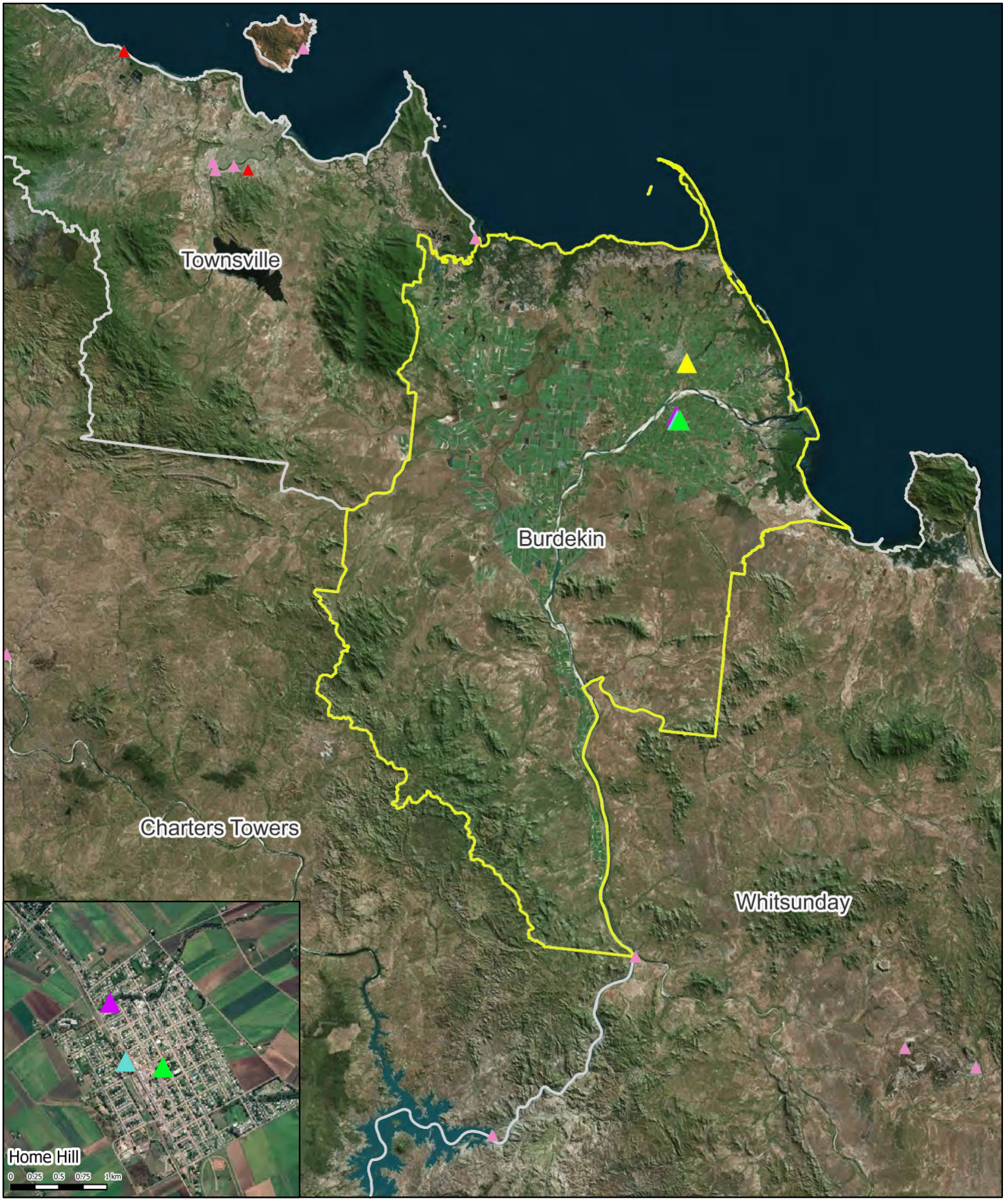

Figure 1 Flying-fox roost regional context

Burdekin Shire Council

BSC Flying-fox Management Plan

Home Hill and Ayr roosts
- Arch Dunn Memorial Park
- Kidby Gully
- Lloyd Mann Park
- Plantation Park

- Nationally significant roosts
- Flying-fox roosts (DESI data)
- Burdekin LGA
- Local Government Areas

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Project: PR8378
Revision: 0
Author: MH
Date: 09/05/2024

0 10 20 km

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

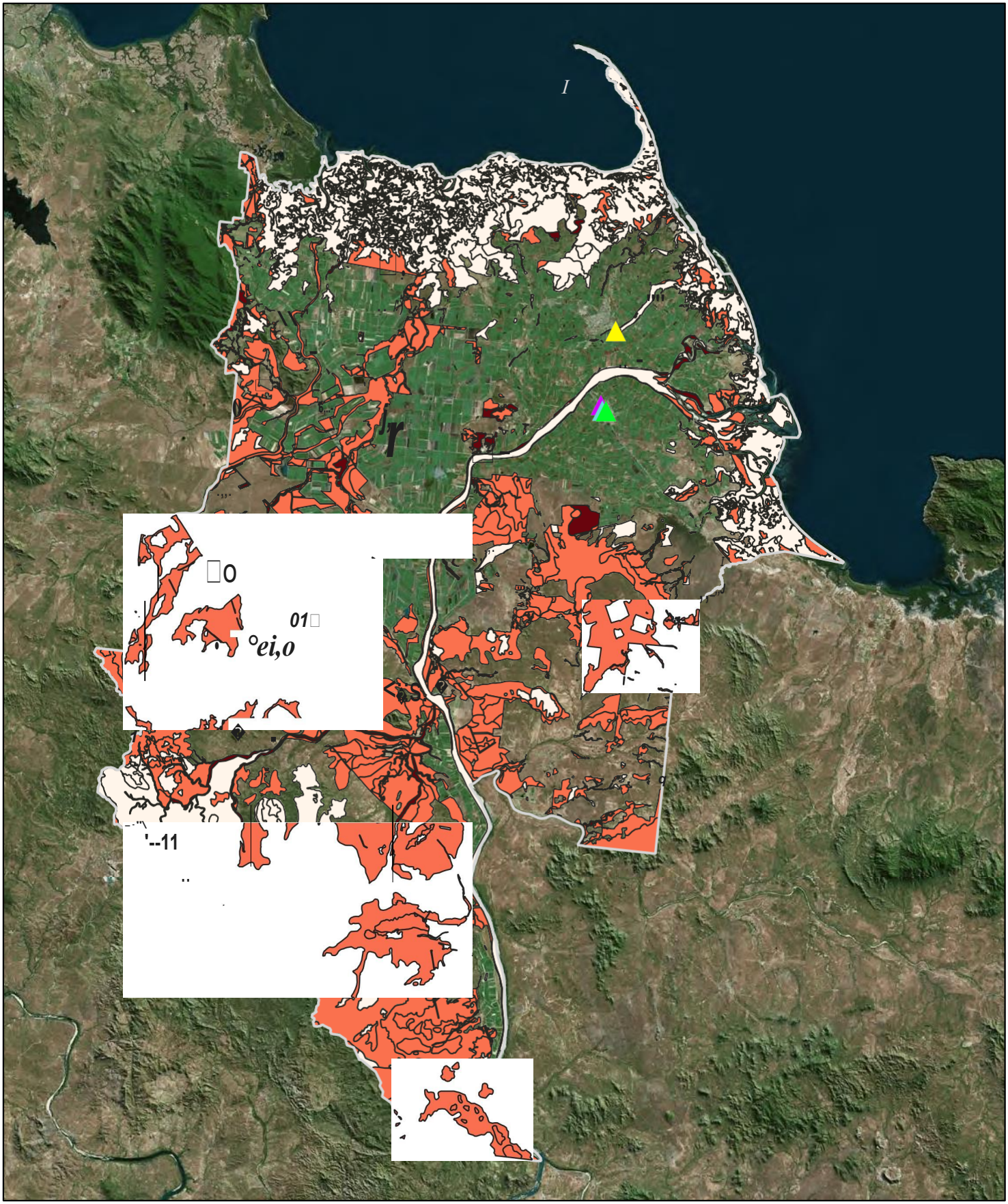

Figure 2 Distribution of the overall static nectar scores for remnant vegetation within Burdekin LGA

Burdekin Shire Council
BSC Flying-fox Management Plan
Data courtesy of QLD Herbarium/DESI/CSIRO

A

Burdekin LGA

Overall nectar scores*
- 0 - 7
- 7 - 16
- 16 - 24

***Eyre et al. 2020**

Home Hill and Ayr roosts
- Arch Dunn Memorial Park
- Kidby Gully
- Lloyd Mann Park
- Plantation Park

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Job number: PR8378
Revision: O
Author: MH
Date: 22/05/2024

0 10 20 km

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

2.6 Potential flying-fox impacts

2.6.1 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. This is often exacerbated during the breeding season (e.g. pup rearing in spring/summer, and during mating mid-March to mid-May; Table 1).

2.6.2 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.

