FLYING-FOX MANAGEMENT PLAN

JANUARY 2025

CHARTERS TOWERS
REGIONAL COUNCIL

Acknowledgement of Country

We at Charters Towers Regional Council acknowledge the first nations people of the land on which Charters Towers and its greater region are located, and where we conduct our business. We pay respect to their Elders past and present.

We are committed to a positive future for all.

This Plan has been prepared with the assistance of Ecosure Environmental Consultancy.

Document approved by Council: 22 January 2025

Council would like to thank those members of the community, industry, government, peak bodies, and Council staff who kindly gave their time to provide input into the development of this Plan through the consultation process.

This Flying-fox Management Plan was developed with funding support from the Queensland Government Flying-Fox Roost Management Local Government Grant Program.

We also acknowledge the Queensland Herbarium/Department of the Environment, Tourism, Science and Innovation/CSIRO for sharing information and spatial data on flying-fox foraging resources in the area.

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1. INTRODUCTION

This Flying-fox Management Plan (the Plan) provides Charters Towers Regional Council (Council) with a framework to manage issues associated with flying-fox roosts within the local government area (LGA). Two species of flying-fox have been recorded within the LGA: the black flying-fox (P. alecto; BFF) which is generally present year-round, and the little red flying-fox (P. scapulatus; LRFF) which is a seasonal visitor (Appendix 1). Ongoing roost occupation and seasonal influxes of flying-foxes at Lissner Park have resulted in conflict with the surrounding community. The Plan includes a range of short and long term actions to appropriately manage roosts, support private landholders and business owners, minimise conflict between humans and flying-foxes, improve awareness, and conserve flying-foxes and the critical ecosystem services they provide.

The Plan has been developed in accordance with relevant legislation and considers feedback received during stakeholder consultation. Council acknowledges the impact flying-foxes can have on the community and is committed to making transparent and collaborative management decisions, providing a safe environment for the community, complying with legislation, maintaining the value of heritage-listed assets, and conserving flying-foxes.

Council intends to manage flying-fox roosts on Council owned or managed land. Management of flying-foxes on private land will generally be the responsibility of the landholder, however Council may assist in providing management advice and facilitate liaison with the Department of the Environment, Tourism, Science and Innovation (DETSI). Where a roost spans Council owned and private land, Council will work cooperatively with landowners to develop joint mitigation actions. Council will consider undertaking management on private land when flying-foxes occur as a direct result of Council management, or it is required as part of a community wide strategic action (and agreed to by the property owner).

Flying-foxes are keystone species for their critical role in long-distance pollination and seed dispersal, which is particularly important over fragmented landscapes. All species and their habitats are protected in Queensland (Qld) under the *Nature Conservation Act 1992 (NC Act)*, administered by the DETSI.

1.1 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 flying-fox roosts nationally, 55% of roosts occurred in urban areas and a further 23% occurred in agricultural areas (Timmiss et al. 2021). Only 7% occurred in protected areas such as national parks (Timmiss et al. 2021). Furthermore, the number of roosts increased with increasing human population densities (up to ~4,000 people per km2) (Timmiss 2017). There are many possible drivers for this urbanising trend (Tait et al. 2014):

- loss of native habitat from urban expansion and agriculture
- food availability from native and exotic species found in urban areas
- disturbance events such as drought, fires, and 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 maneuvering in flight due to the open nature of habitat or ease of navigation due to landmarks and lighting.

Living near a flying-fox roost presents unique challenges for the community. State approval is required under legislation to manage a roost (see Section 1.4). If a roost is recognised as established by DETSI, certain management actions may be undertaken in accordance with the Code of Practice (COP) – Ecologically sustainable management of flying-fox roosts (Management COP).

Effective management strategies take a tiered approach starting with lower-level actions, including community education and site maintenance. Escalation to higher-level actions such as roost dispersal may be investigated, however it is important to consider the risks with all potential management actions. Higher-level actions including attempts to disperse flying-foxes are extremely costly, and often unsuccessful in the short and long term (Roberts et al. 2021) as flying-foxes are likely to attempt to recolonise their preferred roost site. A significant risk of higher-level management actions is that a roost may splinter, forming multiple undesirable roosts, negatively impacting more residents.

1.2 Community concerns

Living near a flying-fox roost can be challenging for communities, with impacts such as noise, odour, faecal drop, and concern about potential health risks (see also Appendix 2). These direct impacts can contribute to anxiety, interrupted sleep, and general reduced wellbeing. Potential secondary impacts are difficult to quantify and will vary with peoples' situations and tolerances (Lentini et al. 2020). Primary impacts identified by Charters Towers residents in response to a survey undertaken to inform the development of the Plan include:

- loss of amenity
- noise and/or smell
- property damage
- health concerns
- impacts to sleep
- damage to property from faecal droppings
- disruption caused by management actions.

Further detail is provided in Section 4.1.

1.3 Plan objectives

Objectives of this Plan are to:

- clearly define roles and responsibilities for management actions
- minimise community impacts and avoid future conflict
- support ways for the community to co-exist with flying-foxes
- ensure actions are in accordance with relevant legislation
- improve community understanding and appreciation of flying-foxes, including their ecological role
- conserve flying-foxes and their habitat.

1.4 Legislation overview

Flying-foxes are protected native wildlife that provide a critical ecological role in long distance seed dispersal and pollination. As such, various legislation and policy governs how flying-foxes and their habitat can be managed in Queensland (Table 1). As native animals, all flying-foxes and their roost habitat are protected under State legislation. Details of relevant legislation are provided below (see further details in Appendix 3).

Table 1: Legislation relevant to flying-fox management and conservation

Level	Instrument	Relevance to the Plan
State	*Nature Conservation Act 1992 (NC Act)*	All flying-foxes and their roost habitat are protected under the *NC Act*. Under this legislation, administered by DETSI, it is an offence to harm the animals or disturb flying-foxes from daytime roosts[1] without approval. In Queensland, local governments are authorised under the *NC Act* to manage roosts in areas subject to an urban zoning under a council planning scheme, inclusive of a 1 km buffer around such areas. This area of management is known as the Urban Flying-Fox Management Area (UFFMA).
	The Code of Practice – Ecologically sustainable management of flying-fox roosts (Management COP) The Flying-fox Roost Management Guideline (the Guideline) Low impact activities affecting flying-fox roosts (Low Impact COP)	Local governments have an 'as-of-right' authority under the *NC Act* to manage flying-fox roosts in mapped UFFMAs in accordance with the Management COP (DES 2020a). The Flying-fox Roost Management Guideline (the Guideline) (DES 2020b) has been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Council is required to apply for a flying-fox roost management permit (FFRMP) to manage roosts outside an UFFMA, or for management actions not specified in the Management COP. It must be noted that this 'as-of-right' authority does not oblige Council to manage flying-fox roosts and does not authorise management under other relevant sections of the *NC Act* or other legislation. 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.
	Animal Care and Protection Act 2001 (ACP Act)	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.
	Vegetation Management Act 1999 (VM Act) and *Planning Act 2016 (Planning Act)*	Native vegetation is protected under various legislation, including the *NC Act*, *VM Act*, and *Planning Act*. Permits/approval may be required for trimming or clearing protected habitat/plants.
Local	Statement of Management Intent (SoMI)	Council endorsed a SoMI in 2019 for flying-fox roost management in Charters Towers LGA for the purpose of articulating Council's approach to management of flying-foxes within the Charters Towers LGA, specifically within UFFMA. The Charters Towers SoMI is currently being revised in conjunction with this Plan.

[1] There are legislative differences between a 'roost', where breeding has been confirmed, and a daytime camp where breeding has not occurred, as outlined in Appendix 3.

2. FLYING-FOX ECOLOGY

2.1 Flying-foxes in Charters Towers

Within the Charters Towers LGA there are three active flying-fox roosts and seven historical roosts that have not been used recently (Figure 1) (NFFMP 2022). Additional active roosts may exist that have not been identified. The National Flying-Fox Monitoring Program recorded flying-foxes at five of these 10 roosts since it began in 2012. Of the active roosts, the Lissner Park and Charters Towers Weir roosts are priority sites.

Flying-fox activity within the Charters Towers LGA is dependent upon flowering of native woodland trees, at the local scale and across Queensland. The local and statewide flying-fox population along with seasonal resource availability is important to consider for management decisions. Flying-fox roosts may be occupied continuously, annually, irregularly, or rarely and the number of individuals can fluctuate significantly on a daily, seasonal, or annual basis (up to 17% daily colony turnover; Welbergen et al. 2020). Being highly mobile and nomadic, flying-fox roosts should be thought of as a network of temporary accommodation across their range. The use of a roost is primarily thought to be associated with the local availability of foraging resources (pollen, nectar, fruit) (Yabsley et al. 2021). A study of satellite tracked individuals over a 60-month period found that BFF (n = 80) and LRFF (n = 12) roosted at 173 and 89 roosts, respectively (Welbergen et al. 2020). This data highlights the mobility of flying-foxes and their transient use of roosts.

Flying-fox occupancy in certain areas can be influenced by a multitude of factors but is generally driven by resource availability in the local area. Between 2019 and 2020, flying-foxes experienced significant challenges across the east coast of Australia due to a range of extreme weather events. A prolonged drought period caused a mass food shortage from Coffs Harbour (New South Wales; NSW) to Gladstone (Qld), 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 roosting (Mo et al. 2024) and foraging habitat for flying-fox populations. With these types of events severely impacting natural areas, foraging and roosting resources in and around urban locations become even more important for flying-foxes.

Local and regional food resource availability influence the number of flying-foxes at a roost. A study compiled a range of data sources to rank LRFF diet trees in bioregions across Queensland (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 Charters Towers LGA indicates extensive areas of valuable foraging habitat (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 both 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 Queensland. Further detail about vegetation communities, their value as flying-fox foraging habitat, and indicative flowering times can be found in spatial data and the literature available from these studies (Eyre et al. 2020).

2.2 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 2020a). This contributes directly to reproduction, regeneration, and viability of forest ecosystems (DCCEEW 2021). 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 are highly mobile and nomadic, each species considered to have a single national population. They move across their national range between a network of roosts (Welbergen et al. 2020). Roost occupancy may be permanent, seasonal, temporary, or sporadic and numbers can fluctuate significantly on a daily/seasonal basis (Vanderduys et al. 2024). Flying-foxes may travel 300 km in a single night (Welbergen et al. 2020) and have been recorded travelling over 500 km in two days between roosts (Roberts et al. 2012). Each night, flying-foxes readily forage up to 20 km from their roost (Meade et al. 2021), however they may travel greater distances and return to the same roost. In comparison, bees, another important pollinator, move much shorter foraging distances of generally less than 1 km (Zurbuchen et al. 2010).

Long-distance seed dispersal and pollination make flying-foxes critical to the long term persistence of many plant communities (Westcott et al. 2008, McConkey et al. 2012), including eucalypt forests, rainforests, woodlands, and wetlands (Roberts 2006). Seeds that are dispersed away from their parent plant that

germinate 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, SEQ Catchments 2012). 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 animals and plants, stabilise river catchments, and add value to the production of hardwood timber, honey, and fruit (NSW Wildlife Council 2010). Native forests also provide recreational and tourism opportunities worth millions of dollars each year (DES 2020b).

2.3 Roost preferences

Little is known about flying-fox roost preferences; however, research indicates that in addition to the proximity to food sources, flying-foxes choose to form roosts 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 1 ha 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 research into LRFF habitat preferences revealed that roosts were most often associated with the following attributes (MacDonald et al. 2021, Westcott et al. 2020):

- 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).

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 year of life, with most individuals breeding from their third year. 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. The breeding cycle must be considered when assessing roosts to implement management actions. Expert assessment is required to accurately determine the phase in the breeding cycle to inform the timing and suitability of management.

Black flying-foxes

Mating begins in January with peak conception occurring around March to April/May (Table 2); this mating season represents the period of peak roost occupancy (Markus & Blackshaw 2002). Young (usually a single pup) are born six months later from September to November (Churchill 2008). The birthing season becomes progressively earlier, albeit by a few weeks, in more northerly populations (McGuckin & Blackshaw 1991), however out of season breeding is not unusual and births may occur at any time of the year (Ecosure pers. obs. 2015-2024).

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). After four weeks they are left at the roost during the night in a crèche until they begin foraging locally in January to March, when they

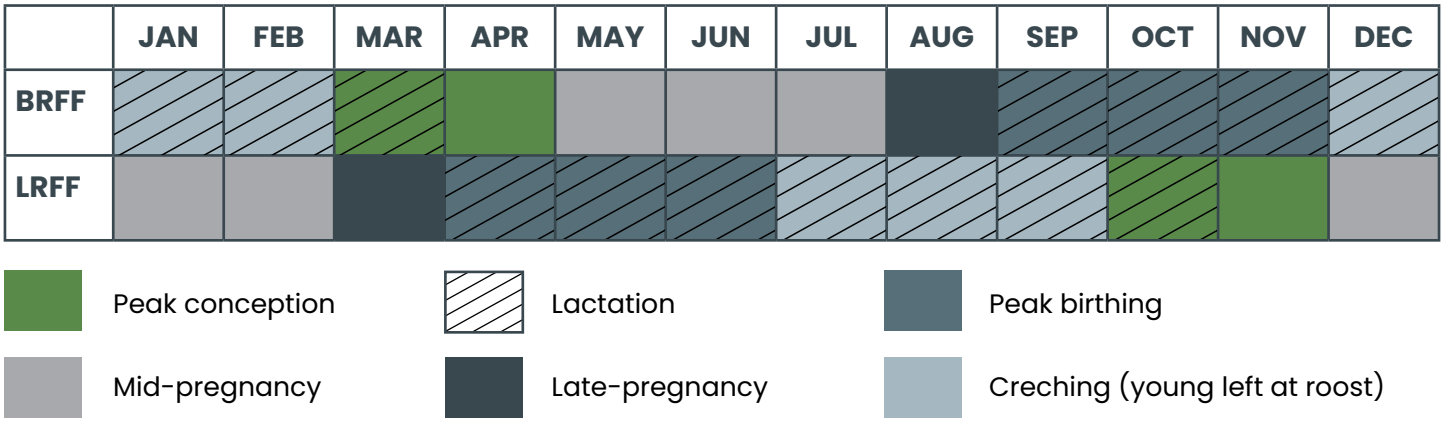
are about four months old (Churchill 2008) and are usually weaned by six months of age around March to May. Sexual maturity is reached at two years of age with an average life expectancy of 5-7 years (Divljan et al. 2006, Fox et al. 2008). Individuals have been recorded to live to 18 years of age in the wild (Tidemann & Nelson 2011).

