SITE SPECIFIC MANAGEMENT PLAN

Ku-ring-gai Flying-fox Reserve 10-Year Site Management and Roosting Habitat Plan

2018 - 2028

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1. Introduction

1.1 Foreword

This 10 Year Site Management and Roosting Habitat Plan for The Ku-ring-gai Flying-fox Reserve (KFFR) is a site specific management plan that has been prepared by Ku-ring-gai Council's Bushland Operations and Natural Areas Divisions in accordance with the NSW *Local Government Act 1993* taking into account the amendments made through the *Local Government Amendment (Community Land Management) Act 1998* and its Regulation. This site-specific management plan has also been prepared in accordance with the Ku-ring-gai Flying-fox Reserve Conservation Agreement.

Council currently invests in its bushland reserves using a special tool called the Bushland Prioritisation Matrix. By weighing variables such as threatened species, resilience and threats, reserves are priority ranked for internal and external funding. The Ku-ring-gai Flying-fox Reserve has been identified by Council as a priority reserve and the first reserve requiring site management attention in the form of a site specific management plan, specifically a 10 Year Site Management and Roosting Habitat Plan.

The aim of this 10 Year Site Management and Roosting Habitat Plan for the Ku-ring-gai Flying-fox Reserve is to assist Council and volunteers to work in a strategic and coordinated manner. This document also allows for public transparency and understanding of the management actions undertaken within the Ku-ring-gai Flying-fox Reserve. Preparation of this plan has included a review of the existing Ku-ring-gai Flying-fox Reserve Management Plan 2013 and incorporates changes in legislation, recent research on Flying-foxes and current best practice in bush regeneration and habitat management. It provides a focus for working with the local community to effectively manage the Reserve with a focus on conservation of the Grey-headed Flying-fox.

This 10 Year Site Management and Roosting Habitat Plan for the Ku-ring-gai Flying-fox Reserve provides detailed actions to address the issues, challenges, limitations and opportunities that are unique to the reserve.

1.2 Statement of significance

From a National and a State perspective, the Ku-ring-gai Flying-fox Reserve is significant for providing roosting and maternity habitat for the Grey-headed Flying-fox, a species listed as Vulnerable under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Biodiversity Conservation Act 2016* (BC Act). The Ku-ring-gai Flying-fox Reserve is important to the Grey-headed Flying-fox as it provides:

- a resting site
- a breeding site
- access to food in both urban landscapes and extensive native forests
- stopover habitat for migrating animals
- habitat for a resident population (group)

- an ideal site for long-term research, including the longest population monitoring of any Flying-fox camp in Australia.

The Ku-ring-gai Flying-fox Reserve also contains Sydney Turpentine Ironbark Forest (STIF), an Endangered Ecological Community (EEC) under the BC Act, a known nesting site of a Powerful owl and other vulnerable listed species such and Red-crowned Toadlet. The Ku-ring-gai Flying-fox Reserve is Council's only bushland reserve specifically managed for the conservation of a threatened fauna species.

1.3 Site Name/s

The site is known as the Ku-ring-gai Flying-fox Reserve and as Gordon Park.

2. Site Description

2.1 Site Location

The Ku-ring-gai Flying-fox Reserve is adjacent to Stoney Creek in Gordon (see Figure 1 and Figure 2), covering an area of approximately 15.34 hectares, which incorporates an additional 0.44 hectares of land added in 2007. The Ku-ring-gai Flying-fox Reserve is bounded by Bushranger Reserve to the east, residential houses along Illeroy Avenue, Maytone Street, Bell Street, and Nelson Street to the south. Houses on Edward Street border the reserve to the west and houses along Taylor Street, Glenview Street and Waugoola Street form the northern boundary.

Reserve/Site size (ha)	15.34
Lot and DP number	Composed of 18 Lots as follows: Lot 158 DP 17131, Lot 1 DP 38541, Lot 2 DP 38541, Lot 3 DP 578212, Lot 101 DP 578212, Lot 1 DP 578212, Lot 1 DP 204102, Lot 2 DP 200605, Lot 10 DP 23994, Lot 34 DP 1079802, Lot A DP 212698, Lot 156 DP 17131, Lot 1 DP 179532, Lot 5 DP 1099395, Lot 154A DP 17131, Lot 35 DP 16006, Lot 7 DP 1132073, Lot 103 DP 17647
LMU Number	364
Council Ward	Gordon
Catchment / Sub Catchment	Stoney Creek
Planning Zone:	E2 - Environmental Conservation
Planning Instrument:	Ku-ring-gai Local Environmental Plan 2015