2.6.3 Human and animal health concerns

Flying-foxes, like all animals, may carry pathogens which can be harmful to humans. These risks can be effectively mitigated through education, protocols, personal protective equipment (PPE), and basic hygiene measures. The key human and animal health risks associated with flying-foxes are lyssavirus and Hendra virus; the latter being particularly important for flying-fox roosts located in close proximity to horse paddocks. Further information on flying-foxes and human/animal health is provided in Appendix 3.

2.6.4 Faecal drop

Flying-foxes have an extremely fast digestive process with only 15-20 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 (Eby and Roberts 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, reduced amenity, create a slip hazard, requires time and resources to clean, and can damage paint if not promptly removed. Appropriate PPE and hygiene measures are required when cleaning any animal excrement. High-pressure hoses and specific cleaning products are available to assist cleaning. Flying-foxes can be deterred from roosting and foraging around areas of concern. Areas of concern, such as picnic tables and play equipment, could also be covered (e.g. with shade cloth).

2.6.5 Water quality concerns

Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses health risks to humans. This is particularly relevant for any residents who rely on rainwater tanks for drinking water. There is no known risk of contracting bat-related viruses from contact with faecal drop or urine (Qld Health 2020). Household water tanks can be designed to minimise potential contamination, such as using first flush diverters to divert

contaminants before they enter water tanks.

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

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

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

2.6.6 Damage to vegetation

Large numbers of roosting flying-foxes can damage vegetation. Most native vegetation is resilient and generally recovers well (e.g. casuarina and eucalypts) and flying-foxes naturally move within a roost site allowing vegetation to recover. However, damage can potentially be significant and permanent, particularly in small patches of vegetation and particularly if large numbers of LRFF are present. LRFF have different roosting behaviour to BFF, they aggregate in high densities which can cause branches to snap. Intervention may be required (as a last resort) to protect tree health if permanent damage is likely.

2.6.7 Flying-foxes and aircraft

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

The main factors determining the consequences of strikes are the number and size of animal(s) struck, the phase of flight when struck and the part of the aircraft hit. The larger the animal, the greater the damage. Large animals can destroy engines and windshields and cause significant damage to airframe components and leading-edge devices. Strikes involving more than one animal (multiple strikes) can be serious, even with relatively small animals, potentially disabling engines and/or resulting in major accidents.

Historically, over 90% of reported strikes have occurred on or close to airports (ICAO 1999). Consequently, airports are the focus of management programs with the responsibility resting on airport owners and operators. It is, however, important that the whole airport community (including airline operators) and surrounding land managers are aware of wildlife strike as an issue and that all stakeholders become involved in reducing the hazard.

For any strike reduction program to be effective it is imperative that wildlife populations in the vicinity of an aerodrome are identified, monitored, and managed. Under international (International Civil Aviation Organisation Annex 14) and national legislation (Civil Aviation Safety Regulations (CASR) Part 139 Manual of Standards (MOS)) airport operators must identify potential wildlife hazards within 13 km of an aerodrome and engage with landowners to implement regular monitoring and, where required, mitigation strategies to help reduce the risk of strike associated with those hazards.

Flying-foxes are large (~800 g) animals that transit in large numbers at relatively low altitudes. Consequently, in terminal airspace, where aircraft are also operating at low altitudes, they may present a significant risk to air safety particularly prior to first light and post last light, daily. Between 2008 and 2017, flying-foxes and bats[1] were involved in 1,303 strikes in Australia and accounted for 10% of damaging strikes (ATSB 2019). Most notably, between 2016 and 2017 flying-foxes was the most struck flying animal.

2.6.8 Protecting flying-foxes and other fauna

2.6.8.1 Extreme weather impacts

Heat

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 can occur when temperatures exceed 42°C (Welbergen et al. 2008, Bishop et al. 2019). However, humidity is an important variable as the flying-foxes cool-down through 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 (Mo et al. 2022) including the largest on record, 45,500 deaths across 52 SEQ roosts in the summer of 2014 (Welbergen et al. 2014).

The Flying-fox Heat Event Response Guidelines SEQ (Bishop & Lyons 2018) provide information for decision makers during HSEs and should be adopted by Council if responding to HSEs in Home Hill and/or Ayr.

A range of intervention methods are used by wildlife rescue and carers to reduce mortality in roosts, including directly spraying water on 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 water. 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).

Storms

Storm events can result in tree loss and damage to vegetation, which can lead to a reduction in roosting and, in particular, foraging resources for flying-foxes. The loss of tree crown can open the canopy, which may result in a hotter drier climate in areas with little canopy cover.

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

Increased sunlight and drier soils often favour weed proliferation which can further degrade the habitat. Habitat restoration is critical to ensure sufficient recruitment over time to allow such canopy losses to be replaced as soon as possible.

Storms can result in injury and mortality in flying-fox roosts, particularly when flightless young are present (during summer, which coincides with storm season). Council notes that wildlife rescue at a roost must only occur when it is safe for human access.

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 will be important to limit impacts of more frequent drought under climate change.

Bushfires

Due to the urban nature of the Ayr and Home Hill roosts, the risk of a bushfire is quite low. 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 (Bat Conservation and Rescue Queensland 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-foxes breeding cycle and the ability to find adequate food for survival (Bat Conservation and Rescue Queensland 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). This may lead to increasing conflict in communities such as Ayr and Home Hill, therefore preparedness for influxes in particularly severe bushfire seasons is key.

3 Roost assessments

Roost assessments were undertaken at Kidby Gully, Loyd Mann Park, Arch Dunn Memorial Park, and Plantation Creek from 20 to 21 February 2024. None of the roosts were included in the NFFMP and monitoring data is limited for these sites.

3.1 Home Hill

3.1.1 Kidby Gully

Site Description

The Kidby Gully roost is located along a mapped ephemeral waterway in Home Hill (Figure 3), bordered on both sides by residential areas between Fifteenth Street and Sixteenth Street. Flying-foxes utilise *Eucalyptus* spp., mango trees (*Mangifera* sp.), and, at times, *Casuarina* sp. to roost along the gully and occasionally in the backyards of surrounding residences. The roost extent can extend from the Bruce Highway, at the western end, to Eleventh Avenue at the eastern end, depending on influxes.

The Kidby Gully roost was not previously monitored as part of the NFFMP.

Land tenure

Kidby Gully has been designated as a Road Reserve. The roost may occasionally encroach on most of the private land lots along the southern boundary, in particular 5RP712475, 6RP712475, 23RP731944, and 17RP731944, as they bridge the road reserve and are densely vegetated.

Ecological values

A WildNet search identified no threatened fauna species occurring within 1 km of the Kidby Gully roost.

The roost is mapped as non-remnant vegetation as the area is a built environment.

Any management undertaken must consider these other values and relevant legislative requirements (see Section 1.2 and Appendix 1).

Flying-fox occupancy and roost extent

The Kidby Gully roost was vacant during Ecosure's site assessment. Anecdotal evidence suggests that BFF are more regularly observed at the Kidby Gully roost than LRFF, however both generally occur in minimal numbers i.e. <100.

Sensitive receptors

It is acknowledged that many land uses conflict with flying-fox roosts, these may include residential properties, public parks, and business properties. Sensitive receptors, as used in the context of this Plan, differ in that there are vulnerable cohorts of people and/or animals where managing risk may be more complex than awareness programs and property modification. These include schools, childcare centres, hospitals, helipads and airports, and equine facilities. Identifying sensitive receptors is necessary to any management actions that

could inadvertently cause the roost to splinter to surrounding undesirable locations (e.g. other conflict locations close to residents) or sensitive receptors.

There is substantial overlap with buffers placed around the roosts in Home Hill, meaning that lists of sensitive receptors are similar. There are nine sensitive receptors located within a 1 km radius of the Kidby Gully roost, including:

- Mayfield Early Education Home Hill
- Saint Colman's Catholic School
- C&K Home Hill Community Kindergarten
- Home Hill Health Services
- TAFE Queensland Burdekin Campus
- Home Hill Ambulance Station
- Regis Home Hill (aged care)
- Home Hill State School
- Michelle's Caravan Park & Services Station.

Management response to date

Council has undertaken intermittent monitoring and active management, in the form of dispersal, for all flying-fox roosts in Home Hill collectively since June 2023. Dispersal at Kidby Gully has been reactive to low numbers of flying-foxes occasionally occupying the roost. Members of Council's Public Health and Environment team used noise (clapping pool noodles and gas cannon) and lights (vehicle flashing beacons and handheld flashlights) to deter roosting activity. Vegetation trimming was also undertaken to reduce available roosting space.

Figure 3 Kidby Gully estimated maximum flying-fox roost extent

Burdekin Shire Council

BSC Flying-fox Management Plan

Estimated maximum roost extent
Freehold land

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Job number: PR8378
Revision: 0
Author: MH
Oate: 22/05/2024

0 0.05 0.1

GOA 1994 MGA Zone 56
krfilrojection: Transverse Mercator
Datum: GOA 1994
Units: Meter

3.1.2 Lloyd Mann Park

Site Description

The Lloyd Mann Park roost is located within a public park at Home Hill between the Bruce Highway and the North Coast Railway corridor (Figure 4). The park is bordered by Michelle's Caravan Park and Service Station to the north and private residences to the south. The park is used as a public rest stop with picnic tables and art installations as part of the Home Hill Harvest Festival – Canefields Ephemera Exhibition.