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

Little red flying-foxes

The LRFF breeding cycle is approximately six months out of phase with BFF (Table 2). Conception occurs around October to November, with peak birthing in April-June (McGuckin & Blackshaw 1991, Westcott et al. 2020). 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.

Table 2: Indicative flying-fox reproductive cycle



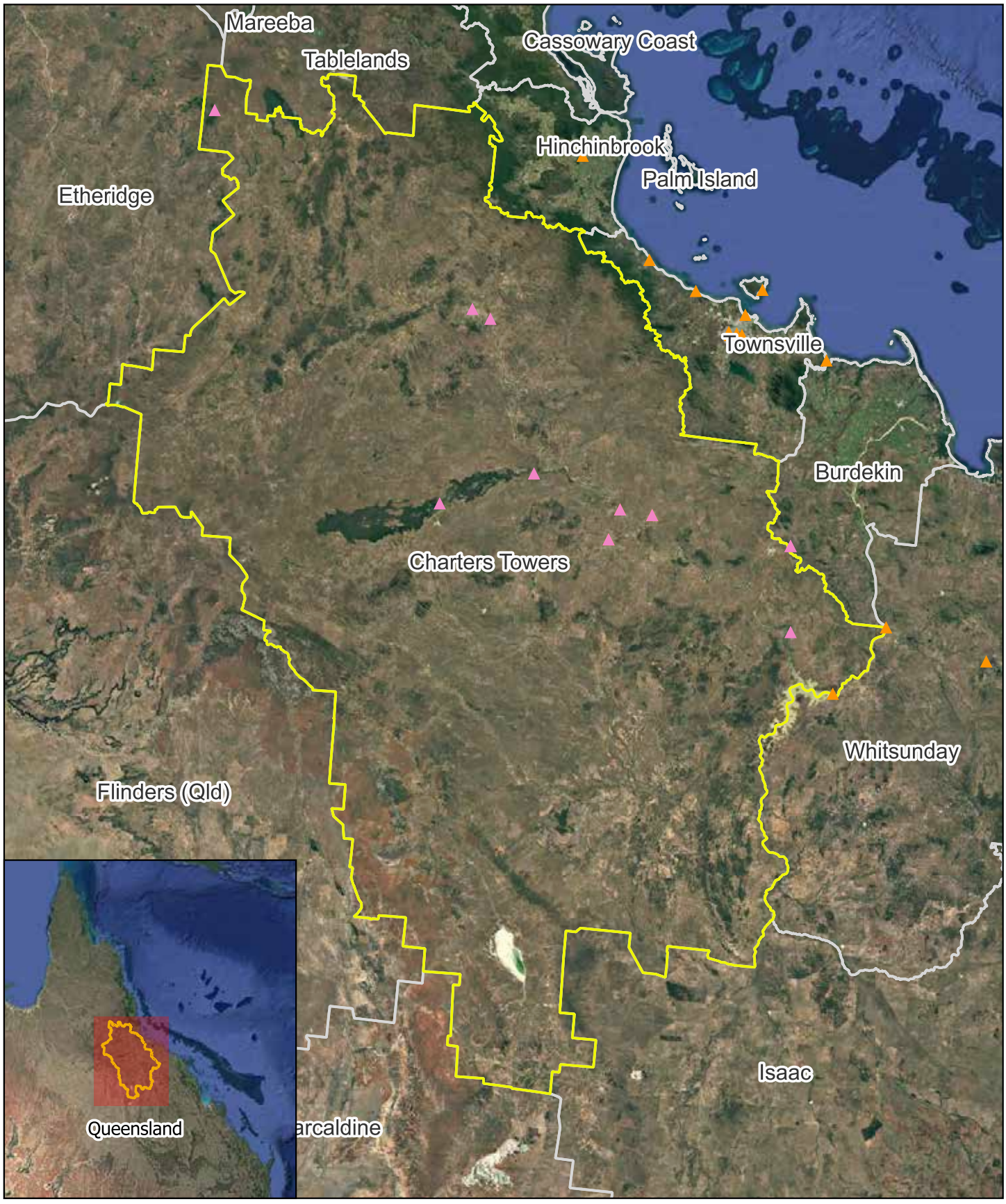


Figure 1 Flying fox roost regional context

Charters Towers Regional Council

Charters Towers Flying-fox Management Plan

- Charters Towers LGA flying-fox roosts
- QLD flying-fox roosts (NFFMP 2022)
- Charters Towers LGA
- Queensland LGAs

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0 25 50 km

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

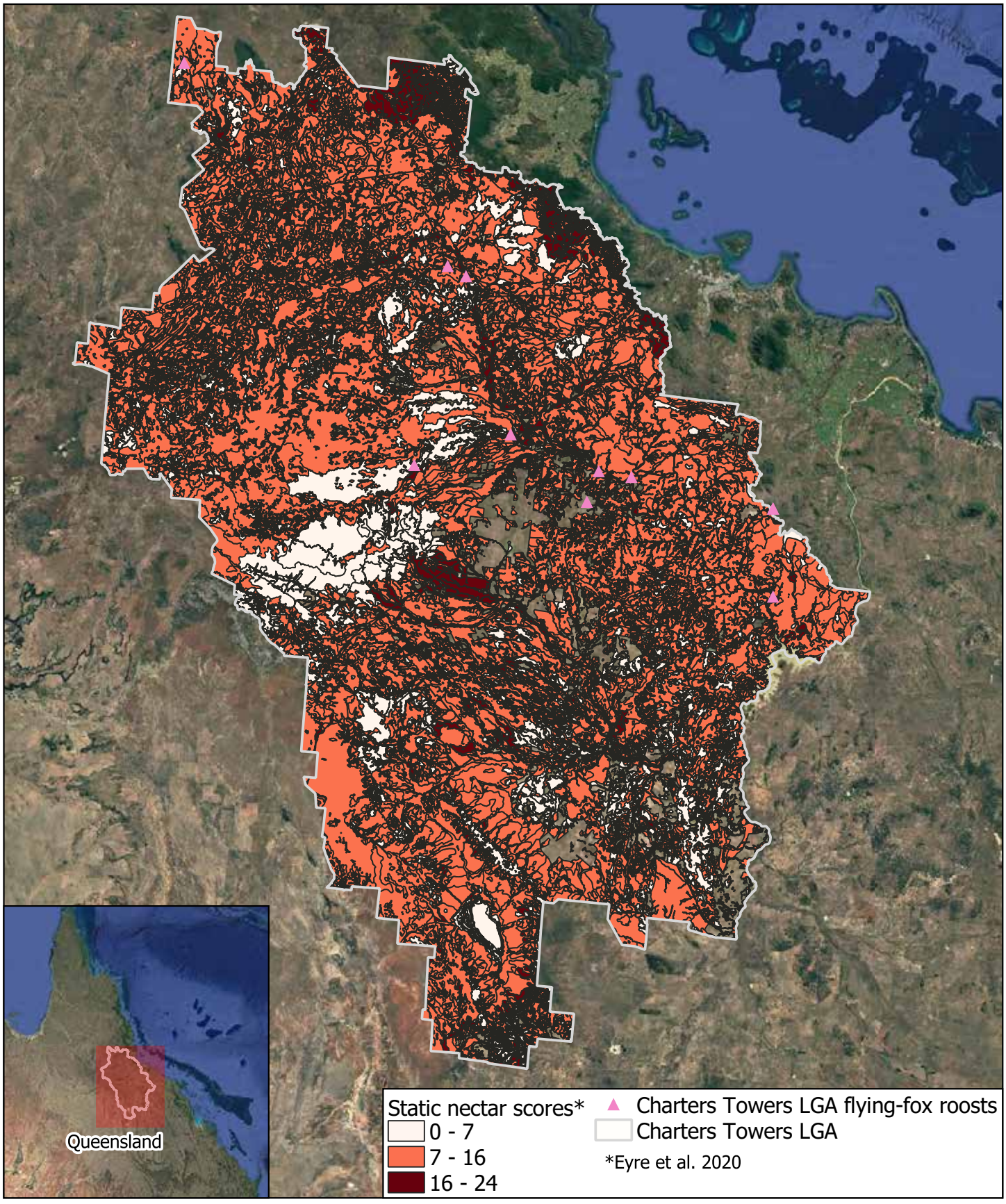

Figure 2 Distribution of static nectar scores for remnant vegetation within Charters Towers LGA as assessed in 2015 by CSIRO

Charters Towers Regional Council
Charters Towers Flying-fox Management Plan
Data courtesy of QLD Herbarium/DESI/CSIRO

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0 25 50 km

GDA 1994 MGA Zone 56
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Datum: GDA 1994
Units: Meter

3. ROOST ASSESSMENTS

Roost assessments were undertaken at Lissner Park and potential suitable relocation habitat at the Sewage Treatment Plant and Young's Block in November 2024.

3.1 Lissner Park

3.1.1 Roost description and extent

The Lissner Park roost is located between Deane Street and Church Street, in the centre of Charters Towers (Figure 3). The park is set on 7 ha and is comprised of native and exotic trees (including heritage-listed plantings) and shrubs, lawns, paved pathways, a playground, war memorial, fountains, Yarning Circle, rotunda, dog off leash area, barbeque and picnic facilities, and an enclosed constructed pond with ducks, chickens, and geese. Residential properties and businesses border the south and south-east of the park, with a Hotel Motel adjacent to the western side of the park and the Kennedy Regiment Memorial Pool at the north-eastern corner of the park.

Flying-foxes have inhabited Lissner Park in the centre of Charters Towers since at least the early 1900s when the planted collection reached a sufficient height to support roosting (M. Macdonald pers. comm. 14 November 2024). Prior to the area being cleared for Lissner Park, it was a Melaleuca wetland connected to Mosman Creek (M. Macdonald pers. comm. 14 November 2024) which was likely used as a flying-fox foraging and potentially roost site for hundreds of years or more.

During the site assessment in November 2024, the roost predominantly occupied the north-west corner adjacent to the swimming pool and the western tree line along Deane Street (Figure 3). Approximately 5,000 BFF and 2,500 LRFF were recorded throughout Lissner Park. Many BFF were observed carrying pups and most of the roost trees within the park are likely used for crèching at times (e.g. Meade et al. In Press). During significant influxes, Lissner Park is unable to sustainably support such large numbers of flying-foxes; we note that these occurrences have only been associated with LRFF influxes. The maximum roost extent covers the park entirely and extends substantially into the surrounding properties, from Baker Street to Mary Street and King Street to Boundary Street, impacting the community (Figure 3).

3.1.2 Land tenure

The Lissner Park roost extent is located on Lot/Plan 230SP345225, which is reserve land with Council as the trustee.

3.1.3 Ecological values

Lissner Park is mapped as non-remnant vegetation, with various native and exotic trees and a large area of maintained lawn. There are areas within 2 km of the site that are classified as regulated vegetation (intersecting a watercourse).

Threatened species recorded within 1 km of the Lissner Park roost include:

- pacific golden plover (Pluvialis fulva) – Special least concern (SL)
- oriental cuckoo (Cuculus optatus) – SL
- black-throated finch (Poephila cincta cincta, white-rumped subspecies) – Endangered (E)
- Australian painted snipe (Rostratula australis) – E
- common sandpiper (Actitis hypoleucos) – SL
- sharp-tailed sandpiper (Calidris acuminata) – Vulnerable (V)
- Latham's snipe (Gallinago hardwickii) – V
- black-tailed godwit (Limosa limosa) – E
- little curlew (Numenius minutus) – SL
- wood sandpiper (Tringa glareola) – SL
- common greenshank (T. nebularia) – E
- marsh sandpiper (T. stagnatilis) – SL
- nubbined fine-lined slider (Lerista colliveri) – E.

It is unlikely that the listed species use Lissner Park.

3.1.4 Flying-fox roost occupancy at Lissner Park

Flying-foxes have been recorded roosting at this site since 2001 and the population size has fluctuated (Figure 5), generally linked to mass flowering events of native vegetation in the area. The number of BFF has remained relatively consistent since 2017, with LRFF fluctuating seasonally. In 2017 and 2019 significant influxes of approximately 175,000 and 250,000 LRFF respectively, appeared in the park and were present

for several weeks. The LRFF numbers continued to fluctuate with several smaller influxes ranging between 25,000 – 50,000 from January 2020 to September 2022. Excerpts from the Northern Miner and Townsville Bulletin provide a brief history of flying-foxes in Charters Towers (Appendix 4).

3.1.5 Sensitive receptors

There are 11 sensitive receptors located within 1 km of the Lissner Park roost, including:

- Eventide Residential Aged Care
- Kennedy Regiment Memorial Pool
- Blackheath & Thornburgh College
- Blackheath & Thornburgh Kindy
- Bright Horizons Australia Childcare
- Richmond Hill State School
- Charters Towers Central State School
- Charters Towers State High School
- Charters Towers Showground
- Charters Towers Veterinary Service
- Charters Towers Hospital
- Columba Catholic College
- Gold City Veterinary Clinic

Charters Towers Airport is located 2.75 km north-east of the Lissner Park roost.

3.1.6 Management responses to date

In response to community concerns, Council has attempted to manage the roost since 2001 (Ecosure 2020). These efforts have included:

- use of deterrents, including helicopter, fireworks, black-hawk foggers, sprinkler system, ultrasonic devices, and visual deterrents. Appendix 5 provides a list of tools that have been used by Council and contractors with varying degrees of success
- an education campaign, including media releases
- facilitating several community and stakeholder meetings and working groups
- removing 20 of the park's trees through approved processes, including exotic coral trees next to the Kennedy Regiment Memorial Pool
- established a Flying-Fox Advisory Committee (FFAC)
- the FFAC facilitated two-way communication between Council and stakeholders including interest groups, state agencies, and the community. The FFAC included members of Council (elected and operational), Members of Parliament, community representatives, CSIRO, and DETSI
- through the FFAC, Council identified suitable alternate roost sites and implemented management to improve their condition with the aim of relocating flying-foxes in 2018
- hosted a public forum: including CSIRO and DETSI in February 2019
- published a Statement of Management Intent (SoMI) in September 2019
- collaborated with Ecosure in the development of a flying-fox relocation strategy in 2020.

Active management has generally been aimed at the LRFF due to minimal impacts associated with the small number of BFF. While some dispersal attempts have been temporarily effective, none have had long-term success. Dispersal has generally caused significant angst and concern among the community with flying-foxes splintering into neighbouring backyards and eventually returning to Lissner Park once dispersal has ceased.

3.2 Alternate roosting habitat

Two alternate roost sites, previously identified by the FFAC, were assessed in November 2024: Flying-fox Reserve at the Sewage Treatment Plant and Young's Block. The Lissner Park roost covers an area of approximately seven hectares at its peak, and the receiving site should have the capacity to hold the maximum number of flying-foxes, otherwise flying-foxes are likely to return to Lissner Park as a known roost location (Bradford 2018). It is important that the conditions of an alternate roost site are improved before dispersal is attempted, to increase suitability.

It should be emphasised that relocating flying-foxes to an alternate roost site will not alter foraging impacts experienced by the community. Additional management actions outlined in Section 5 will assist in mitigating these impacts.

Flying-fox Reserve
Located at the Sewage Treatment Plant, Flying-fox Reserve has approximately two hectares of suitable habitat for roosting. Although this will not support influxes of LRFF, the site has capacity for the relatively consistent smaller number of BFF recorded in Lissner Park. Maintenance works are required to manage weed species that are currently affecting the quality of the site. During the site assessment in November 2024, Rubber vine (Cryptostegia grandiflora) was observed throughout the site impacting the canopy structure. Other weed species, including Parthenium hysterophorus and bellyache bush (Jatropha gossypiifolia), were observed competing with native ground cover species along the creek line. Planting and assisted regeneration of native flora species within the creek alignment will also improve the quality of the site as a roost.

The site was one of the five locations identified by the FFAC for relocation activities in 2018 and was originally intended as a temporary roost stepping-stone between Lissner Park and Young's Block. Due to its considerably smaller roost area compared with Lissner Park, this site was considered unsuitable by CSIRO, with the intention of relocating approximately 250,000 flying-foxes.

Young's Block
Young's Block is not currently in a suitable condition to support flying-foxes. Maintenance of the site infrastructure, including fencing, irrigation, and the dam, is required in addition to weed management at the site and surrounds to restore this site and increase its suitability as a roost.

Originally, Young's Block was selected as the most suitable site by the FFAC due to its canopy vegetation (including mango trees, large tamarinds, and large melaleucas) of similar size to Lissner Park. Flying-foxes have been recorded foraging (and possibly roosting; Council representative, pers. comm., February 2020) at the site. Its proximity to Lissner Park, only four kilometres, makes Young's Block the closest site with suitable vegetation and no predicted potential for future conflict. A permanent water source and irrigation were installed in 2019, and restoration and planting were undertaken to improve the roost sites suitability; maintenance of this site is required to enhance the attractiveness for flying-fox roosting.

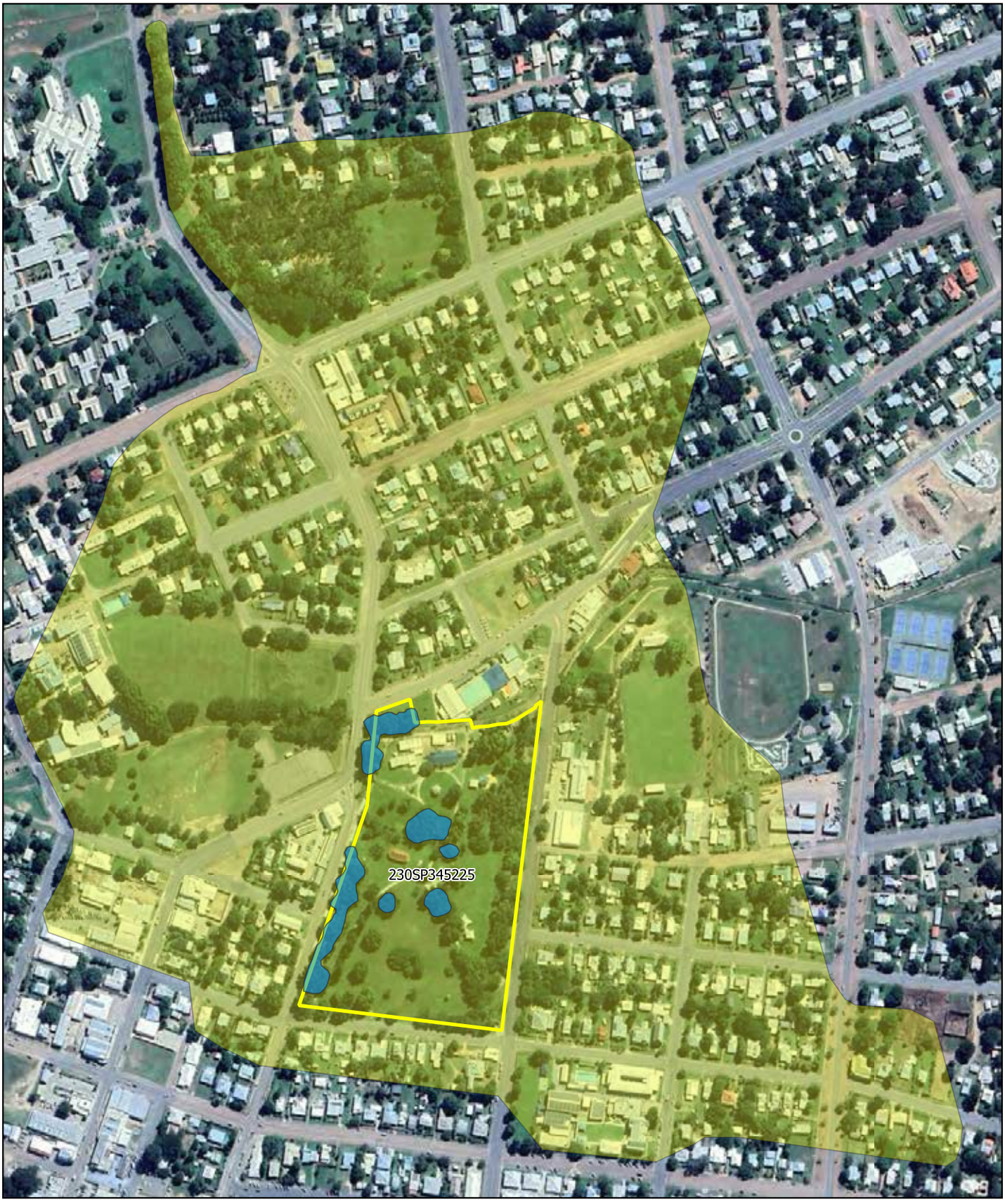

Figure 3 Lissner Park flying-fox roost

Charters Towers Regional Council

Charters Towers Flying-fox Management Plan

Lissner Park flying-fox roost extent (Nov24)

Lissner Park flying-fox roost extent (Dec17)

Lissner Park

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0 100 200 m

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

Figure4 Charters Towers alternate roost sites

Charters Towers Regional Council

Charters Towers Flying-fox Management Plan

Lissner Park

Alternate roost locations

Lissner Park flying-fox roost extent (Nov24)

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0 0.25 0.5 0.75 km

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

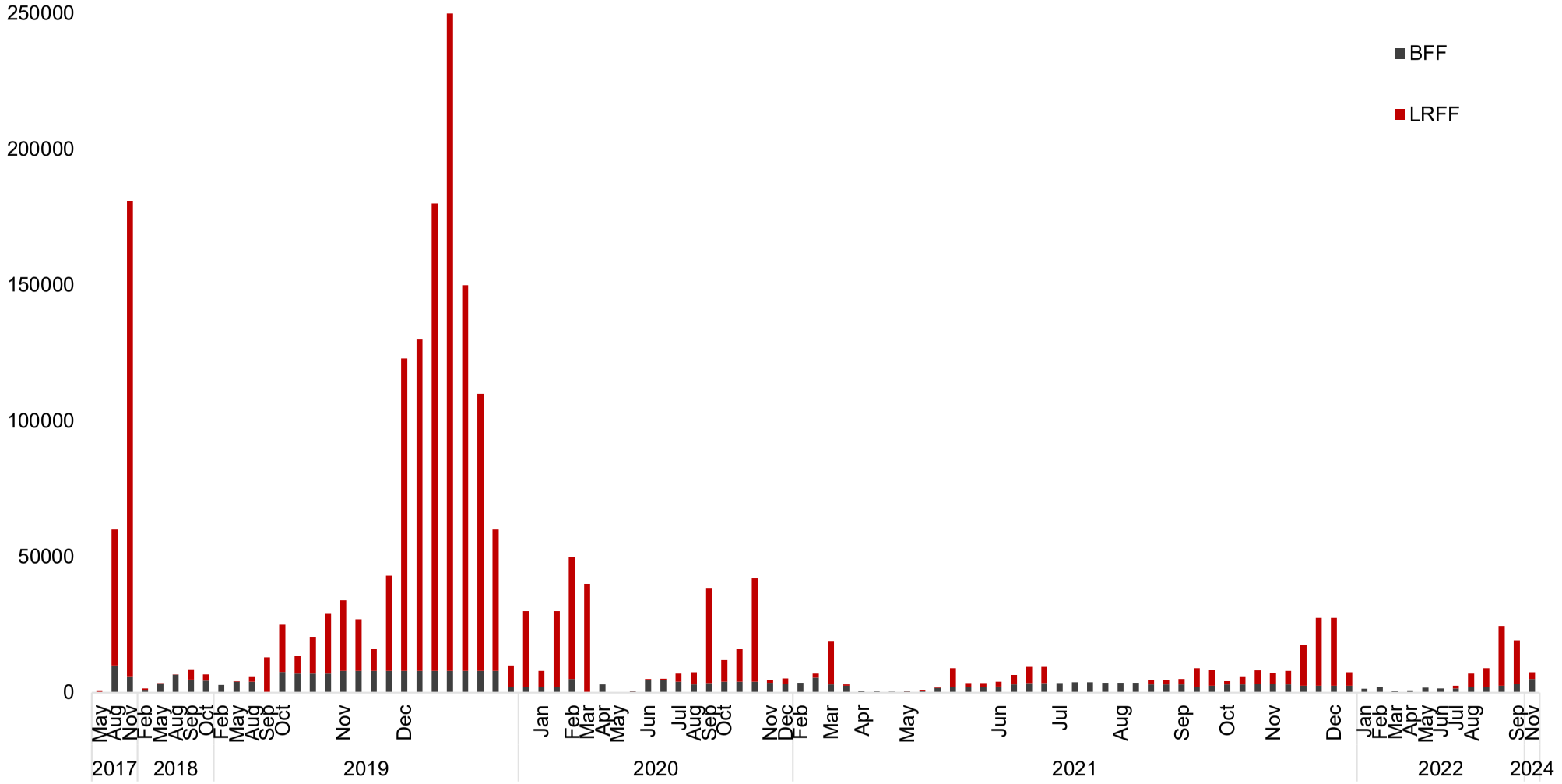

Figure 5: Lissner Park flying-fox monitoring data from 2017 – 2024 (Source: Council 2024, NFFMP 2022, Ecosure 2020).

4. COMMUNITY AND STAKEHOLDER ENGAGEMENT

Early and effective community engagement and education has benefits for both communities and land managers. These 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.

Council sought to consult with all stakeholders with an interest in the flying-fox roosts during the development of the Plan. This included Ecosure site assessments, meetings with Council, and a community workshop for residents of Charters Towers.

The community workshop provided an opportunity to seek feedback directly from residents and the wider community. Attendance was moderate and the consensus was to continue active management to attempt to relocate flying-foxes from Lissner Park. Feedback was particularly strong to attempt to relocate both BFF and LRFF, with the view that allowing BFF to remain at Lissner through the remainder of the year encourages LRFF to return to this location. In addition, the community was invited to complete an online survey; the survey results are outlined below.

4.1 Community survey results

An online survey was hosted on Council's Have Your Say platform to directly inform Council of the community's knowledge and attitudes towards flying-foxes and management options. The survey was open between 18 September and 17 October 2024. A total of 50 people visited the survey web page, of which 42 respondents completed the survey. The survey involved both mandatory and optional questions, as such the sample size of respondents is lower than 42 for some questions. Of the 42 respondents, 85.7% identified as rate payers, 11.9% as occupiers, 2.4% as visitors.

Respondents (n = 42) were asked to identify impacts, from a provided list, that they experience when flying-foxes visit Charters Towers. Loss of community amenity (32) and environmental nuisance (noise, smell; 29), received the highest responses. Increased anxiety due to health concerns (17), property damage (17) and sleep deprivation (10) all received moderate responses. Business losses (3) and no impact (2) received few responses. Respondents could select 'other', allowing them to manually enter qualitative data, to which there were 10 responses. Many of the manual responses repeated listed impacts, however several respondents identified that they were impacted by the noise of active management.

Respondents (n = 42) were presented with a list of management options and requested to identify which options they supported; multiple answer could be selected. Dispersal aiming to remove roosting flying-foxes was the most supported option, with 32 selections. Use of deterrent to create buffers between flying-foxes and properties and targeted noise aiming to gradually push roosting flying-foxes a short distance away from conflict areas were the next most supported options, with 24 selections each. There was moderate support (10-16 selections) for community education, land use planning, protecting and enhancing low conflict flying-fox habitat, tree trimming to create buffers, vegetation removal to create buffers, and use plants that flying-foxes do not like to create buffers. Low support was shown for property modification (5) and noise reduction fencing (4). An 'other' option was provided for respondents to manually enter qualitative data, to which there were six responses. Four of the six responses supported culling or lethal management of flying-foxes.

Satisfaction with current flying-fox management practices in Charters Towers was assessed. Of the respondents (n = 42), 28 answered unsatisfied, eight answered satisfied, three answered very satisfied, and three answered not sure/no opinion.

Respondents (n = 42) were asked to identify which option best reflected their position regarding financial implications of flying-fox management. Most respondents (54.8%) did not support any rate increase for flying-fox management. Learning to live with flying-foxes ($5,000-$10,000 collected through rates) was selected by 2.4% of respondents. Maintaining all Council open spaces ($10,000-$30,000) and maintaining all Council assets inclusive of open spaces ($30,000-$50,000) were each selected by 11.9% of respondents. Protecting all Council assets and, additionally, urban/residential properties and business ($50,000-$80,000) was selected by 19% of respondents.

Respondents (n = 42) were asked to identify methods that they would like to see Council adopt to manage flying-fox populations from a list of options. Multiple answers were selectable. Active relocation of flying-fox colonies received 35 selections. Non-invasive deterrents (noise, light) was selected by 17 respondents. Increased monitoring and reporting was selected by 10 respondents and increased public education

and awareness programs by seven. An 'other' option was provided for respondents to manually enter qualitative data, to which there were 11 responses. A majority of the manually entered responses suggested various forms of lethal flying-fox management.

Respondents (n = 28) were asked to suggest suitable locations for flying-foxes to be relocated. The general response 'out of town' without specification, however few specific responses identified Flying-fox Reserve, Young's Block and Burdekin Wier as relocation sites.

Respondents (n = 34) were asked if they were open to assisting Council with strategies to relocate and manage flying-fox colonies. Of the respondents, 55.9% would support Council with suggestions and feedback, and 29.4% would like to be involved in a volunteer program.