The Lloyd Mann Park roost was not previously monitored as part of the NFFMP.

Land tenure

The main roost site occurs on Lot 2H61687 which is mapped as Reserve. Michelle's Caravan Park and Service Station (9H61696) to the north is mapped as Land Leased and the private residence (3SP323829) to the south is Freehold.

Ecological values

WildNet search results indicated that eastern osprey (*Pandion haliaetus cristatus*), listed as special least concern (SLC), has been recorded within 1 km of the Lloyd Mann Park roost (DESI 2024).

The Lloyd Mann Park roost is mapped as non-remnant vegetation as the area is a built environment.

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

Flying-fox occupancy and roost extent

During Ecosure's site assessment, 19 BFF were recorded roosting within Lloyd Mann Park. The BFF were observed to be carrying pups. Anecdotal evidence suggested that the park historically hosted low numbers of flying-foxes intermittently. The roost primarily occurs within Lloyd Mann Park, however the caravan park to the north and the private residence to the south are impacted during influxes or when the roost is splintered.

Sensitive receptors

In addition to the sensitive receptors listed for Kidby Gully, there are three sensitive receptors located within a km radius of the Lloyd Mann Park (Figure 6), including:

- Home Hill Caravan Park
- Home Hill Swimming Pool
- Home Hill Surgery.

Management response to date

Monitoring and management at Lloyd Mann Park have been undertaken by Council since June 2023. Dispersal efforts from other roost sites at Home Hill likely caused splintering throughout the township leading to roosting activity within Lloyd Mann Park. Reactive dispersal has been undertaken in response to low numbers of flying-foxes occupying the roost and is likely the cause of splintering into the nearby caravan park and private residence. Trees within Lloyd Mann Park have previously been cleared and trimmed in an effort to manage flying-foxes.

Figure 4 Lloyd Mann Park flying-fox roost

Burdekin Shire Council

BSC Flying-fox Management Plan

Current roost extent
Estimated maximum roost extent
Freehold land
Leased land
Reserve

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improving ecosystems

Job number: PR8378
Revision: 0
Author: MH
Date: 23/05/2024

0 10 20 m

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

3.1.3 Arch Dunn Memorial Park

Site Description

Arch Dunn Memorial Park is a public park in Home Hill dedicated to the memory of the Dunn family, who were prominent business people in Home Hill (Figure 5). The park facilities include a playground, picnic tables, barbeque area, war memorial, and public amenities. Each year the park hosts the ANZAC Day commemoration service. It is located between Ninth Avenue and Tenth Avenue and is surrounded by the Home Hill Bowls Club, C&K Home Hill Community Kindergarten, Home Hill Branch Library, and Burdekin Memorial Hall.

Land tenure

The main roost area occurs on Lot 4H61649 which is mapped as Reserve and is surrounded by another Reserve (19SB744) to the south where the Burdekin Memorial Hall is located and Leased Land (1H61649) to the north-west where the Home Hill Bowls Club is located.

Ecological values

Due to the close proximity of the two roosts, the WildNet search identified the same threatened fauna within 1 km of the Arch Dunn Memorial as Lloyd Mann Park.

The Arch Dunn Memorial Park roost is mapped as non-remnant vegetation as the area is a built environment.

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

Flying-fox occupancy and roost extent

During Ecosure's site assessment, 20 BFF were recorded roosting within Arch Dunn Memorial Park. Anecdotal evidence suggests that the flying-foxes roosting within the park were the result of splintering from other Home Hill roosts during management activity. The roost was relatively isolated within the park during the site assessment, however there is potential for larger influxes to expand into other suitable vegetation within the park.

Sensitive receptors

Due to the close proximity to Lloyd Mann Park and Kidby Gully, the overlapping buffers identified similar sensitive receptors within Home Hill (Figure 6). One additional sensitive receptor was identified slightly beyond the 1 km buffer at Arch Dunn Memorial Park:

- Home Hill State High School.

Management responses to date

Monitoring and management at Arch Dunn Memorial Park have been undertaken by Council since September 2022. Dispersal efforts from other roost sites at Home Hill likely caused splintering throughout the township leading to roosting activity within Arch Dunn Memorial Park. Reactive dispersal has been undertaken in response to low numbers of flying-foxes occupying the roost.

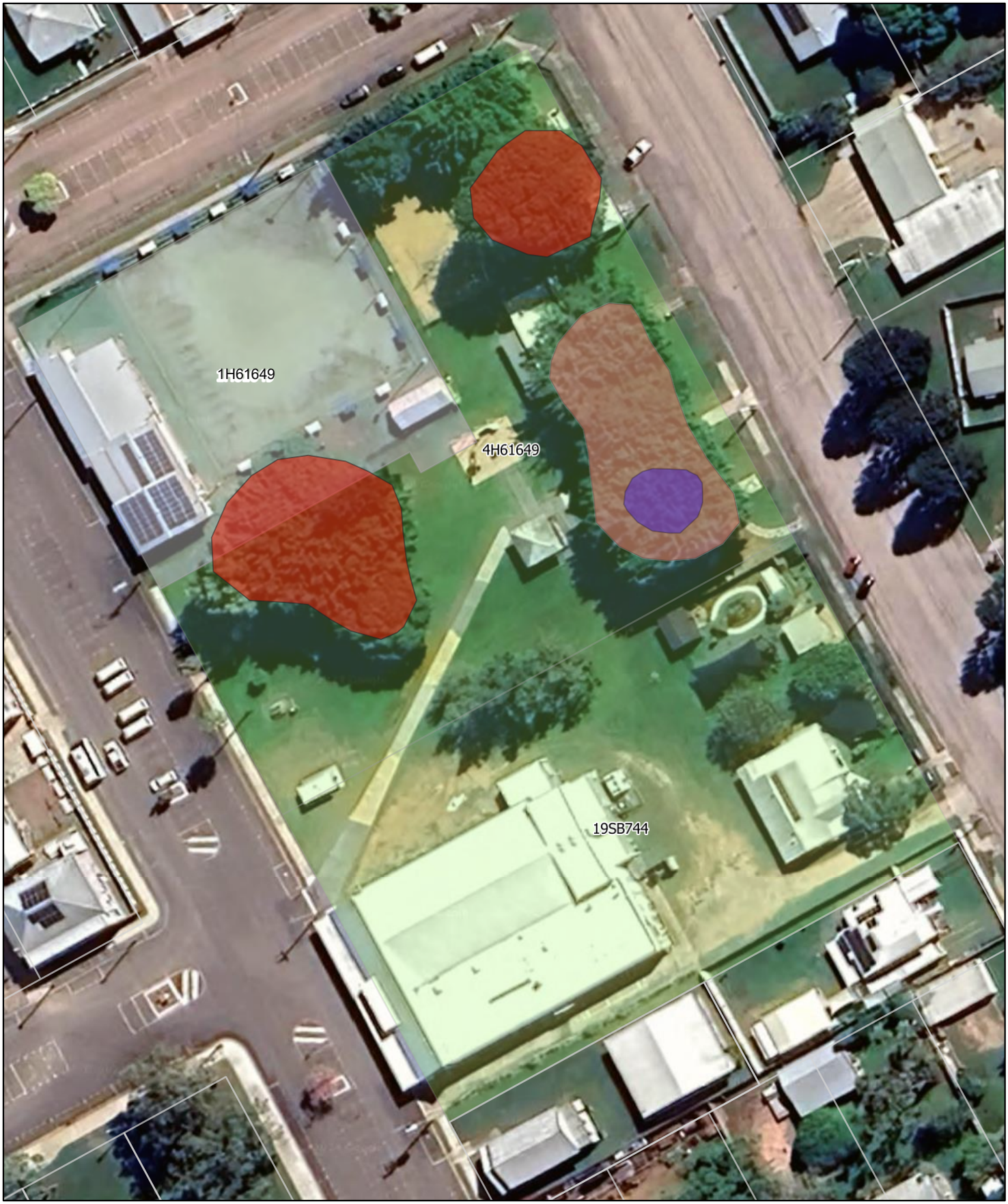

Figure 5 Arch Dunn Memorial Park flying-fox roost

Burdekin Shire Council

BSC Flying-fox Management Plan

Current roost extent
Estimated maximum roost extent
Freehold land
Leased land
Reserve

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improving ecosystems

Job number: PR8378
Revision: 0
Author: MH
Date: 22/05/2024

A

0 10 20 m

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

Figure 6 Home Hill sensitive receptors

Burdekin Shire Council

BSC Flying-fox Management Plan

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Job number: PR8378
Revision: 0
Author: MH
Date: 23/05/2024

0 0.25 0.5 km

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

3.2 Ayr

3.2.1 Plantation Creek

Site Description

Plantation Creek is a non-perennial waterway on the outskirts of Ayr (Figure 7). Ayr is located ~10 km north of Home Hill. The roost occurs within *Livistona* sp. palm forest bordered by *Eucalyptus* sp. fringing Plantation Creek. The creek itself is considered hydrologically modified and prevents access to the roost site. Due to its isolated location and restricted access, the roost is considered to be low conflict.