Respondents (n = 42) were asked to convey the personal importance of several listed statements ranging from not important to extremely important. A majority of respondents selected very important or extremely important for Council undertaking active management of flying-foxes, Council management actions being cost-effective, Council assisting with managing impacts associated with flying-foxes and Council protecting vegetation and other historical/environmental values in parks and bush areas. A majority of respondents selected not important or somewhat important for Council protecting flying-foxes and community members not disturbing flying-foxes during the day.

Respondents were presented an optional question to provide Council with feedback to improve the relationship between Council and the community regarding flying-fox management. The common response was greater consultation with the community regarding decision making to keep the community informed of objectives and outcomes and to improve transparency and open communication.

5. PLANNED MANAGEMENT ACTIONS

Management actions aiming to reduce impacts on residents and habitat associated with flying-fox roosts in the Charters Towers LGA are outlined (Table 3) following assessment of available options (Appendix 6 and 7). The actions align with legislation (Section 1.4), roost assessments (Section 3), and consultation with Council and the Charters Towers community. Implementation of management actions must be considerate of approvals potentially required, site values, and in accordance with measures to avoid impacts (see Section 5.2). Evaluation measures are provided for each action which will be used to evaluate progress and success. Details of how the Plan and the actions below will be implemented are described in the table below.

An analysis of general management options used to inform these actions, and their suitability for the Charters Towers LGA flying-fox roosts can be found in Appendix 6.

Table 3 - Planned management activities

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
Routine management actions						
Development of a communication plan for community engagement and awareness	Ensure clear and up-to-date information available regarding legislation and human and animal health	Ensure the community is aware of legislation around flying-foxes, and that management affecting flying-foxes is illegal without relevant approvals. Education should be delivered in the form of engagement events, online material and/or hardcopy brochures, and should include up-to-date health information (Appendix 7), impact mitigation options available at a property level (e.g. odour-neutralising gel pots), and legislative responsibilities. One-on-one engagement may be required for primary-affected residents.	Lissner Park	No	Short term and ongoing	Community informed and engaged.
	Keep community informed of flying-fox numbers, routine management, and up-coming management, including trialling new methods	Engagement platforms including social media, websites, media release, and digital/hard copy mail (e.g. brochures, fact sheets) will be utilised to maintain awareness and keep the community updated and informed. Support land managers of sensitive sites as required. Council will ensure all landowners have consented to works and provided permission to access properties if or where required.	Lissner Park	No	Short term and ongoing	Up-to-date information readily available for the community.
Impact mitigation	Roost monitoring	Ensure regular (e.g. monthly; at least quarterly) monitoring of active flying-fox roosts within urban areas under the Planning Scheme; recording roost spatial extent is valuable. Share survey data with DETSI and the NFFMP. Drone monitoring can provide more accurate results on roost numbers and extent, this method should be considered however ground counts are required to assess species level population estimates.	All urban roosts within Charters Towers LGA	Monitoring approaved by DETSI. Animal ethics may be required for some monitoring	Ongoing	Regular monitoring undertaken at urban roosts and quartlery monitoring at all roosts.

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
	Community Assistance Program	Investigate a Community Assistance Program to offer distance scaled subsidies for residents affected by flying-fox roosts during large influxes. Subsidies may cover property modification and/or services to manage impacts associated with flying-foxes. Note, receiver sites are not anticipated to support influxes at the scale previously recorded, therefore subsidies will assist with managing impacts to the community during uncommon and temporary influxes.	Lissner Park and future urban roosts	Public notification requirements	Short and long term	Investigated feasibility, community support, and best practice implementation.
	Alternative habitat creation, restoration and maintenance	Protect, improve, and restore low conflict roost habitat to avoid future conflict. Flying-fox Reserve at the Sewage Treatment Plant has been identified as the target receiver site that will support the general number of BFF present at Lissner Park. Weed management and planting of suitable roosting species will improve the site's suitability as a roost and capacity to support larger flying-fox numbers. Young's Block has been identified as a secondary receiver site. Maintenance works, including repairing infrastructure and weed management, will improve the sites suitability as a roost.	Flying-fox Reserve at the Sewage Treatment Plant and Young's Block	No approvals required where improvements includes increasing the density of the mid and upper canopy and where possible expanding the area of available habitat	Long term	Maintenance works undertaken and maintained at Flying-fox Reserve. Investigated opportunties to restore Young's Block.
Avoiding future conflict, conservation	Protocols to manage incidents	Collaborate with wildlife rescue and care organisations to monitor potential future Heat Stress Event (HSE) during predicted hot weather and other extreme weather (Appendix 8). Develop a Heat Stress Response Plan that outlines information on the factors that contribute to HSEs, how to monitor flying-fox stress, the importance of having a roost-specific response plan, personnel roles in attending to HSEs, active spraying of flying-foxes, recovery, and response to mortalities, as well as the importance of collecting data on HSEs.	Lissner Park and future urban roosts	No	Short term and ongoing	Heat Stress Response Plan developed and communicated. Ongoing communication with wildlife rescue and care organisations.

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
	Support flying-fox carers	Support the ongoing rescue, care, and conservation efforts of local wildlife carers, particularly during flying-fox influxes in the LGA and HSEs.	Lissner Park and future urban roosts	No	Ongoing	Strong relationship between flying-fox carers and Council.
	Support research	Support research, particularly projects which will assist in understanding local flying-fox movements, diet, population, and ways to mitigate impacts on the community. A priority area of research is to better understand foraging resources in the area to allow proactive management and preparation for future influxes.	Lissner Park and future urban roosts	No	Long term and ongoing	Council up-to-date on contemporary research and relevant outcomes used to inform roost management.
	Appropriate land use planning	Work with Council's Town Planners to investigate implementing measures to avoid future conflict between roosts and the community when assessing development applications, including new urban areas. Identify potential buffer areas to zone as natural areas/flying-fox management areas, as appropriate, to mitigate impacts to residents. Consider habitat protection measures (zoning, Biodiversity Agreements) for existing flying-fox roosts.	Lissner Park and future roost sites	No	Long term	Flying-fox roost management areas incorporated into planning instruments.

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
Log Impact COP						
Impact mitigation	Routine roost maintenance	Continue routine roost maintenance as usual. Develop protocols to mitigate operations that may disturb flying-foxes during sensitive periods e.g. night works. Disturbance can increase impacts such as noise and smell and can create flying-fox welfare issues (e.g. dropped pups). Operational teams to consider use of electric tools to reduce noise where possible. Machinery should be started away from the roost and work towards it while monitoring behaviour. Layering mulch around tree bases will mitigate disturbance to roosts from activities such as mowing. Weed management should be staged and mindful of inadvertent dispersal or exacerbating HSEs.	Lissner Park	No permit required for weed management or habitat improvement, and if tree trimming is in compliance with the Low Impact COP and heritge limitations	Ongoing	Successional vegetation management and maintenance where appropriate.
	Consult with residents about supporting buffer maintenance through vegetation management (trimming/ removal)	Liaise with residents to assess attitude and support for property owners and Council to implement buffer vegetation work on targeted properties, whilst minimising removal of roosting habitat. Council can support by providing the necessary licences (where required), liaise with DETSI, assist with developing the work plan, assist with oversight, and, where appropriate, help with the implementation of the work.	Lissner Park and future roost sites	No permit required for weed management or habitat improvement, and if tree trimming is in compliance with the Low Impact COP and heritage limitations	Ongoing	Actions implemented to reduce conflict roosting around dwellings. Residents wishing to maintain buffers supported by Council.

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
	Consult with residents about potential buffers between dwellings/ properties	Buffers of less desirable roosting habitat, such as on private property, up to 20 m from dwellings can be established through a collaborative approach. This includes a combination of weed removal, selective trimming/removal, CMS, and/or lighting strategies. Management actions will be undertaken by property owners with support from Council. Council can support by providing the necessary licences (where required), liaise with DETSI, assist with developing the work plan, assist with oversight, and, where appropriate, help with the implementation of the work.	Lissner Park and future roost sites	Authorised under the Low Impact COP - permit required for protected vegetation	Short term/ ongoing	Buffers implemented if appropriate and funds available.
Management COP						
Impact mitigation	Provision of artifical roosting habitat	Artificial roosting habitat aims to supplement vegetation damaged by flying-fox roosting behaviour (defoliated branches) and increase the capacity of roosts. The provision of artificial roosting habitat has no definitive supporting evidence that it will be used by flying-foxes; experimentation would be required as this would be a novel, innovative solution.	Flying-fox Reserve and Young's Block	Authorised under the Management COP	Short term and ongoing if effective	Investigated and feasibility and application.
	Nudging	Coordinated application of deterrents (e.g. noise, light, CMS, smoke, human presence) to deter flying-foxes from roosting in trees/ areas that are deemed unacceptable while not dispersing all roosting flying-foxes. Nudging the flying-foxes to identified non-disturbance areas aim to habituate the flying-foxes to use specific areas and reduce human-wildlife conflict associated with roosting in undesirable locations.	Lissner Park	Authorised under the Management COP	Short and long term conflict mitigation	Nudging planned, implemented as required, and outcomes assessed. Monitoring conducted to assess pup crèche trees to inform management.

Strategy	Action	Details	Application Locations	Approvals Required	Timeframe/ Progress	Evaluation Measure
	Strategic dispersal	Active management of the Lissner Park roost aiming to relocate BFF population to the receiving site i.e. Flying-fox Reserve. Dispersal to be planned outside of BFF breeding season (March/April 2025) to mitigate risks of abandonment or abortion. Once BFF population have established at receiving sites, LRFF influxes can be managed without limitations of flying-fox welfare issues caused by presence of dependent BFF pups. Due to the unpredictable nature of flying-fox dispersal, actions will need to be adaptive for the duration of the strategy. In combination with habitat improvement (greater capacity) and frequent monitoring at receiver sites, active management of LRFF influxes at Lissner Park will encourage LRFF to join BFF at receiver sites. Different behaviours are generally exhibited between LRFF and BFF during dispersal activities: LRFF can often be 'herded' as one large group whereas BFF tend to splinter into many small groups. Dispersal planning to consider community communication plan, a structure for personnel roles and responsibilities, action timing and duration, appropriate and authorised management tools, monitoring and reporting, and contingencies. Council to communicate and engage with community for assistance during strategic management. This may include temporarily avoiding disturbance on private properties for short periods. It is also essential to communicate that the community does not interfere with relocation actions. Subsidies will assist in mitigating impacts experienced by impacted residents. Note, dispersal will not mitigate foraging impacts experienced by the community. Subsidies will address foraging impacts.	Lissner Park	Authorised under the LGA's as-of-right authority. Notification to DETSI.	Short and long term conflict mitigation	Dispersal planned, implemented as required, and outcomes assessed and recorded. Monitoring undertaken by suitably qualified person to determine stages of breeding. Community aware of actions and outcomes.

5.1 General roost management framework

A general procedure to assess and manage other flying-fox roosts is presented in the below flow chart (Figure 6). This procedure can be applied to emerging roosts within the Charters Towers LGA[2]. Once assessed, the management of roosts should align with the options detailed in Appendix 6.

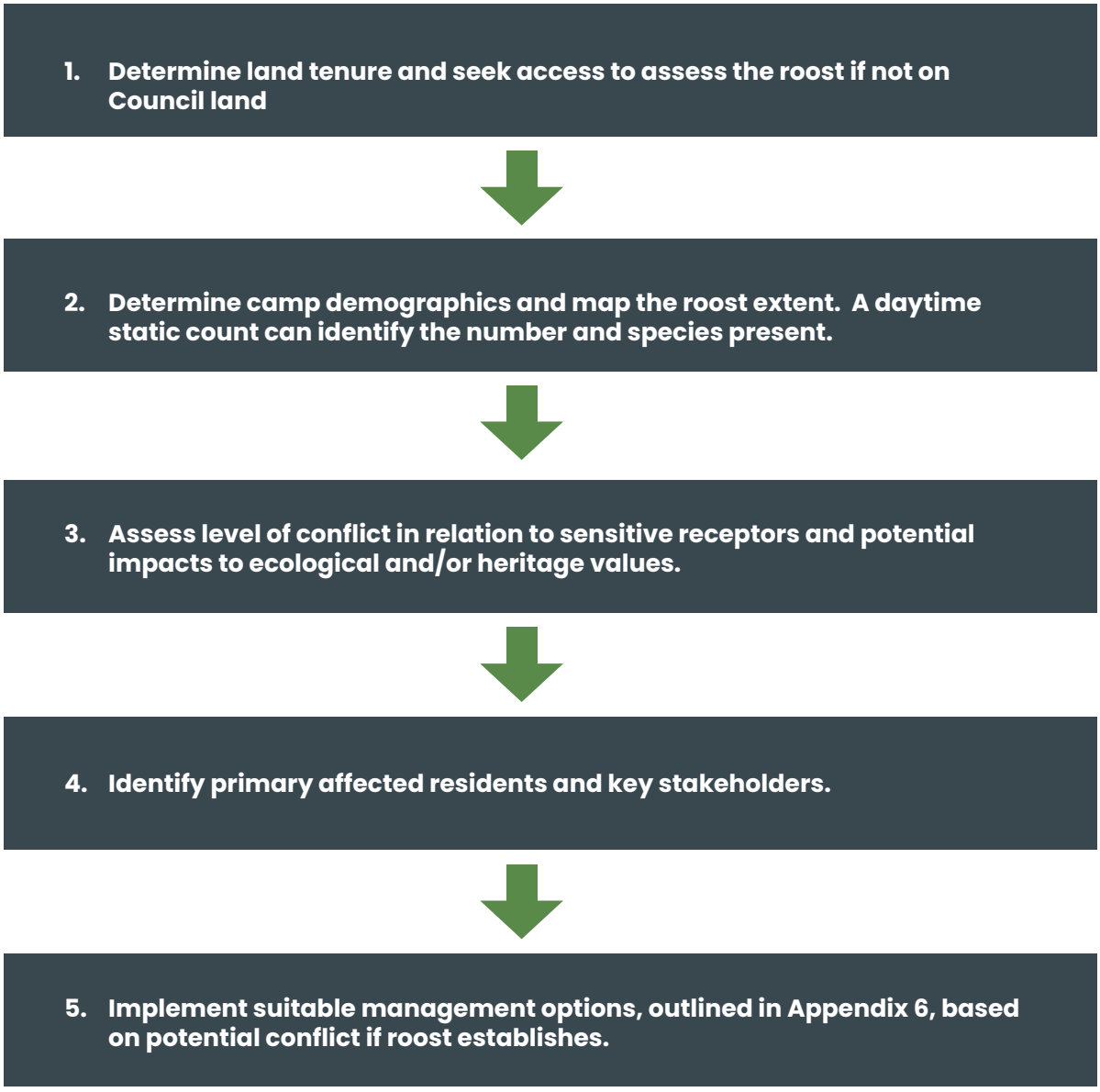

Figure 6: General framework for flying-fox roost management

[2] 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 2021b). 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.