Land tenure

The main roost site at Plantation Creek is located on a parcel of land mapped as a watercourse slightly east of Lot DAP20169.

Ecological values

A WildNet search identified no threatened fauna species occurring within 1 km of the Plantation Creek roost, however the BPA ACA report identified estuarine crocodile (*Crocodylus porosus*), vulnerable under NCA, and northern quoll (*Dasyurus hallucatus*), endangered under EPBC, recorded within 4 km of the roost site.

The Plantation Creek roost is mapped as Of Concern - Dominant vegetation. The regional ecosystems present include:

- 11.3.25g: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (16-16d).

The roost vegetation is mapped as regulated vegetation as it occurs within 100 m of a wetland and holds medium aquatic conservation significance (riverine wetlands).

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

Flying-fox occupancy and roost extent

During Ecosure's site assessment, approximately 1,200 BFF were present within the roost.

Sensitive receptors

There were no sensitive receptors located within a 1 km radius of the Plantation Creek roost, however potential sensitive receptors across Ayr are mapped in Figure 8.

Management responses to date

No management response has been recorded to date as the roost is considered low conflict due to its isolated location and restricted public access.

Figure 7 Plantation Creek flying-fox roost

Burdekin Shire Council

BSC Flying-fox Management Plan

Current roost extent
Estimated maximum roost extent
Freehold land
Leased land

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Author: MH
Date: 22/05/2024

0 25 SO 75 m

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

Figure 8 Ayr sensitive receptors

Burdekin Shire Council

BSC Flying-fox Management Plan

Flying-fox roost
1 km roost buffer

Sensitive receptors
- Aged care
- Health Care
- Holiday Park
- Public pool
- School

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Job number: PR8378
Revision: 0
Author: MH
Date: 23/05/2024

0 0.25 0.5 0.75 km

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

4 Community Engagement

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

Ecosure has developed this Plan following a site assessment (February 2024) and meetings with Council, stakeholders, and affected residents. The general public was also given an opportunity to complete an online survey (see survey results in Section 4.2).

Council sought to consult with all stakeholders with an interest in the flying-fox roosts during the development of the Plan. The results of the engagement are detailed below.

4.1 Community consultation sessions

Council and Ecosure representatives hosted a stakeholder engagement meeting at Burdekin Memorial Hall on 21 February 2024. Council advertised the meeting on their website and social media inviting residents to the community engagement session. The purpose of this meeting was to understand the issues experienced by the community to assist with development of suitable management options. Attendance was minimal, however a range of concerns were raised during the meeting including misconceptions about disease transmission, impacts to ANZAC Day commemorative services at Arch Dunn Memorial Park, effectiveness of management actions to date and the observation of increasing flying-fox numbers in urban Home Hill.

4.2 Community survey results

Council undertook a community survey in March and April 2024, by distributing a QR code by letter drop to the Home Hill and Ayr communities and advertising on the Council website.

A total of 68 community members completed the survey. Some respondents skipped survey questions, varying the sample size for each response. Of the respondents, 84% (n = 67) reported that they live near a flying-fox roost and 82% (n = 67) reported that they owned a business near a flying-fox roost. Based on these data it must be acknowledged results are more indicative of people living near a roost and may not be representative of the wider community across the LGA.

The primary concerns of the residents (n = 66) were the impacts of faecal droppings (91%), smell (86%), noise (79%), fear of disease (77%), foraging in backyards (58%), damage to vegetation (52%), and fruit loss at orchards (53%).

The community was asked to assess their experience or interaction with flying-foxes. Of the 67 responses, 76% (51) reported negative experience or interaction, 18% (12) positive, and 7% neutral.

When presented with true or false statements, 65% (44) residents (n = 68) answered that flying-foxes are protected under legislation; flying-foxes are protected. 79% (54) answered that flying-foxes were increasing in number in Burdekin Shire; limited data is available to

answer confirm or deny this trend. 59% (40) answered that flying-fox populations are not decreasing nationally; two of the four species are listed as threatened due to population decline and loss of habitat. Lastly, 88% (60) answered that flying-foxes carry disease that is easily transmitted to humans and animals; as noted in this Plan, it is extremely rare for flying-foxes to transmit Australian bat lyssavirus (ABLV) to humans or Hendra virus to horses (see Appendix 3).

When asked how strongly participants agreed or disagreed with statements about flying-foxes, the majority of the 68 respondents strongly agreed that flying-foxes are a nuisance in their community (65%). Similarly, the majority of respondents strongly agreed that flying foxes in their community should be managed (69%, n = 67), and that living near flying-foxes is horrible (76%). Respondents strongly disagreed that they enjoyed when flying-foxes visited their garden (74%), and that flying-foxes and humans should be able to share the urban environment (62%, n = 66).

The main times of the day that respondents (n = 67) were impacted by flying-foxes at their properties included pre-dawn (47%), early evening (67%), and late evening (66%). 67% (n = 63) responded that they were home 'Most of the time'.

A large portion of respondents (45%, n = 67) identified that cost-effectiveness of management actions for rate payers was very important to them. When asked how important it is to them that Council protect flying-foxes, the majority of respondents (58%, n = 67) selected 'not important'. Most respondents (63%, n = 67) felt that Council assisting to manage impacts associated with flying-foxes was very important. It was very important to 67% (n = 67) of residents that Council protects vegetation and other environmental values in parklands and bushland areas.

Many of the respondents (48%, n = 64) answered 'no' when asked if receiving funding subsidies (e.g. to contribute to double glazing, car covers) would help in reducing flying-fox impacts on their property. 23% answered 'yes' and 28% answered 'don't know'.

When asked to select considerations for subsidy programs, responses (n = 64) were relatively similar for all options, ranging from 22% to 38% for the listed choices. The most popular listed options included clothesline covers, car covers, wildlife friendly netting for backyard fruit trees and subsidised outdoor cleaning.

Management options that were most highly supported by respondents (n = 64) were the use of plants that are not suitable for flying-fox roosting to create buffers between flying-foxes and property/dwellings (52%) and tree trimming to create buffers (open space e.g. mown grass) between flying-foxes and property/dwellings (50%). These options were closely followed by vegetation removal to create buffers between flying-foxes and property/dwellings (36%) and use of deterrents (e.g. canopy-mounted sprinklers) to create buffers between flying-foxes and property/dwellings (34%).

Fact sheets with up-to-date information regarding flying-foxes or the roosts (34%), educational signage (27%), and a website with links to up-to-date information (23%) were the most appealing educational options to respondents (n = 64). The majority of respondent (61%, n = 64) answered 'none of the above' when presented with management actions that they felt were appropriate to protect flying-foxes. Listed actions included habitat restoration and tree planting to protect the roosts and to provide more native foraging habitat, support wildlife rescuers to rehabilitate sick or injured flying-foxes, monitoring flying-fox behaviour and welfare and measures aimed at reducing the impact of heat stress events on flying-foxes.

5 Management options analysis

Table 2 outlines a site-specific assessment of flying-fox management options commonly used across Australia, and their suitability for the Home Hill and Ayr roosts, as well as emerging roosts. Descriptions and examples of management options are provided in Appendix 4.

Table 2 Management option analysis

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
Education and awareness programs	**Advantages:** Low cost, 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 landholders 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. Continued education and ensuring all residents have access to the latest health information is required.	Proactive engagement with surrounding landholders and sensitive site occupants/attendees (e.g. schools, hospitals) is vital to address impacts and concerns before they arise.	No	Continue and increase at all sites, particularly for the Home Hill community.
Subsidy program - property modification / item	**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) 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. **Disadvantages:** May be cost-prohibitive for private landholders, unlikely to fully mitigate community concerns.	Property modification is not likely to be well-received by the community as a management option (see Section 4.2). However, it may be more supported if costs were able to be assisted by a Council-funded subsidy program. Costs are likely to be more expensive than roost management due to the number of residents in close proximity to roosts although management costs are hard to predict.	Suitable for emerging roosts in high conflict areas, particularly if residents are experiencing impacts related to noise and smell, or other issues that could be alleviated through an item/property-based subsidy program	No	Investigate subsidy options and communicate options with affected residents.