5.2 Avoid impacts to flying-foxes

Scheduled works at or near roost sites should adhere to the below (Table 4)

Table 4: Planned actions for potential impacts during any works under or near 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-fox appear to be leaving the roost	• In situ management • Works to cease and recommence only when flying-foxes have settled*/moved to alternative locations at least 50m from the roosting animals
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 site • loss of condition evident	• Works to cease immediately and DETSI notified • Rescheduled or stopped indefinitely and alternerative management options investigated • Adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by an independent expert.
Reproduction condition	• Females in final trimester • dependent/creching young present	• Works rescheduled • Stopped indefinitely and alternative management options investigated

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

Council can further reduce the risk of negative impacts to flying-foxes, and the increased risk of close contact by the community, by considering the following:

- reducing or eliminating the amount of barbed wire on Council projects, by
  - shifting to non-barbed alternatives for new projects, and making current barbed wire fences visible with white tape or metal discs (e.g. at the edge of Lissner Park)
  - using non-barbed alternatives when conducting maintenance that required wire replacement
  - replacing out barbed wire in areas with recorded flying-fox mortalities
- 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, e.g. existing aboveground powerlines could be upgraded to aerial bundled cable to prevent electrocution mortalities
- avoiding management during extreme weather conditions
- implementing strategies to avoid disturbance to roosts during maintenance activities including smaller teams, quieter electric tools, starting machines away from the roost
- implementing HSE emergency response actions outlined in Appendix 9.

5.2.1 Timing of dispersal

BFF generally birth in September/October with young beginning to reach independence in February. The LRFF breeding cycle is out of phase by about six months with peak birthing in April/May (Section 2.4).

While LRFF have only been recorded birthing and rearing at Lissner Park on two occasions, if this behaviour continues the ideal window for initial dispersal is between February-March and when LRFF birth (generally April/May). To ensure the presence of pups is immediately identified, and because the breeding season is variable and out-of-season breeding common, dispersal will only commence after assessment by a person highly knowledgeable in flying-fox biology.

It is the intent that BFF will have relocated to the alternative site following initial dispersal in the BFF non-rearing season, and dispersal later in the year will target returning non-breeding LRFF.

5.3 Plan evaluation and review

5.3.1 Plan administration

This Plan will be reviewed annually including ongoing evaluation of the strategies (Table 3). The Plan shall remain in place until a revised version is adopted by the Council; a 5-year review is recommended. The following may also trigger a review of the Plan:

- completion of a significant action (Low impact COP or above)
- changes to relevant legislation
- outcomes of research that may influence the Plan
- any negative incident associated with roosting or foraging flying-foxes.

5.3.2 Monitoring

Council will monitor and keep internal records to allow the effectiveness of each management action to be evaluated and inform future planning. Monitoring of the roosts will be undertaken on a quarterly basis to determine the extent of the roost as well as estimate the number and composition of flying-foxes; more frequent monitoring, e.g. monthly, is encouraged and is more informative for Council, management, and the community. Council is encouraged to share monitoring data with DETSI and the NFFMP.

5.3.3 Reporting

Council is responsible for implementation of the Plan. Council will complete the DETSI 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.

Information to collect and report includes:

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

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APPENDIX 1 - SPECIES PROFILES

Black Flying-fox (pteropus alecto)

Black flying-fox indicative species distribution (DPE 2023)

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

Little Red Flying-fox (pteropus 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 2 - POTENTIAL IMPACTS FROM FLYING-FOXES

Flying-foxes in urban areas and in close proximity to dwellings can result in conflict with the community. The Plan aims to provide Council with management actions to reduce impacts on residents.

Human and animal health concerns

Flying-foxes, like all animals, may carry pathogens which can be harmful to humans. These risks are frequently associated with direct contact with flying-foxes, with indirect contact posing little risk; Council education includes the phrase "no touch, no risk". Health concerns can be effectively managed through education, proper protocols, personal protective equipment (PPE) such as gloves, and good hygiene practices.

The key human and animal health risks associated with flying-foxes are Australian bat lyssavirus (ABLV) 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 8.

Noise

A highly social and vocal animal, the activity heard from flying-foxes at roosts includes courting, parenting, and establishing and defending mating territories. Noise is often most disturbing to people pre-dawn. Throughout the year, noise is made as the flying-foxes return to the roost pre-dawn, sometimes several hours before sunrise (Welbergen 2011). This noise is often exacerbated during pup rearing (spring/summer) as adult female flying-foxes return to the roost to feed their pups during the night. Often, the largest number of complaints occur from January to May, peaking during the mating season (mid-March to mid-May). At this time males vocalise to defend their mating territories and may stay at the roost through the night (Welbergen 2011).

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.

Faecal drop

Flying-foxes have an extremely fast digestive process with only 12-30 minutes between eating and excreting (SEQ Catchments 2012). Given that flying-foxes regularly forage up to 20 km from their roost (Markus & Hall 2004) and establish new roosts within 600 m to 6 km when dispersed (Eby & 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, require 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, such as picnic tables and play equipment, which could also be covered (e.g. with a shade canopy).

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 (DPE 2023). 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, occurs near the supply or catchment area. Should this occur, increased frequency of monitoring should be considered to facilitate early detection and management of contaminants if required.

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/or due to long-term roosting, and/or due to large numbers of LRFF. The roosting behaviour of LRFF differs to the other three species, they clump together creating dense, heavy aggregations that can snap branches. Intervention may be required (as a last resort) to protect tree health if permanent damage is likely.

APPENDIX 3 - 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.

State

Nature Conservation Act 1992

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

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

Note that the definition under Queensland law means that once a flying-fox roost is established, it remains as such even when it is unoccupied. The interim policy for determining when a flying-fox congregation is regarded as a flying-fox roost under section 88C of the *NC Act* (DES 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 DETSI if required.

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

Council 'as-of-right' management

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

Councils must however still notify DETSI of the planned management. Notification is by means of a completed 'flying-fox management notification form' from the DETSI website submitted at least two business days prior to commencing any management actions, unless an authorised person from DETSI 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 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 DETSI 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 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 DETSI 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 DETSI-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). These activities are authorised provided they are 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 Charters Towers region. Local councils may also opt to develop a flying-fox management plan for the whole of their LGA (i.e. this Plan). If this is approved by DETSI, the local council can be granted three years' approval to manage flying-foxes outside their UFFMAs under an FFRMP.

The 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 threatened or near threatened plants and their supporting habitat.
- if a flora survey identifies that threatened or 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 vulnerable plants are present.
- clearing of least concern plants will be exempt from requiring a clearing permit within a low-risk area.

Vegetation under the *Fisheries Act 1994*

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

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

Vegetation Management Act 1999

The clearing of native vegetation in Queensland is regulated by the *VM Act*, the *Planning Act* 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, Manufacturing, and Regional and Rural Development Queensland for each proposed vegetation clearing activity.

No explicit *VM Act* exemptions for clearing flying-fox roosting or foraging vegetation were in place as of September 2024.

Animal Care and Protection Act 2001

The *ACP Act* provides for animal welfare. The *ACP Act* is administered by Biosecurity Queensland within the Department of Primary Industries. 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. C*ivil Aviation Safety Regulations 1998* Part 139 contains specific requirements for wildlife hazard management.

APPENDIX 4 - HISTORICAL RECORDS OF FLYING-FOXES IN CHARTERS TOWERS

Northern Miner (Charters Towers. Qld.: 1874 - 1954), Monday 31 January 1927, Page 2

FLYING FOXES.

SATURDAY'S RAID.

Shooters assembled in great force at Lissner Park on Saturday afternoon, when a flying fox raid was conducted. The City Council, it is said, provided some ammunition, and the shooters were pretty generous in their own provision, apparently appreciating that fox shooting is fairly good sport, and being close to home, pretty convenient. For some weeks past the foxes have been camping principally in two trees, one just inside the Park gate and one on an allotment just outside. Dozens of guns were posted about these trees and when the first few shots were discharged foxes emerged literally in thousands. The air was thick with them for a time, and they were bowled over in rare style. The Council ammunition was cheap, however, and there was a deal of indiscriminate and unwise shooting. This was eliminated a good deal, however, as the afternoon progressed, sore shoulders possibly being the biggest contributory cause. It would be difficult to estimate just how many foxes were annihilated, but there could not have been many short of a thousand, and the raid should, for a time at least, have a marked effect on the nocturnal vulpine screechings.

In regard to flying foxes, a correspondent in a recent issue of the "Sydney Bulletin" has the following interesting paragraph: "In desperation, the orchardists of the Manly and Newport districts (N.S.W.) recently organised a grand battue of flying foxes, which was attended by scores of shooters armed with double barrelled guns. Though several resorts of the pests were attacked, and at least 20,000 to 30,000 of the creatures slain, the slaughter does not seem to have markedly diminished their numbers. One wonders why the attackers did not use some toxic gas, such as chlorine, which is cheap and easily prepared, and may be used without danger to humans. It would kill hundreds where guns account for single foxes only. A few applications, indeed, would certainly wipe out entire colonies. The cost would be very small, probably less than the damage half a dozen foxes can do in a single night."

Now this "Bulletin" correspondent seems to be on the right track, and, to wipe out all the foxes in the Charters Towers district, it would seem that we have only to induce them to camp in the trees overhanging the drain that runs through Lissner Park. But how can they be so persuaded?

CHARTERS TOWERS

Discovery In 1872

(BY BARTLE FRERE.)

The Charters Towers Goldfield was discovered in 1872 by Hugh Mossman, George E. Clarke and John Fraser, and, when developed, it proved for a period of some years to be the most prolific producer of gold in Eastern Australia.

Early in 1871 Messrs Mossman, Clarke and Fraser started from the Rockhampton district on a prospecting expedition. Their starting point was 450 miles south of Ravenswood.

The facts disclosed by Mr. Clarke are to the effect that the members of the party were then young and comparatively inexperienced. But they were enthusiastic and they were always sanguine of discovering a good goldfield.

Their efforts were for some time fruitless, but they agreed to spend a year in gold prospecting over a wide stretch of country on the Burdekin watershed and its tributaries.

They examined the country as far as Ravenswood, and towards the close of the year were in the Broughton River district, near what became known as the 71-Mile. If they were not successful in this territory they were determined to move still further north.

Mr. Clarke described the life as pleasant and although disappointments were numerous yet the possibilities, if somewhat uncertain, were great.

The prospectors spent several weeks in exploring the 71 Mile Pinnacles and prospecting the country south and west. One pinnacle carried stone which was gold bearing, but the prospectors did not consider it was good enough for them. On the same pinnacle, a resident of Charters Towers (James Pile) subsequently secured 100 ounces to the ton.

Northwards was a cluster of conical and square topped peaks and to them they directed their attention. When four or five miles off they found gold, but they did not consider it was payable. This was near the future Merrie Monarch lease. It was hot summer weather and water was scarce, the nearest supply being five miles away in an opposite direction from the hills. This date would be about the last week in December, 1871.

Mr. Clarke described the incident in later years as follows:

"A storm was near and while we were deliberating as to whether we should go to the water or camp and trust to the water coming to us, the question was settled rather abruptly. A terrific peal of thunder started our pack horse at his best pace through the bush—an unlucky stampede resulting in the loss of all our cooking apparatus except one tin dish. Rain fell in a perfect torrent and we camped at once."

The prospectors were then a few miles from the richest quartz deposit yet exploited in Queensland. Next morning they resumed their journey through a gap in the hills that had been the object of their observation—camping near what was later known as The North Australian Reef of the Charters Towers Goldfield. Round about and a little further on were rich outcrops in which the glistening quartz was thinly ribbed with gold. Masses of quartz were strewn about

quartz was thinly ribbed with gold. Masses of quartz were strewn about the surface, and Messrs. Mossman, Clarke and Fraser at once recognised that they had at last reached the land of their hopes. The masses of quartz first seen yielded three ounces and upwards to the ton, while stone raised beneath the surface of the North Australian Reef returned four and a half ounces to the ton.

On the following day the party found payable quartz in reefs which afterwards became known as The Mary, Wyndham, Moonstone, Ophir and Rainbow. The richest specimens were obtained in the Rainbow, but during several succeeding days they found other reefs carrying gold. After shifting their permanent camp from the Seventy-one Mile to the site of their discoveries they selected the North Australia, Ophir and one other reef as reward claims and on January 2, 1872, Hugh Mossman started on a journey to Ravenswood to obtain the first protection ticket for a prospecting area. This was issued in the names of Mossman, Clarke and Fraser on January 26, 1872, while the first claim was laid off for them by Warden Charters on February 6, 1872.

That is the story briefly told of the work of the prospectors, no effort being made to describe the months of unrewarded toil, their journeying through primeval bush, their curious searching of half hidden valleys and precipitous ranges, their vicissitudes and sufferings.

Hugh Mossman became a member of the Queensland Legislative Council and lived for many years to enjoy the honour. George Clarke, after winning a fortune at Charters Towers left there on a prospecting expedition at the Russell River Goldfield, north of Innisfail, and subsequently assisted the prospecting party which found the Gold Creek in Papua. Late in 1895 he was murdered in the Mambare River Valley, in New Guinea. At that time John Fraser had already passed on, but the Hon. Hugh Mossman (M.L.C.) still survived.

* * * * *

In 1899 Charters Towers had a population of 25,715 souls, and for some years it was the greatest gold producer on the Australian continent, the production rose from 20,063 ounces in the first year, 1872, to 457,850 ounces in 1898.

Although explorers such as Dr. Ludwig Leichhardt, E. B. C. Kennedy, Sir Augustus C. Gregory, Burke and Wills, William Landsborough, Frederick Walker and John McKinlay had traversed portions of North Queensland in separate expeditions between 1845 and 1861, no settlement had been formed in this teritory until the foundation of Bowen in 1861. Then several pastoralists established stations west of Bowen and on the Burdekin River and contiguous country, their cattle and sheep spreading over the district extending north to the future site of Townsville (Cleveland Bay), opened as a port in 1865 and as far west as the future site of the Charters Towers Goldfield. Amongst these early pastoralists were John Melton Black, Captain Robert Towns, G. E. Dalrymple, P. F. Selheim, R. Haughton, W. Hann, J. M. Dillon, Edward Cunningham, Atticus Tooth, Stone, Antill, Collins, Bode and McDonald. The country which was later occupied by the Charters Towers Goldfield in 1872 had been included in the Burdekin Downs Station, owned by Edward Cunningham.