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
Subsidy program - services	**Advantages:** Service subsidies (e.g. assistance with cleaning faecal drop) 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. **Disadvantages:** Costly over a large scale which must be considered if proposed development intends to increase dwelling density around roost.	This management technique can be costly over a large scale, it is suitable for smaller sites with fewer impacted residents than larger townships. Other management techniques should be adopted in addition to prevent flying-foxes from roosting in close proximity to properties. Mess from droppings was identified as a main concern for many community members. Service subsidies to clean faeces off amenities would therefore be highly regarded.	Suitable for emerging roosts in high conflict areas, particularly if residents are experiencing impacts related to mess from faecal matter (e.g. on cars, solar panels, in water tanks), or other issues that could be alleviated through a service-based subsidy program.	Council to investigate potential for a Council-funded subsidy program which may include service subsidies, and opportunities to apply for grants to supplement such a program.	Investigate subsidy options and communicate options with affected residents.
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 heat stress events	Where Council considers appropriate, vegetation in high conflict areas at each site may be thinned, removed or lopped so it is less attractive for roosting in future. Vegetation at low conflict sites, such as Plantation Creek in Ayr, should be maintained and improved without deterring flying-foxes from roosting in an effort to attract flying-foxes from close high conflict sites, providing a destination for dispersal efforts.	Avoid undertaking roost management activities that are likely to discourage flying-fox roosting at low conflict sites (e.g. weed removal). Encourage roosting at low conflict sites through habitat improvement activities. For an emerging roost in a high	No permit required for weed management or habitat improvement.	Investigate suitable areas and undertake at appropriate times (ideally in the non-breeding season or adapted during the breeding season to be less disruptive).

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
			conflict area, roost vegetation should be managed to discourage roosting (e.g. vegetation thinning, weed removal).		
Alternative habitat creation	**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 Plantation Creek roost in Ayr provides an alternative roost for flying-foxes if no suitable site occurs in Home Hill. However, this site is ~10 km away; a site within 1 km of the roosts in Home Hill is highly likely to be more realistic (see Roberts et al. 2021). Council should avoid disturbance at Plantation Creek and support habitat restoration to maintain flying-foxes roosting here (e.g. liaising with Council contractors and educating the public). At Home Hill, Council should aim to identify suitable roost habitat in low conflict locations and restore and/or enhance habitat to encourage flying-fox roosting. Habitat enhancement should aim to maintain good canopy health through weed and vine removal, and maintain good canopy succession (i.e. lower, mid, and upper storey) to prevent complete forest deterioration during large flying-fox influxes and provide refuge habitat during HSEs. This is likely to be well received by the community, as the most supported management option from the community survey was protecting and enhancing flying-fox habitat in low conflict areas.	If emerging roost is in high conflict location, Council should aim to identify suitable roost habitat in low conflict locations and restore and/or enhance habitat to encourage flying-fox roosting there. At low conflict sites, habitat should be improved to encourage roosting (as row above).	No	Avoid disturbance at Plantation Creek roost. Identify alternative, low-conflict sites at Home Hill for habitat restoration/ enhancement.
Provision of artificial roosting habitat	**Advantages:** Artificial roosting habitat (e.g. suspended ropes) could be considered to supplement the canopy if weed removal or roost management affects available roosting space.	To date artificial habitat structures have not been effective. Further trials could be considered with the aim of reducing pressure on roosting vegetation where this is a concern.	Potentially suitable to enhance a low-conflict emerging roost where there is pressure	No	Low priority; if vegetation damage becomes a concern, investigate this

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
	Disadvantages: No guarantee that flying-foxes would use artificial habitat but collaborating with a researcher on varying design options would increase the likelihood of success.		on roosting vegetation.		option.
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 should respond to HSEs as per the Flying-fox Heat Event Response Guideline developed for South east Queensland (Bishop et al. 2019) or consider developing a region-specific HSE document. It is worth noting that the likelihood of a HSE is lower in Burdekin compared with SEQ. Council should engage with wildlife carers and nearby residents, particularly during potential mass mortality events such as HSEs and post-storm recovery.	Protocols for managing incidents should be established at both low and high conflict emerging roosts.	No	Manage any incidents in close communication with local wildlife carers.
Research	**Advantages:** Support research that improves understanding and more effectively mitigates impacts. For example, outdoor odour-neutralising technology could be used to mitigate odour impacts to residents. Develop understanding of native flowering event in area. GPS tracking to assess foraging movements and connectivity between local and national roosts. **Disadvantages:** Permits required, and costs associated with all options. Uncertain outcomes of an odour-neutralising trial.	Smell was identified as the second highest concern associated with flying-foxes amongst the community. An odour-neutralising trial could be conducted at affected sites – focusing on high trafficked areas. New research should be reviewed at least annually and incorporated into management where appropriate.	Odour-neutralising trial could be considered at high conflict sites where odour is regarded as the major impact. Research should be ongoing for both low and high conflict sites.	Research permit and Animal Ethics approval required for outdoor odour-neutralising trial	If community concerns warrant, investigate conducting an outdoor odour-neutralising trial. Information on foraging resources and behaviour would inform management and education programs.
Appropriate land-use planning	**Advantages:** Planning for future land use where possible, will reduce potential for future conflict between community and flying-fox roosts.	Incorporate planning controls where possible.	Incorporate planning controls where possible.	No	Investigate

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
	Disadvantages: Will not generally mitigate current impacts.				
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.	This option is considered cost-prohibitive and unlikely to be accepted by affected residents.	This option is considered cost-prohibitive and unlikely to be accepted by affected residents.	No	Investigate if appropriate.
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 to create additional conflict. Vegetation removed may exacerbate the impacts of HSEs.	Buffers should be created between flying-fox habitat and the residences bordering the Kidby Gully roost to prevent flying-foxes roosting along the boundary fence. The community survey revealed high acceptance of vegetation removal (trimming was more accepted) as a management option. Buffers should also be created around sensitive receptors adjacent to the Lloyd Mann Park and Arch Dunn Memorial Park roosts, though visual and olfactory deterrents would be more suitable here (below). Where there is a high infestation of weeds or a dense mid/understorey (particularly below a low canopy), weed and understorey management may sufficiently alter buffer habitat, making it unfavourable for roosting flying-foxes. If weeds and/or understorey are not present, trees may require trimming to create a buffer.	Suitable at high conflict sites where residents are in close proximity to flying-fox roosting habitat. Vegetation removal should be avoided/limited at low conflict sites to avoid inadvertent dispersal of flying-foxes.	Possibly under VM Act* Weed removal can occur as a general maintenance program and is permitted under the DESI Low Impact COP. If undertaking vegetation works outside of the Low Impact COP, DESI notification will be required.	Consider at Kidby Gully roost if other methods (below) are unsuccessful.
Buffers without vegetation removal – visual	**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 plastic bags, fluoro	CMS may be feasible as a buffering method for residents bordering Kidby Gully. Other methods, such as PROVolitans, could be trialled to create a buffer between residential dwellings directly adjacent to flying-fox habitat.	Suitable at high conflict sites where residents are in proximity to flying-fox	Notification to DESI and possible approval under the	Investigate CMS for Kidby Gully. Investigate PROVolitans lighting in trees

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
deterrents, taste deterrent, noise emitters, canopy mounted sprinklers (CMS)	vests (GeoLINK 2012), and balloons (Ecosure pers. comm. 2016) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 m of the deterrents. Lights tend to have limited effectiveness in deterring roosting. For example, a high-intensity strobe light was trialled in the Sydney Botanic Gardens to deter roosting; flying-foxes demonstrated only a slight reaction and lights did not deter flying-foxes from roosting (van der Ree & North 2009). However, a recent study identified a light that flying-foxes perceive as abnormal (Olkkola 2019), which PROVolitans trialled above the canopy of a roost tree, reporting an 80% decrease in the number of flying-foxes roosting in the tree. PROVolitans lights may offer a non-harmful method of flying-fox deterrence for future trials. D-ter is a smell and taste deterrent commonly used as a bird repellent but has also been trialled as a deterrent for flying-foxes (van der Ree and North 2009). The overall success of D-ter was deemed limited as it was only effective short-term and in individual trees (van der Ree and North 2009). **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.	Visual, olfactory, and audio methods could be trialled to deter flying-foxes from roosting in specific trees to preserve tree health. While D-ter has a very localised effect, it could be used to deter flying-foxes from specific, individual trees. PROVolitans lights should also be trialled to deter flying-foxes from high conflict areas. CMS may be logistically difficult to install and have limited effectiveness.	roosting habitat. Buffering method (e.g. CMS) should be determined on a site-specific basis.	VM Act* (if removing vegetation to install sprinklers).	at Home Hill roosts.
Noise	**Advantages:** Standard noise attenuation	Noise was identified as a high concern to	Potentially	No	Consider and