Ironbark and other trees grew over the future site of the town. One of the cattle camps of Edward Cunningham was situated in close proximity to the future Defiance Crushing Mill site. The country to the north west was at that time (1871), held by William Mark, of Dalrymple. It was then known as The Plains, and is now known as Gainsford.

On the other side of the Burdekin River was the Fanning Downs Station, owned by Fred Hamilton, who was later a resident of Townsville, and the proprietors of Pajingo Station. Messrs Carr and Curr had a station south of Fanning Downs. Burdekin Downs Station was later confined to the further sides of the river.

This inland country would probably have remained for years in its partially settled state had not prospectors discovered gold at various points, such as Cape River, Gilbert and Percy rivers,, Etheridge River, Ravenswood, Charters Towers and Palmer River, between 1868 and 1873.

* * * * *

As soon as it became known that rich reefs had been discovered beyond the 70 Mile miners and diggers rushed to the new goldfield from Ravenswood and other northern fields. In a few weeks there were several hundred men on the sites of Charters Towers and Millchester and the number was being constantly augmented by new arrivals from Southern Queensland, and from other Australian States. Some came on horseback, some in vehicles and many of them, who afterwards became the city's most useful citizens, came on foot.

In the meantime the three prospectors had discovered the Washington, Old Warrior, Alexandra, St. Patrick and other reefs from which they took 1660 ounces from the surface alone.

and other reefs from which they took 1600 ounces from the surface alone.

There was a scarcity of water everywhere but at Millchester and then the main body which had originally camped about the North Australian Reef collected there.

Amongst the earliest arrivals on the field were Wyndham Palmer, Thomas Mills, T. Kelly, George Aubrey, Joseph Harvey, John Macrossan, R. Russell, I. Lissner, R. Craven, P. Foy E. Ward, T. Pfeiffer, W. C. and J. Little, T. Buckland, Joe Leech, J. Woodburn, J. B. Whitehead, J. Hutton, P. Hehir, D. Rollston, John Deane, E. H. T. Plant, J. Tilley, J. J. Connolly, T. Raine, A. Farrelly, J. Quirk, S. Allen, J. Gollan, Fred O'Donnell, D. Rowcastle, D. Creighton, J. Joyce, H. Connolly, Jack Thomas, Costello Brothers, W. Graham, Arthur McElmeel, Greaves Bros. Hurle, J. Little, J. Tronson, J. Ahern, John Malone, R. Long, M. M. Morris, T. Byrne, W. and J. Henderson, T. McQuillen, W. S. Jones, J. Taylor, W. Auld, T. Christian, E. Phillipson, R. Kirkbridge, R. Tregaskis, Osborn, Thompson, E. D. Miles, J. Leyshon, J. Holt, T. B. Bearup, J. Millican, Millett Brothers, R. Collins, E. Tubbs, C. F. Plant, N. Maynes, A. W. Wilson, Peyton, Hishon, D. Nagel, Owen, P. Nigro, Marshall, I. Lemel, Hamilton Jones, Tully, J. Shives.

W. S. E. M. Charters was the Warden at Ravenswood and the new field was named Charters Towers in the Warden's honour.

The Wyndham, North Australian, Rainbow, Mary, Queen and St. Patrick lines of reef soon gave evidence that the richest end of the field was not far from Mosman Street and so the future town of Charters Towers was built up there.

The life of the miners during 1872 was a merry one. Public houses of bark, dancing saloons and stores were quickly opened. In 1872 at Charters Towers a butcher named Trevarthan raised the price of meat, which the miners resented.

The main camp was then at Millchester, where the shop was situated. One Saturday night (November 2, 1872), the mob made a long rope fast through the gable of the shop and pulled the whole structure bodily into the road. Three of the ringleaders were arrested and taken to the lock-up at Charters Towers, a distance of two and a half miles. That night an armed mob of several hundred men marched up from Millchester and demanded the release of the prisoners. Warden Charters was at his residence ill, but Police Magistrate Jardine and Warder J. G. McDonald were equal to the occasion and by their tact and good judgment prevented a very serious riot. After a long parley the prisoners were granted bail.

On Monday morning the men were brought before the court, when fully 3000 persons were congregated in and around the court house. When Trevethan attended to give evidence he was rushed by the mob, but he escaped through the police lock-up. The excited mob then wrecked the lock-up. A large force of police was sent up from Brisbane and other towns, and many of the ringleaders were afterwards arrested, tried and punished.

* * * * *

On August 31, 1872, the goldfield had been proclaimed, with an area of 1700 square miles. This was subsequently reduced to 600 square miles. In August, 1877, Charters Towers was proclaimed a municipality.

In 1875 the Charters Towers Hospital Committee comprised the following members: President, W. S. E. M. Charters; treasurer, R. Allnut; secretary, John O'Flynn; committee, J. Lund, R. Long, W. S. K. Cusack, H. Hubert, I. Lissner, E. P. Graham, W. Tierney, A. Murphy; medical superintendent, A. Scharffenberg (M.D.).

Assayer, Thomas Buckland; Banks, Australian Joint Stock Bank, Bank of New South Wales, Queensland National Bank; General Storekeepers, Brodziak, Rogers and Co., I. Lissner and Co., J. M. Ryan, and A. V. Hilliard, Co-operative Stores; Chinese storekeepers, On War Jang (Millchester), Sun Yong Lee (Millchester).

In 1875 there were 36 hotels at Charters Towers, including the following Chinese hotels: All Nations (Jimmy Hong), New York Hotel (Chap Wong) and Sam Gongs.

Newspapers: "Northern Miner," and Northern Advocate," Surgeons: H. G. Purcell, J. A. Schaffenberg. Solicitors: H. W. J. Bowker (Millchester), and T. S. Carter (Millchester). Mining machines: John Deane (Black Dog and Defiance), Hishon and Co. (Never Despair), Hutton and Whitehead (Venus), W. Sadd (Enterprise), Tough Bros. (One and All), and J. Thomas (Maria Louisa). Butchers: Harvey and Co., Hubert, Trevethan and Williams.

The first crushing mill was erected in July 1872, and the first police gold escort to Townsville was in August, 1872. Mosman, Clark and Fraser received £1000 reward from the Queensland Government for the discovery of this goldfield.

In 1878 Cobb and Co's coaches carrying mails and passengers ran three times a week to and from Townsville (distance each way 100 miles). A bill had been passed then by the Queens-

(distance each way 100 miles). A bill had been passed then by the Queensland Parliament making provision for railway connection with Townsville.

The District Court sat at Charters Towers three times a year. Butchers' meat at the field in 1878 was 4d. per pound for beef, 5d. per pound for mutton.

The Charters Towers Municipal Council in 1878 comprised the following: Mayor, John McDonald; aldermen, H. W. Palmer, W. Jackson, H. R. Rutherford, T. Buckland, J. Deane, R. Hargraves, T. Mills, D. O'Neill.

Charters Towers District Hospital: President, W. S. E. M. Charters; vice-president, H. W. Palmer; treasurer, John Archibald; secretary, John O'Flynn; auditors, W. H. Doherty and W. J. Richards; surgeon, Dr. J. H. Little (M.B.) M.C.S. (E.D.).

Towers Jockey Club: President, F. H. Stubley; vice-president, J. S. Carter; treasurer, H. R. Rutherford; secretary, I. Aland; committee, H. R. Boulton, John Archibald, H. R. Rutherford, J. G. Jackson, O. O'Neill, J. Boles, F. J. Bladon, J. B. Whitehead, J. M. Carroll and W. A. Ackers.

There were 36 hotelkeepers at Charters Towers. At Capeville, G. Ah Pan (Royal Charter Hotel), J. T. Houghton (Exchange Hotel), W. Lotten (Union Hotel) and E. Tyler (Welcome Home Hotel). Burdekin: F. Hamilton (Fanning Downs Hotel), W. McAndrew (Burdekin Hotel). Millchester: M. Murray (Millchester Hotel). Queenton: G. G. Peeps (Junction Hotel) J. Burns (Queen's Hotel).

Butchers: Bucklands and Co., Harvey and Chick, Budge and Co., Aracott and Boles (Millchester) T. Bourne (Millchester). Hawker: Peter the Greek. Bakers: J. Clark, C. Kerr, H. T. Nottle, C. Edwards (Millchester). Auctioneers and Commission agents: W. A. Ackers, I. Aland, W. J. Allom, A. N. Bince, J. M. Carroll, W. J. Jackson. Newspapers: "Northern Miner" (T. O'Kane) "Towers Herald" (Jones and Co.) Solicitors: H. W. J. Bowker, J. S. Carter, J. Elliott. Steam sawmills: W. D. Casey and John Deane. Plumbers and tinsmiths: Wakefield and Co., J. Barker. Aerated water manufacturers: Harty and Co., Mrs. W. J. Toll. Blacksmiths: R. Rollinson, M. J. Thompson, O'Connor and Eustace, C. G. Lamond, Brown and Latham (Millchester). Bootmakers: L. Hamond, W. S. Hetherington, P. Crameri, MacDougall (Queenton), Ell Green and J. Moore (Millchester). Booksellers: T. Willmett and Co., A. Maicolm, J. Foley (Millchester). Building contractors and carpenters: G. Balding, A. Fraser, E. Lee, H. Ross, T. Wyatt. Hairdressers: J. Oxman, H. Walker. Mining machines: Byrnes' (Maria Louisa), Cravens' (Enterprise), Hutton and Whitehead (Venus), Nagle and Kelly (Never Despair), Stubley (Defiance) Tough Bros. (One and All), Ward's (Fair Rosamond). Tailings machines: Plant and Jackson, John Deane, Hutton and Whitehead.

1879, Charters Towers Municipal Council: Mayor, T. Buckland; aldermen, H. W. Palmer, W. Jackson, H. R. Rutherford, John Deane, Thomas Mills, O. O'Neill, J. W. Moses, A. St. Vincent.

Charters Towers Amateur Dramatic Club: Stage manager, Cecil Henning; musical director, W. A. Ackers; secretary, Herbert Warren; treasurer, W. H. Doherty.

1883, Charters Towers Municipal Council: Mayor, T. Buckland; aldermen, John Deane, M. Grogan, C. G. Lamond, F. Hamilton, J. T. Dunstan, J. Neal, I. Lissner, W. D. Casey; town clerk, E. D. Miles.

Fire Brigade Board: T. Buckland (Mayor), M. Grogan, I. Lissner, P. F. Sellheim and H. R. Rutherford; superintendent, A. St. Vincent.

Goldmining Companies (1883): Day Dawn, P.C.G.M. Co. Ltd (E. D. Miles, secretary); Diamond Drill Co. Ltd. (J. Longdon, secretary), Union G.M. Co., Ltd. (E. D. Miles, secretary); Victory G.M. Co., Ltd. (W. C. Burey, secretary); Peabody Extended G.M. Co. (E. D. Miles, secretary). Hope G.M. Co., Rainbow G.M. Co., and Mossman G.M. Co. (John O'Flynn, secretary).

Charters Towers Hospital Committee: President: I. Lissner; vice-president, Ross Robinson; treasurer, F. O'Donnell; committee, J. McDonald, T. Buckland, E. Phillipson, R. J. Sayers, J. S. Henderson, C. W. Bromhall, F. W. Brown, J. McElnea, J. Elford, H. Grant, A. Campbell, W. Robins; secretary, J. N. Longden.

Towers Pastoral, Agricultural and Mining Association: Patron, F. H. Stubley, M.L.A.; secretaries, Ackers and Wilson.

Towers Jockey Club (1883): President, Hon John Deane (M.L.C.); vice-president, H. R. Rutherford; treasurer, F. Coyle; secretary, R. Russell.

Police Magistrate and Warden: P. F. Sellheim; C.P.S., J. Archibald; Assistant Mining Registrar, W. K. Cusack.

Surgeons: Dr. Devis, Dr. W. Smith, Dr. Maxton; Solicitors: L. W. Marsland, M. Milford, H. W. Bowker; Surveyors: George Mossman, Hugh Swan.

The "North Queensland Register" weekly newspaper was first published in Charters Towers in 1891, edited by

weekly newspaper was first published in Charters Towers in 1891, edited by the late David Green.

The "Northern Miner" a morning daily, was established in 1873 by J. Smith Reid and was subsequently owned by Thaddeus O'Kane.

In 1898 there were two evening papers "The Herald," established in 1879, and "The Standard," established in 1895. There was also a weekly Labour paper, "The Eagle" established in 1894.

1898, Charters Towers Municipal Council: Mayor, J. A. Benjamin; aldermen, P. J. Allen, R. Gardner, A. B. Bright, C. J. Fraser, W. J. Paull, E. D. Miles, R. Kirkbride and B. Toll; town clerk, H. B. Walker.

Dalrymple Divisional Board: Chairman, E. H. T. Plant (since 1892), R. J. Sayers, T. Raine, Hon. John Deane, F. Hamilton, E. Gelling (jnr.), Hon. W. Alpin, A. W. O White and H. Abbott; shire clerk, R. Gibson.

The Cape River Goldfield had been discovered in 1868 and this led to the discovery of Ravenswood and Charters Towers. The Cape River was a decidedly rough locality in that period. There were fully 2500 men there, representing many nationalities. There were many miners from the southern goldfields. The Warden was W. S. E. M. Charters, Mining Registrar W. R. O. Hill. A well known Chinese hotelkeeper at the Cape was Ah Pan, in its early years.

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Some of the early miners at Charters Towers became prominent in the public life of Queensland.

The Hon. John Murtagh Macrossan M.L.A., was born in County Donegal, Ireland, in 1832. He was attracted to North Queensland by the Cape River rush, and later worked a claim called the Saratoga at Ravenswood. He first became prominent as the champion of the miners in disputes with the Mining Warden. In 1878 he was elected to the Queensland Parliament as the representative of Townsville. In the McIlwraith Government he was Minister for Works. He was mainly responsible for the construction of the railway line from Townsville to Reid River as the first section of the line to Charters Towers. With Sir Robert Philp he did much to advance North Queensland interests. He died in Sydney on October 20, 1891 while attending the first Federal Conference in that city.

Although Macrossan had many chances of enriching himself he died as he had lived—a man poor in the world's goods, but rich in the esteem and respect of all, not excepting those who very widely and strongly differed with him on political, national or religious matters.

By some means (not easily understood) the miners of North Queensland very seldom put their confidence or trust in the wrong man, and in John Murtagh Macrossan they found their idol. Mentally big, physically small, his eloquence, ability and courage brought him on their behalf into conflict with strong and powerful influences.

His eldest son, the late Hon. Hugh D. Macrossan, was Chief Justice of the Supreme Court of Queensland at the time of his decease, and his youngest son, the Hon. Neal W. Macrossan is now senior Puisne Judge of the same Supreme Court.