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
attenuation fencing	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.	residents that responded to the community survey. To avoid the high costs associated with permanent acoustic fencing, and where flying-fox presence is transient, temporary fencing could be erected in property backyards. Residents/businesses could have the ability to fold down the acoustic fence when there are no flying-foxes present and erect it when flying-foxes return to the site.	suitable at high conflict sites where noise is identified as the main concern for residents. Not suitable for low conflict sites due to cost.		liaise with residents at affected sites.
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 narrow width of Kidby Gully and the lack of alternate roosting habitat at other Home Hill roosts, it is unlikely that nudging will be effective and will shift flying-foxes closer to other residents or cause the roost to splinter into private residential yards (as has done before during large influxes). If other management techniques (e.g. buffers through vegetation removal, PROVolitans, D-Ter, lighting, etc.) to shift flying-foxes away from high conflict areas are unsuccessful, and negative impacts increase, nudging only in very high conflict areas may be considered in future.	Early intervention nudging may be suitable for new roosts in high conflict areas to prevent the roost from establishing in high conflict locations (e.g. directly adjacent to residents or sensitive sites).	Nudging may be done at certain times under the Management COP and Council's as-of-right but should be during the day to avoid inadvertent dispersal/splintering of the roost which would require a FFRMP. If attached young are present, nudging activities should be as passive as possible. Nudging is not appropriate	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
				if creching young are present.	
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.	Vegetation removal is unlikely to be a viable option at Lloyd Mann Park and Arch Dunn Memorial Park as to retain the parks' aesthetics. However, it is likely to be supported by the community, as vegetation removal was a highly selected management option in the community survey. Removal of vegetation from Council-managed land is likely to push flying-foxes onto private land (as previously during influxes), and private residents may not be receptive to removing trees from yards.	Early intervention dispersal through tree removal may be suitable for new roosts in high conflict areas to prevent the roost from establishing in high conflict locations (e.g. directly adjacent to residents or sensitive sites). Suitability for vegetation removal will need to be determine on a site-specific bases.	Removal of vegetation would require approval.	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.
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 and Eby 2013), and often splinter into several locations which may result in more widespread impacts. Appendix 7	Active dispersal is very costly with highly unpredictable outcomes and can often worsen human-wildlife conflict. As such, it is not currently recommended for the Home Hill and Ayr roosts. Previous dispersal and nudging attempts at Home Hill have had temporary success, none have provided a long-term solution for the conflict at the sites and often result in splintering the colony throughout higher conflict areas. If conflict increases and/or alternative management strategies are deemed ineffective following effective implementation, dispersal may be considered at high conflict sites. However, with the above management strategies implemented,	Early intervention dispersal may be suitable for new roosts in high conflict areas to prevent the roost from establishing at the site. Once a roost has established, the suitability of dispersal significantly	Dispersal in accordance with the Management COP is permitted under Council's as-of-right authority with notification to DESI.	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts

Management options	Advantages & disadvantages	Suitability for Home Hill and Ayr roosts	Suitability for emerging roost	Permits required	Appraisal
	provides a summary of research conducted on flying-fox dispersals in Australia.	the potential need for dispersal is considered very low.	decreases.		

6 Management approach

Management actions are outlined for the Home Hill and Ayr roosts (Table 4) based on site-specific analysis of available flying-fox impact management options (Section 5). It is recommended that management actions undergo a case-by-case assessment, this includes determining if funding is available. An overview of the approach in the short-term is to reduce current impacts on residents through:

- creating buffers between residential dwellings/businesses and flying-fox habitat through vegetation modification
- potential buffers through installation of canopy mounted sprinklers as well as trialling PROVolitans lighting
- implementing a subsidy program for property modification, services subsidies and/or rebates.

An overview of the long-term approach for roosts in the LGA is to:

- regularly maintain the site to improve its amenity
- increase community engagement and education, particularly during larger influxes
- undertake regular monitoring of roost dynamics to better inform management actions
- identify and improve low conflict roost options in the townships to encourage roosting elsewhere
- avoid habitat disturbance at Plantation Creek roost to encourage flying-foxes to remain there.

Education and community engagement will form an important part of the ongoing management of flying-foxes to alleviate misconceptions and unnecessary fears. Fear of disease was identified as one of the main issues concerning residents. 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 very little risk associated with living or playing near a flying-fox roost (Qld Health 2021) – 'no touch, no risk' (Bat Conservation and Rescue Queensland 2019). Council should aim to provide regular and easily accessible information, through educational signs, informational sheets, updates on Council's website/social media and school engagement programs. Community engagement will be particularly important during larger influxes of flying-foxes at Home Hill.

Active management, including nudging and/or dispersal activities, should only be considered for very high conflict sites where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts. Where necessary, nudging attempts should be as passive as possible (e.g. lighting as opposed to noise), particularly when attached young may be present, to avoid welfare impacts. No form of nudging is appropriate in areas where crèching young are present as it will likely result in harm and breach legislation. Further, it will not be effective when flightless young are present.

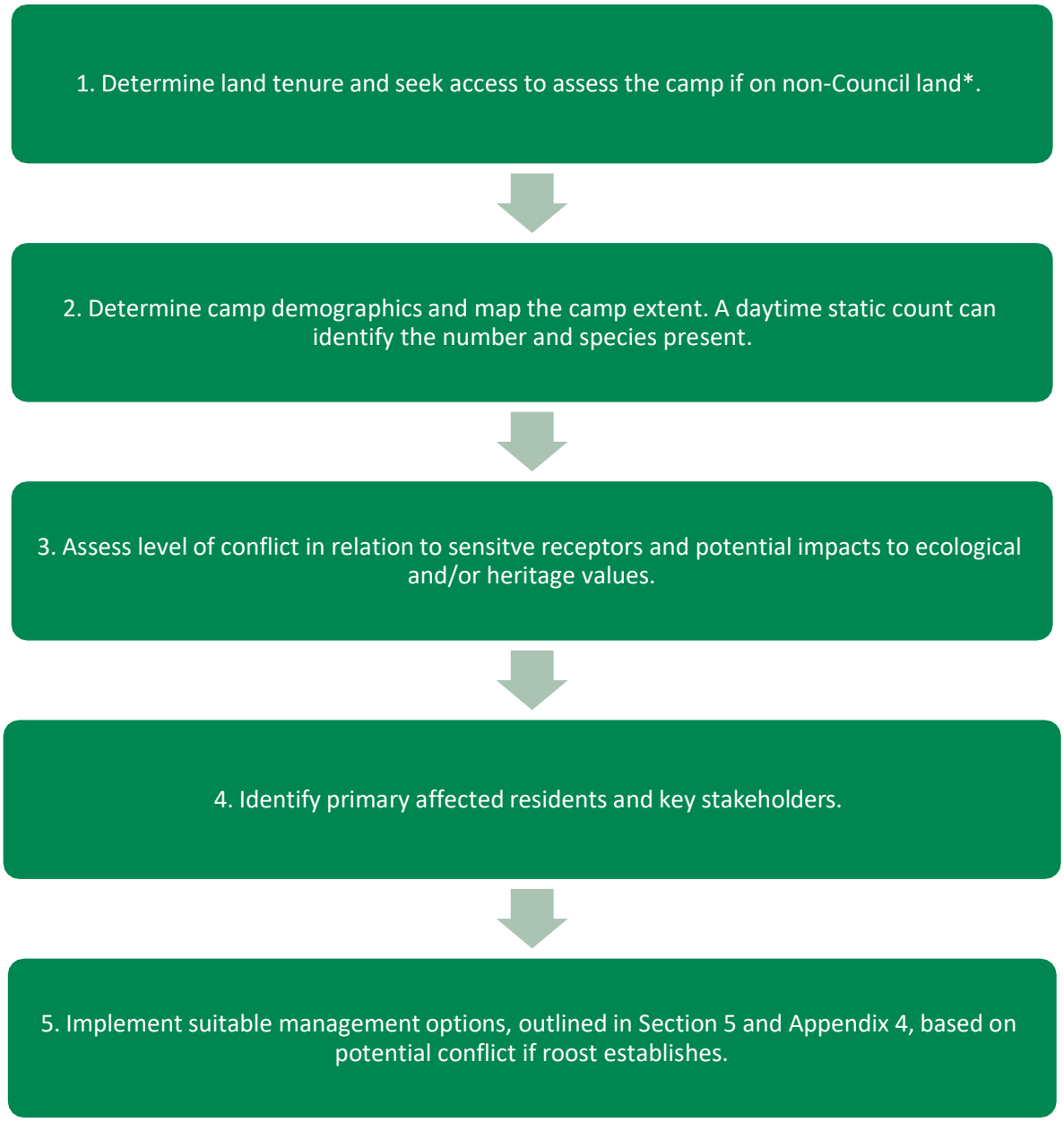
Table 3 Management actions to be implemented at Home Hill and Ayr roosts, subject to available funding. Note costs are indicative only for external assistance (i.e. estimates not provided for Council time).