The Hon. John Deane was engaged in mining pursuits at the Cape River and Ravenswood before travelling to Charters Towers in 1872. In 1878 he was elected to the Queensland Parliament, but retired in favour of J. M. Macrossan. He was subsequently appointed a member of the Legislative Council of Queensland. He was a most progressive colonist and did much to assist the progress of the North. Although he was deeply interested in gold production he was also actively engaged in the pastoral industry. His greatest accomplishment was the establishment of the Burdekin Meatworks at Selheim in 1895.

Sir Thomas Buckland (who is now in his 98th year) was the first assayer on Charters Towers Goldfield. He moved to Sydney and until late years was chairman of directors of the Bank of New South Wales.

The following became members of the Queensland Legislative Assembly: Messrs. F. H. Stubley, I. Lissner, W. J. Paull, J. Millican and J. T. Dunstan. The Hon. Hugh Mossman, Hon. John Deane, Hon. A. W. Aplin and Hon. E. H. T. Plant were appointed to the Legislative Council.

Samuel Allen moved to Townsville and founded the company of Samuel Allen and Sons Ltd. W. A. Ackers moved to the same port and later became chairman of the Townsville Harbour Board.

Criticising Australia's attitude to worth-while tourist trade, the Lord Mayor of Melbourne (Cr. Connelly) stated that the service offered to people of other countries, stamped this country as second class.

CORRESPONDENCE.

WHAT'S WRONG WITH CHARTERS TOWERS.

(To the Editor.)

Sir,—I notice that Mr Ward has been writing to the "Courier," pointing out all the advantages of the Charters Towers district. He wrote a good letter, too, and deserves credit for the noise he made but if he wants to impress visitors to the field, he should try a clean-up right here at home. He might ask "What's the matter with the Towers itself, anyway?" There is a lot the matter, and no harm can be done by a citizen calling attention to it. They might seem trivial things, but they all count. They are all distasteful, and tend to make a man hate any place. Here are a few at random. When I feel bilious again, I'll send along a few more. Let us start on the bike pest, the scorching yahoo who sprints along footpaths and past private gates, regardless of children or anybody. He is aged from six to sixty, or thereabouts. The paths alongside Lissner Park are his favorite beats. I have seen women flattening themselves against the barb wire, or paddling up the slimy gutters to avoid him. Children scatter like fowls. He'll kill somebody one fine day, and it won't be himself. No such luck. The City Council takes no notice apparently. Then we have the Park sportsman, who [illegible] miss) flying foxes during the busy part of the day. It gives one a fine feeling of security to see a Park official (or employee, or sharp-shooter or whatever he is) spread out his legs, take a rotten aim, and send a bullet ping over anybody's house. The foxes might be a pest. They might be, I say, but—give me the foxes before the amateur snipers who spread lead about promiscuously. No doubt they mean well, but if some alderman loses an eye or a child through a stray bullet no doubt he'll get very little comfort watching the fox-misser wring his hands and sobbing 'I'm sorry." Now for the dogs. Ah, those dogs. Nasty coarse looking dogs, fed chiefly on cow-heel and trousers. They lurk in gateways and behind corners. Lean dogs and fat dogs, bleer-eyed and sour looking, but nearly always cattle dogs, sneaky and treacherous. I saw one leap at a child passing by, but a passer-by saved the mite. The owners ought to be made to tie them up, or shoot them, or eat them—the dogs, I mean—They are a menace. The Council surely has a by-law that could effectively deal with them, as the goats. Who owns this town—the people or the goats? Any poor one-horse bush town is usually goat-ridden, but Charters Towers should not be. They haunt vacant ground, and prowl and wait for the unwary to leave gates open. They squeeze through fences and wax fat on horticulture and other soft stuff, what time infuriated women and temporarily insane men pelt rocks, chairs, axes and language at them. Is the Council a Goat Protection Society, or a Nanny Club, or are they local agents for L. T. Piver, Paris, or what? One thing about the angora, though, I like. It does not sweep out its shop at 9 a.m. or later. The goat is considerate enough there. It's not so bad, after all, is Nanny. It never envelops me in offensive floor dust, or sweeps fluff and rubbish and germs on to my nice clean number twelves and best six and elevenpenny trousers. But it happens in the Towers. The Council hasn't noticed it, perhaps. Perhaps it never walks on the footpath, but keeps to the middle of the road, where, by the way, a lot of the traffic goes when it isn't on the wrong side. Oh, there's a lot Mr Ward has overlooked. The smelly drains, the weedy allotments given over to goats, tin cans and scrap iron, and the untidy habit migratory people have of leaving lonely chimneys and fireplaces and rusty tanks standing about. (Those chimneys, and the [illegible] of house-sites might with a stretch of imagination, be taken to represent a gathering of citizens being addressed by the Mayor, or the bailiff, or somebody). Talking about tanks reminds me that Charters Towers is cursed by a mosquito plague. Why don't people screen their tanks, or kerosene them? I don't mean the

don't people screen their tanks, or kerosene them? I don't mean the human tanks. I mean the usual receptacles for water, mud and leaves, and insects. No doubt mosquitoes would breed in the Main Drain, (if they could), but they can't, so it's no use blaming the local Yarra, or whatever it is that drifts through the park. I tell you, sir, there are any amount more things Mr Ward ought to start on before he tries to attract people here. I am getting out of breath. I'm waiting until I meet "Along the Line," and I'll ask him to help me write a letter to the "Courier," or you, or the Council, or the goats or somebody. We'll start on this village, and try to put a new bib on it, and then sit down and await results. It's a grand district all right, but it needs a tonic. which reminds me,—I must go and have one.

Yours truly.

DON SOTR.

APPENDIX 5 – PAST DISPERSAL TOOLS USED BY COUNCIL AT LISSNER PARK

Noise

- Ultrasonics - both directional and omnidirectional
- Dog whistle
- Air horns, Vuvuzela horns, horns from cars, prime movers
- Train whistle from steam train
- Birdfrite - 12 gauge shot gun
- Harley Davidson bikes
- Mowers, chainsaws, brush cutters
- Police sirens
- CD recordings of happy colony
- CD recordings of distressed colony

Firearms/Fireworks

- Birdfrite - 12 gauge shot gun
- Compressed salt - 12 gauge shot gun
- "22" - rubber bullets
- Paint Ball guns
- Fireworks

Light

- Flashing lights
- Strobe lights
- Spot lights
- Movement activated lights
- Car/truck lights

Water

- Fire trucks
- Fire hydrant
- Water hoses
- Hoses
- Ground sprinkler systems
- Tree sprinkler systems
- Wobbler sprinkler system

Animals/Bugs/Kites

- Hellium balloons
- Powered balloon man
- Various kites
- Trained eagles
- Green ants
- Rubber and plastic snakes

Smoke/Misting

- Fogging device
- Misting device
- Hickory wood smoke

Other

- Chilli wax
- Vibrating plucking mower against a tree
- Repellent
- Camphor - Moth & Silverfish repellent
- Canopy modification
- Tree removal
- Reflective type tapes
- Helicopter

Note that for future dispersals only approved methods that do not risk flying-fox harm will be employed.

APPENDIX 6 - MANAGEMENT OPTIONS

Below is an overview of management options commonly used across Queensland and Australia which were considered in the development of the Plan. An analysis of site-specific management options and their suitability for the Charters Towers LGA flying-fox roosts can be found in Appendix 7.

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.

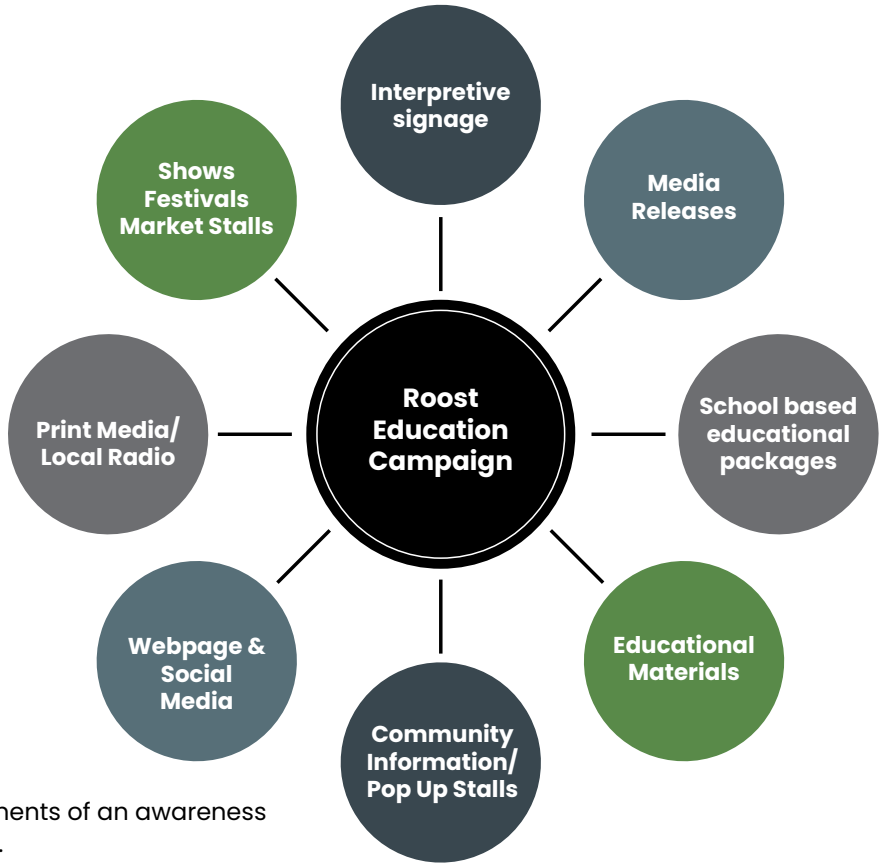
Residents should also be made aware that faecal drop and noise at night is mainly associated with plants that provide food, independent of roost location. Staged removal of foraging species such as fruit trees and palms from residential yards, or management of fruit (e.g. bagging, pruning) will greatly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

- 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 nine 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 efficancy 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 Low Impact COP 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.

No action

The management option to No Action 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:

- Physical visual deterrents – Visual deterrents such as fluoro vests (GeoLINK 2012) and balloons (Ecosure, pers. obs.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The balloon method (and similar methods) has the potential to create rubbish. In the absence of effective maintenance, this option could potentially lead to an increase in rubbish in the natural environment.

- Visual 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 study identified a light that flying-foxes perceive as abnormal (Olkkola 2019). A trial using the PROVolitans system illuminating the canopy of a roost tree, reported 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.
- 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 Sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and current use in Queensland is 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 CMS 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)

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 numerous 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 3). 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 assess if sprinklers increase humidity and potential heat stress impacts; results should be considered for sprinkler usage during HSE).

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.

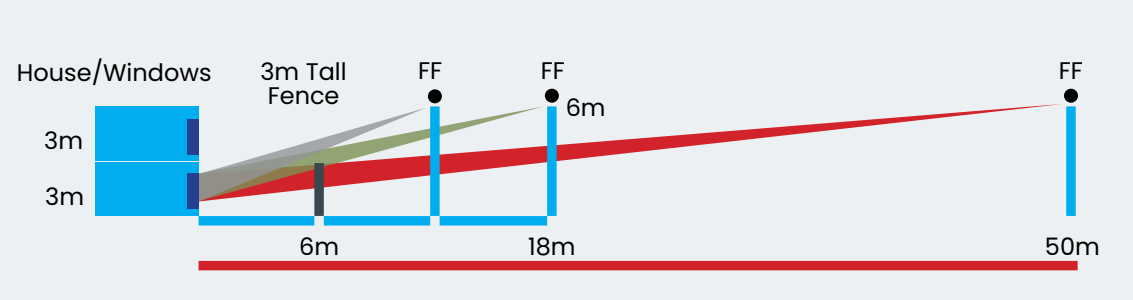
Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in 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. Temporary fencing is also available which is more cost effective.



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.

Figure 7: Temporary noise fencing - 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-fox 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 km and resulted in new conflict sites (Roberts et al. 2021). In addition, a review of 25 dispersal attempts in Queensland between November 2013 and November 2014 found that when flying-foxes were dispersed, they did not move further than 6 km away 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.

Passive dispersal

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

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

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

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

Active dispersal through disturbance

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

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

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

Early dispersal before a roost is established at a new location

This management option involves monitoring local vegetation for signs of flying-foxes roosting in the daylight hours and then undertaking active or passive dispersal options to discourage the animals from establishing a new roost. Even though there may only be a few animals initially using the site, this option is

still treated as a dispersal activity, however it may be simpler to achieve dispersal at these new sites than it would in an established roost. It may also avoid considerable issues and management effort required should the roost be allowed to establish in an inappropriate location.

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

Maintenance dispersal

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

Unlawful activities

Culling

Culling is addressed here as it is often raised by community members as a preferred management method; however, culling is illegal under local, State, and Commonwealth legislation and is not permitted as a method to manage flying-fox roosts.

APPENDIX 7 - MANAGEMENT OPTIONS ANALYSIS

Site-specific assessment of flying-fox impact management options commonly used across Australia, and their suitability for the Charters Towers flying-fox roosts (Table 5).

Table 5: Management options for the Charters Towers LGA flying-fox roosts. Further information on management options is provided in Appendix 5, and appraisal in Section 5.