Management type	Management action	Indicative costs (ex GST)	Timeframe
Education	Increase education within the community to ensure access to up-to-date health information is available, and residents are aware of impact mitigation options available at a property level (e.g. methods to prevent water tank contamination, odour-neutralising gel pots, noise attenuation fencing, vegetation management on private land) and legislative responsibilities. Educational tools should include flyers, regularly updating Council's website, and installing interpretive signage roost sites. Direct, one-on-one engagement may be required for primary-affect residents.	Council time.	ASAP
	Facilitate community information sessions, targeting primary-affected residents. Information sessions should be offered prior to the predicted influx of LRFF in summer months and continue during large influxes.		ASAP
Active removal of flying-fox carcasses	Council should undertake sweeps of the grounds to identify and remove deceased or sick, injured, or orphaned flying-foxes in a safe manner, thus reducing health risks to residents. Sweeps should be done every morning while flying-foxes are roosting adjacent to high conflict or high traffic areas and during large influxes of flying-foxes. Otherwise, sweeps may be undertaken once weekly during other times.	Council time.	ASAP and ongoing during large influxes
Buffer	Trial PROVolitans lighting at Lloyd Mann Park and Arch Dunn Memorial Park, and vegetation bordering Kidby Gully to deter flying-foxes from these high-conflict areas and create a buffer where possible. If unsuccessful, CMS and/or vegetation removal may need to be considered.	≈ $80,000	ASAP
	Create a buffer (where possible) between residential properties and flying-fox habitat through weed removal and vegetation trimming and/or removal. Buffers should be created between vegetation lining the Kidby Gully and residential properties adjacent. During influxes, flying-foxes roost on or adjacent to private properties along Kidby Gully. As such, residents should be directed to the Low Impact COP for information on how they can maintain vegetation on their properties. Vegetation adjacent to Lloyd Mann Park and Arch Dunn Memorial Park should also be trimmed to create a buffer between the caravan park and kindergarten, and flying-fox habitat, with the anticipation that flying-foxes may once again occupy this area.	≈ $30,000 (including labour, environmental assessments, offset).	ASAP - prior to next anticipated flying-fox influx
Subsidy program	Investigate a subsidy program for residents to modify properties and assist with the cost of services. Subsidies could be provided for items (e.g. 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) or services (e.g. clothes washing, cleaning outside areas and property, solar panel cleaning, car washing, removing exotic trees, or contributing to water/electricity bills). Alternatively, a nominal amount of money could be offered to residents based on their proximity to the flying-fox roost, on the basis they can prove the relevance of expenditure to mitigating flying-fox	Variable as budget allows.	ASAP

Management type	Management action	Indicative costs (ex GST)	Timeframe
	impacts. Further information regarding subsidy programs (e.g. subsidy options, means of delivery, and potential outcomes) is provided in Appendix 4. Council should aim to engage one-on-one with affected residents to establish how their concerns could be addressed through a subsidy program.		
Habitat improvement	Avoid disturbance to Plantation Creek roost habitat to encourage flying-foxes to roost at this low conflict site.	Council time (e.g. liaising with Council contractors and educating the public)	ASAP and ongoing
	Identify suitable roost habitat in low conflict locations and restore and/or enhance habitat to encourage flying-fox roosting. Habitat enhancement should aim to maintain good canopy health through weed and vine removal, and maintain good canopy succession (i.e. lower, mid and upper storey) to prevent complete forest deterioration during large flying-fox influxes and provide refuge habitat during HSEs.	Costs will depend on extent of restoration efforts.	Identify sites by the end of 2024 and seek funding during 2025
Active management (nudging and/or dispersal)	Active management will only be considered for very high conflict sites where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.	Costs will depend on the size of the roost, location, resources, and personnel required to undertake initial works, and ongoing costs to maintain nudging/dispersal outcomes.	Only when required
Regular monitoring	Undertake regular monitoring of the Home Hill roosts (static count), and monthly monitoring (fly-out count) of the Ayr roost to detect any changes in population numbers or distribution in the area. Monitoring at the roosts should increase to weekly in the four weeks leading up to and following any active roost management. Moreover, monitoring should increase to daily in the three days prior to, during, and following active management.	Half-day for suitably qualified contractor to monitor the key roosts (one person required for static counts at Home Hill and fly-out counts at Ayr.)	ASAP and ongoing

6.1 Management framework for emerging roosts

Emerging roosts will be assessed and managed in accordance management options detailed in Section 5. The following flow chart outlines a general procedure to assess and manage emerging flying-fox camps in Burdekin LGA.



*Early management intervention at an emerging roost may be possible without state approval, before it meets the criteria for a flying-fox roost (see DES 2021). In this case, it is important to note that the NC Act still applies, meaning any actions to kill, injure or harm flying-foxes are prohibited, and native vegetation is protected. Planning required to properly coordinate management actions to avoid community and flying-fox impacts should always be prioritised over the speed of management actions implemented.

6.2 Reducing additional risk to flying-foxes

Council can further reduce the risk of negative impacts to flying-foxes by considering the following:

- reducing or eliminating the amount of barbed wire on Council projects, by
  - shifting to non-barbed alternatives for new projects
  - using non-barbed alternatives when conducting maintenance that required wire replacement
  - replacing out barbed wire in areas with recorded flying-fox mortalities
- considering the installation of underground power cabling instead of new overhead power lines where possible
- maintaining records of wildlife injury and deaths to monitor potential hotspot areas that may require further intervention
- implementing heat stress event emergency response actions.

Scheduled works at or near roosts sites should adhere to the below:

Table 4 Planned actions for potential impacts during any works under or near a flying-fox roost.

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

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

7 Plan administration

7.1 Evaluation and review

A review of the Plan, including community consultation and expert input, should be scheduled annually. The Plan shall remain in place until a revised version is adopted by the Council; a 5-year review is recommended.

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.

7.2 Reporting

Council will complete the DESI 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.

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Appendix 1 Legislation

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth's EPBC Act provides protection for the environment, specifically MNES. A referral to the 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.

Nationally important GHFF and SFF roosts are afforded additional protection in line with the Referral Guideline for Management Actions in Grey-headed and Spectacled Flying-fox Camps (DoE 2015). To be considered a nationally important GHFF roost, a roost must have had more than one influx of ≥10,000 GHFF within the last 10 years or have been occupied by more than 2,500 GHFF permanently or seasonally for the last 10 years. Nationally significant SFF roosts must have had more than one influx of ≥16,000 SFF within the last 10 years or have been occupied by SFF in at least 50% of surveys over the last 10 years. Worth noting is that since the Referral Guideline was written, SFF EPBC status changed from vulnerable to endangered. Therefore, any roost containing SFF should be assessed as nationally important.

State

Nature Conservation Act 1992

As native species, all flying-foxes and their roosting habitat are protected in Qld 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 Qld 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 2021b) has recently been released and is currently in consultation. It is our understanding that this Plan aligns with this roost policy, however amendments can be made to this Plan in consultation with DESI 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'.

<u>Council 'as-of-right' management</u>

Under the NC Act, local governments have an 'as-of-right' authority under the NC Act to manage flying-fox roosts in mapped 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 DESI of the planned management. Notification is by means of a completed 'flying-fox management notification form' from the DESI website submitted at least two business days prior to commencing any management actions, unless an authorised person from DESI 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 Management COP. It must be noted that this 'as-of-right' authority does not oblige a 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 VM Act).

Anyone other than local government is required to apply to DESI 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 Code) (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 DESI for a FFRMP. Under the *Nature Conservation (Animals) Regulation 2020 (the Animals Regulation)*, 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 DESI-approved flying-fox management plan (e.g. this Plan).

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 other than:

- certain low impact activities (e.g. mowing, minor tree trimming) if undertaken in accordance with the Code of Practice – Low impact activities affecting flying-fox roosts (Low Impact COP) (DES 2020c)
- instances where Council is enacting their as-of-right authority.

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 Code (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 SoMI to articulate the approach for management of flying-fox roosts in the

Burdekin region. Local councils may also opt to develop a flying-fox roost management plan for the whole of their LGA. If this is approved by DESI, 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* (DES 2020b) 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 flying-fox roost management plans.

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 plants and their supporting habitat.
- if a flora survey identifies that endangered, vulnerable, and near threatened 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 endangered, vulnerable, and near threatened 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 Qld law through provisions of the *Fisheries Act 1994*. Approval must be gained from Fisheries Qld 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 Qld 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 June 2024.

Animal Care and Protection Act 2001

The ACP Act provides for animal welfare. The ACP Act is administered by Biosecurity Qld 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

The Civil Aviation 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.

Appendix 2 Species profile

Black flying-fox (*Pteropus alecto*)

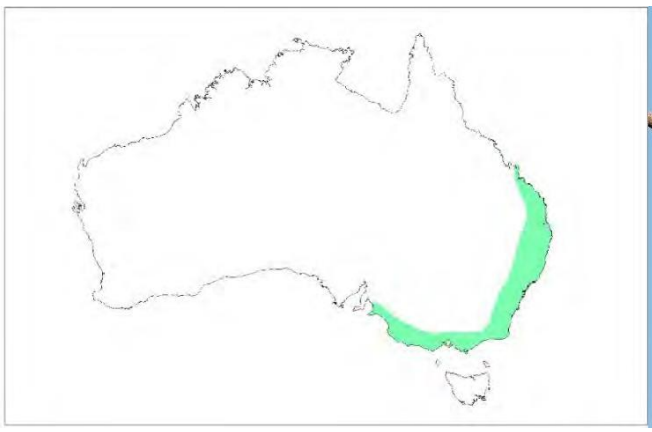
Black flying-fox indicative species distribution (Department of Planning and Environment [DPE] 2023)

The BFF has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Qld and into NSW (Churchill 2008). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann 1995). This shift has consequently led to an increase in indirect competition with the threatened GHFF, which appears to be favouring the BFF (DAWE 2021).

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 and 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.