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Routine management actions				
Community engagement & awareness programs	Fear of disease Noise Smell Faecal drop Water contamination	Low cost, increasing awareness will help the community understand the ecology of flying-foxes, providing options for landholders to reduce impacts. This is an effective short and long term solution. Education can be undertaken on an ongoing basis and in response to community concerns/needs.	Education and advice alone may not mitigate all issues, and on its own may not be acceptable to the community.	Community education, advice, and awareness programs are key components of any plan to manage flying-foxes and their roosts. Install educational signs at Lissner Park, especially during times of high conflict i.e. influxes. Signs could include a QR code to Council's website to provide additional information. Council should continue to provide up to date information to the community. This may include notifying the community that part of a park is closed for a day or a period for visitor safety and/or flying-fox welfare. For example, paths are closed to allow cleaning. Similarly, areas may be closed if large numbers of flying-foxes are present to reduce disturbing the roosting animals. This action also aims to reduce noise impacts to properties surround the park, flying-foxes alarm call when disturbed and will often take flight; this can shift roosting flying-foxes to undesirable locations. Council should also consider community engagement sessions to convey Council's management intentions and provide advice to affected residents, especially during times with large influxes, and support land managers of sensitive sites as required. **Appraisal: Adopt.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Roost monitoring	Noise Smell Faecal drop	Relatively inexpensive. Allows for an understanding of population dynamics over time which is important to inform community engagement actions. Allows for data to be used to determine the efficancy of management actions.	Not a direct management action that will minimise impacts.	Council undertakes frequent monitoring of Lissner Park roost. A minimum of quarterly monitoring, feeding this information to DETSI and the NFFMP. Monthly monitoring allows for the collection of key information. Including: roost extent, flying-fox numbers, seasonal trends, flying-fox demographics (species present, age), and can assist in informing when proactive management actions can be implemented and allows for data to be collected over time to assess management efficacy. **Appraisal: Adopt.** Drone monitoring (thermal) could be considered as a complimentary method of obtaining count and roost extent data. **Appraisal: Investigate.**
Property modification/ service subsidies	Noise Smell Faecal drop Health/ wellbeing	Property modification is one of the most effective ways to reduce amenity impacts of a roost. Property modification can promote conservation of flying-foxes, provide long-term outcomes, can be undertaken quickly, will not impact on the site, and may add value to the property. Property modification, such as glazing windows or installing noise attenuating insulation, will greatly assist with noise impacts inside residences and businesses. Installing shade sails, carports, or covering other affected areas will reduce the impacts of faecal drop.	May be cost-prohibitive for private landholders, however subsidies would assist.	Interest from the community was expressed in a subsidy program during the consultation session. The next step is to secure funding as part of future budgets and plan a staged delivery. Funding is recommended to be allocated using a tiered approach based on distance to the roost. For example, the first tier may include houses within 50 m, the second tier may include houses within 100 m, etc. Eligibility criteria will need to be applied and amount available per house per tier will be funding dependent. **Appraisal: Investigate.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Routine roost maintenance	Health/ wellbeing Damage to vegetation (Heritage listed plantings)	This action is not aimed at managing flying-foxes, it allows the landholder to undertake routine maintenance at or near the flying-fox roost (in line with the Low impact COP). Note, weed removal has the potential to reduce habitat at a roost and reduce numbers of roosting flying-foxes.	Will not, in general, mitigate amenity impacts for nearby landholders.	Protocols should be developed for carrying out operations that have the potential to disturb flying-foxes, which can increase impacts such as noise and smell, and create a flying-fox welfare issue. While pups are present and the risk of abandonment or abortion is high, efforts to reduce disturbance could include the use of battery powered tools to reduce noise, smaller teams, mulching under roost trees to avoid operations in the area and starting machinery away from the roost and working towards it whilst monitoring. This will assist in reducing the risk of human/flying-fox interaction. Vegetation maintenance should aim to identify opportunities to enhance or create future roosting habitat where the roost can extend into or shift to in the future. Any weed removal should be staged and mindful of disturbance or exacerbating the potential for HSEs. **Appraisal: Adopt.**
Alternative habitat creation	Noise Smell Faecal drop Health/ wellbeing	If successful in attracting flying-foxes away from high conflict areas, dedicated habitat in low conflict areas will mitigate most impacts and help flying-fox conservation. Rehabilitation of degraded habitat that is likely to be suitable for flying-fox use could be a more practical and a faster approach than habitat creation. Improving potential alternative roost habitat should be part of a medium-to long-term plan.	Generally costly, long-term (~5-10 years for roost tree growth) approach so cannot be undertaken quickly, previous attempts to attract flying-foxes to a new site have not been known to succeed.	Feasible and highly supported by Council and the community for BFF at Lissner Park. Flying-fox Reserve at the Sewage Treatment Plant was identified as a receiver site with the potential to support the BFF numbers at Lissner Park. Subsequently, this will reduce management limitations associated with overlapping breeding season of LRFF and BFF, when influxes of LRFF occur at Lissner Park Staged weed management and planting of roost habitat should be undertaken at Flying-fox Reserve and restoration of Young's Block investigated as a long term management option. **Appraisal: Adopt**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Odour reducing/ masking plants	Noise Smell Health/ wellbeing	Planting dense screens and fragrant plants to assist with odour and noise and trim tall trees to less than 5 m high and/or use wildlife friendly netting to prevent occupation by flying-foxes.	May take time for plants to provide the desired effect, and unlikely to mitigate odour during large influxes.	Residents could be encouraged to modify properties by planting dense screens and fragrant plants. This information can be provided in an education program and Council could provide free plants. **Appraisal: Investigate.**
Indoor neutralising pots	Smell	Indoor odour neutralising pots (Hostogel™) contain a gel-based formula to chemically mask odour have been shown to have a localised positive effect in reducing odour. Inexpensive, has been trialled before for neutralising indoor odour.	If residents rely on keeping windows open for airflow in warmer months, this may not be a suitable option for minimising odour.	Indoor odour neutralising pots could be trialled for residents impacted by odour. This could be considered as part of a subsidy program and incorporated into future budgets. **Appraisal: Investigate.**
Provision of artificial roosting habitat	Noise Smell Faecal drop Health/ wellbeing	Artificial roosting habitat could be considered to supplement vegetation damaged by large numbers of flying-foxes	Potentially very costly. No guarantee that flying-foxes would use artificial habitat, but collaborating with a researcher on varying design options would increase the likelihood of success.	Investigate the potential for implementing innovative solutions for roost structures at identified receiver sites to support influxes; would require a trial phase. Methods to enhance roosting opportunities while simultaneously working on establishing additional roost trees could be explored. **Appraisal: Investigate**
Protocols to manage incidents	Health/ wellbeing Fear of disease	Low cost will reduce actual risk of negative human/pet– flying-fox interactions, promotes conservation of flying-foxes, can be undertaken quickly.	Will not mitigate amenity impacts but will reduce fear of disease.	Community education regarding disease risk to humans and pets. Council to maintain/develop (where required) standard internal procedures for operations, response to HSEs, and other potential incidents. **Appraisal: Adopt.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Support flying-fox carers	Health/ wellbeing Flying-fox welfare	Low cost, fosters relationship between Council and wildlife carers, can decrease risk of negative human/pet/ flying-fox interactions with early intervention of carer support during HSEs, food shortages, etc.	Will not mitigate amenity impacts.	Council to maintain good working relationship and support flying-fox carers, especially during times of increased likelihood of HSEs, food shortages, and during pupping and crèching periods. **Appraisal: Adopt.**
Research	Noise Smell Faecal drop Health/ wellbeing	Support research that improves understanding and more effectively mitigates impacts. Develop understanding of local flowering.	Generally cannot be undertaken quickly, management trials may require cost input.	Council should stay up-to-date with contemporary research and review the Plan as required. Analysis of scats to assess foraging species. Monitoring the timing, distribution, and extent of flowering across the LGA. Drone surveys provide increased accuracy over ground count methods. GPS tracking movements in your area would inform community engagement and an assessment of foraging habitat. **Appraisal: Investigate.**
Appropriate land use planning	Noise Smell Faecal drop Health/ wellbeing	Suitable planning for future development will reduce potential for future conflict.	Will not mitigate current impacts.	Incorporate planning controls where possible. **Appraisal: Investigate.**
Property acquisition	All for specific property owners Nil for broader community	Mitigation for directly impacted residents (within the approved criteria threshold).	Potentially cost prohibitive.	In combination with habitat improvement and frequent monitoring, this option is potentially suitable for low conflict areas that dispersed flying-foxes show natural preference to. Council should record areas of high fidelity that have not been designated as receiver sites during active management and consider acquisition and improvement. **Appraisal: Investigate.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Do nothing	Nil	No resource expenditure.	Will not mitigate impacts and would not be considered acceptable by impacted members of the community.	Not appropriate. **Appraisal: Disregard.**
Low Impact COP				
Buffers through vegetation modification	Noise Smell Health/ wellbeing	Any vegetation modification should be done using a staged approach, with the aim of changing native vegetation as little as possible and only if flying-foxes' use of this vegetation is directly affecting residents.	Modifying vegetation can increase visibility into the roost and noise issues for neighbouring residents which may create further conflict. Vegetation removed too quickly could cause inadvertent movement to less desirable locations within/ adjoining a roost or dispersal of a roost.	A vegetative buffer could include the removal or trimming of trees and the retention of native shrubs and grasses. Vegetation management should start with the removal of weed species. Buffer creation can also include screening shrubs, particularly species with fragrant flowers or foliage. This option should be suitable for residents surrounding Lissner Park. **Appraisal: Adopt.**
Buffers through visual deterrents, canopy mounted sprinklers	Noise Smell Health/ wellbeing Damage to vegetation	Successful creation of a buffer will reduce impacts, promotes flying-fox conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community, particularly in Lissner Park (heritage listing).	May impact the site, buffers will not generally eliminate impacts, maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.	The use of canopy mounted sprinklers (CMS) could be considered as favourable compared with a vegetative buffer in some locations. Equally, both methods are often complementary: a buffer of shrubs and CMS in the trees along the buffer edge to deter flying-foxes roosting close to high conflict areas. The use of PROVolitans or LED lighting systems can create a buffer or asset protection (e.g. deter roosting within an individual high value tree). A cost-benefit analysis should compare the cost and effectiveness of various methods (e.g. vegetative, CMS, light buffer creation) before deciding on the appropriate approach as this is likely to differ between roosts and the specific context. **Appraisal: Investigate.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Noise attenuation fencing	Noise Smell Health/ wellbeing	Noise attenuation fencing is intended to alleviate amenity issues for residents. Advice from an acoustic consultant may provide site specific alternatives.	Noise attenuation fencing is costly and can be considered unsightly for property fencing. This management action may be negated if flying-foxes move to roost in vegetation within residential gardens, above/past the noise attenuation fencing.	Unlikely to achieve a meaningful and lasting outcome in relation to the Lissner Park roosts. However, temporary noise attenuation fencing may be an option for Council to install at properties surrounding Lissner Park during large influxes. **Appraisal: Investigate.**
Management COP				
Nudging	All	Can encourage flying-foxes to shift away from high conflict areas next to residential areas.	May lead to inadvertent dispersal and splintering of the roost if not done at the correct time, frequency, or intensity.	Effective option for splintered groups during active dispersal. Council should use nudging as a method to temporarily move flying-foxes to the least high conflict areas of each site at the conclusion of each dispersal attempt. Active dispersal can then continue the following day. Transparent management planning and communication with residents required. Monitoring is required to ensure that nudging isn't implemented if pups are in a crèche tree. Council monitoring should aim to inform staff, contractors, and the community of this behaviour and where it is occurring. Alternatively, nudging could be paused during months when pup crèche trees are identified. **Appraisal: Adopt.**

Management Option	Relevant Impacts	Advantages	Disadvantages	Suitability
Active dispersal	All (generally appropriate for amenity impacts only)	If successful can mitigate all impacts at that site. It is important to note that the outcomes of dispersal are generally temporary, and repeat dispersal is likely to be required as flying-foxes attempt to re-establish the roost. This may be seasonally, annually, or more regularly.	Dispersal is rarely successful without significant vegetation removal or ongoing effort and excessive expenditure (e.g. several years and $1M for Sydney Botanic Gardens). Flying-foxes will almost always continue to roost in the area generally within 600 m), and often splinter into several locations nearby (including many remaining at the original site).	This option is highly supported by Council and the Charters Towers community. To be effective, low conflict receiver sites have been identified and require maintenance and monitoring. A strategy has been developed aiming to move BFF to the Flying-fox Reserve, allowing Council to respond promptly to influxes of LRFF at Lissner Park without limitations caused by BFF pups being present. **Appraisal: Adopt.**

APPENDIX 8 - 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 (Queensland Health 2022).

Below is current information at the time of writing. Please refer regularly to Queensland 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 bats (Saccolaimus flaviventris), an insectivorous microbat, and seroconversion (development of virus-specific antibodies) has been found in seven microbat genera (WHA 2023). It is assumed that all bats may be capable of hosting ABLV (WHA 2023). The probability of human infection with ABLV is very low, with less than 1% of the flying-fox population being affected (WHA 2023), 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 2023).

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 2023, 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 (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 Queensland 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 be monitored 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/vet 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 2024). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (WHA 2024). 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 2024). As of 2021, over 106 HeV infections in horses (confirmed or possible cases) have been reported (WHA 2024). 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 2024). The most likely route of transmission is through exposure of horse mucous membranes to infected flying-fox urine, body fluids, or excretion (WHA 2024). 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 2024). 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 (Queensland 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% (Queensland 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 9 - PROTECTING FLYING-FOXES IN RESPONSE TO EXTREME WEATHER EVENTS

Heat

Flying-foxes are especially susceptible to extreme heat. Temperatures above 38°C, consecutive hot days, lactation, age, and other weather variables such as high humidity contribute to the likelihood of a Heat Stress Event (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 40.6°C have caused HSEs in Qld (Bishop 2015, Collins 2014).

Over 40 HSEs have occurred in Australia since 1994 (see Lab of Animal Ecology 2024, 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. A '*flying-fox heat stress guideline*' is available from the Queensland government.

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. 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).

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

The risk of a bushfire is quite low at Lissner Park. However, with the increasing impacts of climate change and more severe bushfire seasons in Australia, evident in the 2019-20 bushfire season, flying-foxes are vulnerable to widescale habitat loss (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. 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 associated with urban roosts, therefore preparedness for influxes in particularly severe bushfire seasons is advisable.

APPENDIX 10 - ACRONYMS & ABBREVIATIONS

ABLV	Australian bat lyssavirus
ACP	*Act Animal Care and Protection Act 2001 (Qld)*
BFF	Black flying-fox (Pteropus alecto)
Council	Charters Towers Regional Council
DPI	Department of Primary Industries (formerly 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)
DETSI	Department of Environment, Tourism, Science and Innovation (formerly Department of Environment, Science and Innovation) (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999(Commonwealth)*
FFAC	Flying-fox Advisory Committee
FFRMP	Flying-fox Roost Management Permit
the Guideline	Flying-fox Roost Management Guideline (Qld)
HeV	Hendra virus
HSE	Heat stress event
LGA	Local government area
Low Impact COP	Code of Practice – Low impact activities affecting flying-fox roosts (Qld)
LRFF	Little red flying-fox (P. scapulatus)
Management COP	Code of Practice – Ecologically sustainable management of flying-fox roosts (Qld)
NC Act	*Nature Conservation Act 1992 (Qld)*
NFFMP	National Flying-Fox Monitoring Program
the Plan	Charters Towers Flying-fox Roost Management Plan
Planning Act	*Planning Act 2016 (Qld)*
Qld	Queensland
SoMI	Statement of Management Intent
UFFMA	Urban Flying-fox Management Area
VM Act	*Vegetation Management Act 1999 (Qld)*

CHARTERS TOWERS
REGIONAL COUNCIL

Flying-Fox Management Plan

PO Box 189 Charters Towers Qld 4820
ADMINISTRATION: 12 Mosman Street
Charters Towers Qld 4820 Australia
PH: (07) 4761 5300 | **F:** (07) 4761 5344
E: mail@charterstowers.qld.gov.au
ABN: 67 731 313 583

www.charterstowers.qld.gov.au