Grey-headed flying-fox (*P. poliocephalus*)



Grey-headed flying-fox indicative species distribution (DPE 2023)

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

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

The GHFF population has a generally annual southerly movement in spring and summer, with their return to the coastal forests of north-east NSW and South East Qld in winter (Ratcliffe 1932, Eby 1991, Parry-Jones & Augee 1992, Roberts et al. 2012). This results in large fluctuations in the number of GHFF in New South Wales, ranging from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby 2000). They are widespread throughout their range during summer, but in spring and winter are uncommon in the south. In autumn they occupy primarily coastal lowland roosts and are uncommon inland and on the south coast of New South Wales (OEH 2020).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000, Richards 2000). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, culling in orchards, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, and power line electrocution) and competition and hybridisation with the BFF (DCCEEW 2021). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation.

Little red flying-fox (*P. scapulatus*)

Little red flying-fox indicative species distribution (DPE 2023)

The LRFF is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

The LRFF forages almost exclusively on nectar and pollen, although will eat fruit at times and occasionally raids orchards (Australian Museum 2020). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability of food resources (predominantly the flowering of eucalypt species) (Churchill 2008), which means the duration of their stay in any one place is generally very short.

Habitat preferences of this species are quite diverse and range from semi-arid areas to tropical and temperate areas, and can include sclerophyll woodland, melaleuca swamplands, bamboo, mangroves and occasionally orchards (Australian Museum 2020). LRFF are frequently associated with other *Pteropus* species. In some colonies, LRFF individuals can number many hundreds of thousands and they are unique among *Pteropus* species in their habit of clustering in dense bunches on a single branch. As a result, the weight of roosting individuals can break large branches and cause significant structural damage to 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 Qld) during key breeding periods (Vardon & Tidemann 1999). LRFF travel south to visit the coastal areas of South East Qld 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 Human and animal health

All animals can carry pathogens that may pose human health risks. In Australian bats, the most well-defined of these include ABLV and Hendra virus HeV. Specific information on these viruses is provided below.

Excluding those people whose occupations require contact with bats, such as wildlife carers and vets, human exposure to ABLV and HeV, their transmission, and frequency of infection is extremely rare. These diseases are also easily prevented through vaccination, PPE, 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 2022).

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

Australian bat lyssavirus

ABLV is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been identified in yellow-bellied sheathtail baits (*Saccolaimus flaviventris*), an insectivorous microbat, and seroconversion (development of virus-specific antibodies) has been found in seven microbat genera (WHA 2019). It is assumed that all bats may be capable of hosting ABLV (WHA 2019). The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (WHA 2019) and transmission requiring direct contact with an infected animal that is secreting the virus. In Australia, three people have died from ABLV infection since the virus was identified in 1996 (WHA 2019).

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 (WHA 2019, Merritt et al. 2018). ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (Department of Agriculture and Fisheries; DAF 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 (DAF 2020).

The incubation period in humans is assumed to be similar to rabies, generally around three to eight weeks (Merritt et al. 2018). However, in few cases, the incubation period has ranged from a few days to several years (Merritt et al. 2018). 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.

Domestic animals are also at risk if exposed to ABLV. In 2013, ABLV infections were identified in two horses (Shinwari et al. 2014). A dog that caught and consumed a flying-fox also tested positive for ABLV antibodies in 2013 (Wright 2013). According to the Qld Government's ABLV

factsheet for veterinarians, clinical symptoms are most likely to appear in animals within 1 – 6 months following exposure (DAF 2020). Given the incubation period variability, animals that are bitten or scratch by a flying-fox should monitor for clinical symptoms for months to years following potential exposure (DAF 2020). Consultation with a veterinarian should be sought if exposure is suspected.

If a person or pet 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.

Please refer to WHA's Australian bat lyssavirus fact sheet for further information.

Hendra virus

Flying-foxes are the natural host for HeV, which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses, humans and on two occasions, dogs (WHA 2021). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (WHA 2021). Clinical studies have shown cats, pigs, ferrets and guinea pigs (as well as hamsters and African green monkeys – not applicable to Australia) can carry the infection, though there is no evidence of direct HeV transmission from flying-foxes to any species other than horses (WHA 2021). As of 2021, over 106 HeV infections in horses (confirmed or possible cases) have been reported (WHA 2021). These infections occurred across over 60 disease outbreak events, three of which also involved human infections. 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.

The transmission of HeV from flying-foxes to horses is thought to be complex and involve several host and environmental factors (WHA 2021). The most likely route of transmission is through exposure of horse mucous membranes to infected flying-fox urine, body fluids, or excretion (WHA 2021). This may occur directly (direct contact of infected fluids with mucous membranes) or indirectly (e.g. ingestion of contaminated forage or water). The incubation period of HeV in horses is estimated to be 5 – 16 days (WHA 2021). The mortality rate of HeV in horses is approximately 80% (Qld Government 2023).

While considered very rare, humans may contract the disease after close contact with respiratory secretions (e.g. mucous) and/or blood of an infected horse (WHA 2021, Qld Government 2023). Similarly, the dogs may become infected following close contact with infectious bodily fluids of infected horses (Qld Government 2023). 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 of HeV in humans is approximately 70% (Qld Government 2023).

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 Government 2023), 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.

Please refer to WHA's Hendra virus and Australian wildlife fact sheet for further information.

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. 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 4 Management options

Below is an overview of management options commonly used across Qld 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.

Possible components of an awareness-raising program

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, pools/spas, and clothes lines (e.g. with carports or tarp covers) where faecal contamination is an issue, or remove washing from the line before dawn/dusk (e.g. use clothes dryers)
- 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, door seals, insulation, and sound-proof curtains, and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby roost.
- Use white noise machines and fragrance dispensers or deodorisers within the home to reduce noise and odour impacts.
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Install rainwater first-flush diverters on rainwater tanks to remove potentially harmful bacteria and microbes from flying-fox faecal drop
- 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.

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, however initial results indicated both the indoor and outdoor systems were beneficial. 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 councils 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; Mo et al. 2020). As such, it is important (as with any community-based program) to assess the needs of residents and have open, ongoing communication throughout the program to ensure the subsidies are effectively reducing impacts, and if not, how the program can be adapted to address these needs.

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

Property modification/item subsidies

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. Property modifications/items listed under 'Property modifications' above may be included in a subsidy program. 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 & 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 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. Lights tend to have limited effectiveness in deterring roosting. For example, a high-intensity strobe light was trialled in the Sydney Botanic Gardens to deter roosting; flying-foxes demonstrated only a slight reaction and lights did not deter flying-foxes from roosting (van der Ree & North 2009). However, a recent study identified a light that flying-foxes perceive as abnormal (Olkkola 2019), which PROVolitans trialled above the canopy of a roost tree, reporting an 80% decrease in the number of flying-foxes roosting in the tree. PROVolitans lights may offer a non- harmful method of flying-fox deterrence for future trials. Ultimately, 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 use in Qld 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

CMS can be used to deter flying-foxes from a buffer 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).

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.

CMS 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). CMS can reach a radius of 15 m but due to vegetation cover this reach may be less.

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.

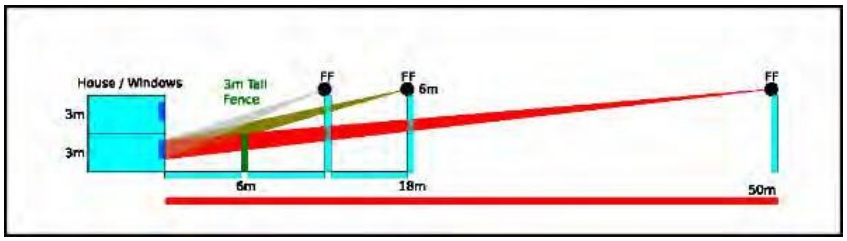
Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in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

There is a plethora of research that demonstrates flying-foxes dispersals are not effective long-term, and often have unpredictable outcomes. 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 roosts established within 1

kilometre and resulted in new conflict sites (Roberts et al. 2021). In addition, a review of 25 dispersal attempts in Qld between November 2013 and November 2014 found that when flying-foxes were dispersed, they did not move further than 6 km away from 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 are also 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. See Appendix 6 for further information regarding dispersal attempts across Australia.

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, Qld 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 illegal under local, State, and Federal legislation and is not permitted as a method to manage flying-fox roosts.

Appendix 5 Dispersal summary results

Multiple studies have clearly demonstrated the long-term ineffectiveness of flying-fox roosts dispersals. 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).

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 Qld between November 2013 and November 2014 (the first year since the current Qld 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 Qld (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.
- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.

[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.

- 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:

- In 95% of cases, dispersal did not reduce the number of flying-foxes from the local area.
- 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.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	23/05/2024	Burdekin Shire Council Flying-fox Roost Management Plan Draft	Mitch Horan, Senior Fauna Ecologist	Dr John Martin, Senior Ecologist	Heather Richards, Senior Environmental Scientist
01	23/08/2024	Burdekin Shire Council Flying-fox Roost Management Plan	Dr John Martin, Senior Ecologist	Jess Bracks, Principal Wildlife Biologist	

Distribution List

Copy #	Date	Type	Issued to	Name
1	23/08/2024	Electronic	Burdekin Shire Council	Preeti Prayaga
2	23/08/2024	Electronic	Ecosure	Administration

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PR8378-RE.Burdekin Shire Council Flying-fox Roost Management Plan

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