Figure 1. Location of the Ku-ring-gai Flying-fox Reserve

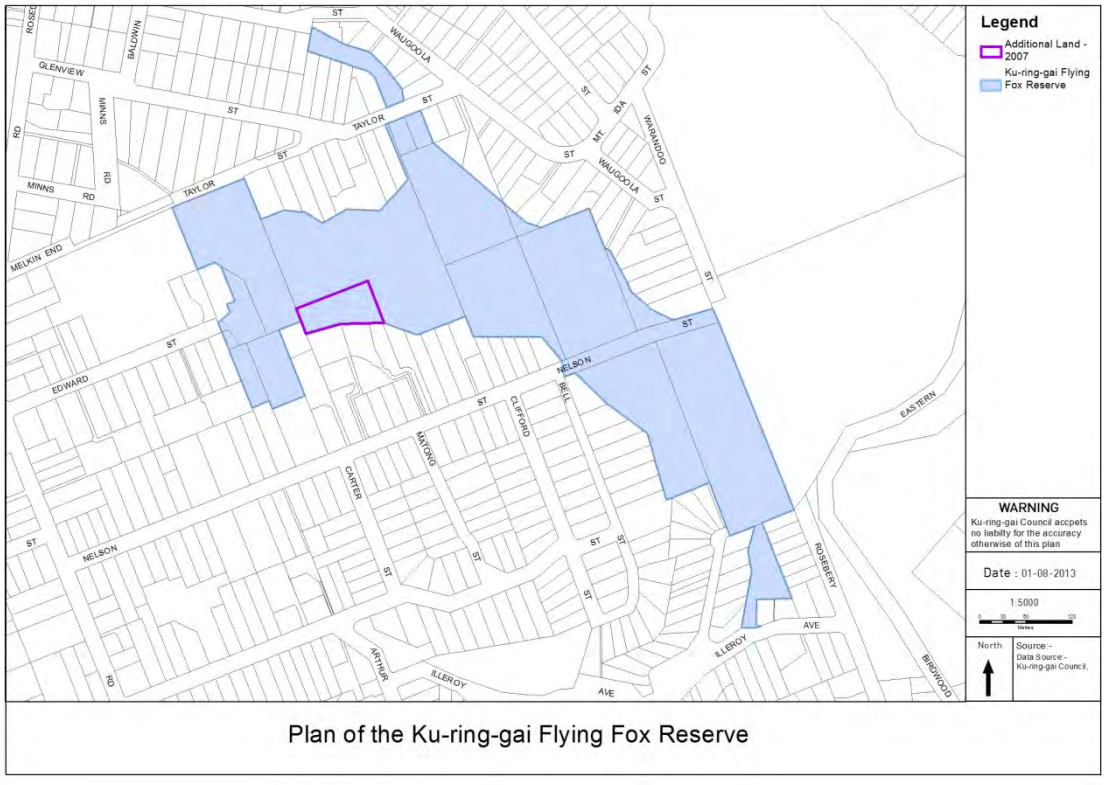


Figure 2. Plan of the Ku-ring-gai Flying-fox Reserve

2.2 Management authority and planning instruments

2.2.1 Local Government Act 1993 (NSW)

The *Local Government Act 1993* requires a specific Plan of Management (PoM) for community land that comprises habitat for a threatened species listed under the *Threatened Species Conservation Act* 1995 (NSW). This requirement is addressed through Council's Bushland PoM however; this management plan provides additional site-specific information and guidance specific to the KFFR.

The Management Plan for the Ku-ring Flying-fox Reserve will not always be consistent with Council's current Bushland Reserves PoM. Where there are inconsistencies, the KFFR Management Plan will override the Bushland Reserves PoM. For example, some species of non-local native plants or weeds that are brought in to Ku-ring Flying-fox Reserve by the Flying-foxes may be beneficial as roosting habitat for Flying-foxes so may be left on site.

2.2.2 Conservation Agreement

This Management Plan is consistent with the purpose, terms and conditions of the Ku-ring-gai Flying-fox Reserve Conservation Agreement, in accordance with the provisions of s. 72 (1) of the *National Parks and Wildlife Act 1974* (NSW).

2.2.3 Ku-ring-gai Flying-fox Reserve Management Plan 2013

The Ku-ring-gai Flying-fox Reserve Management Plan (Ku-ring-gai Council 2013) has been prepared in accordance with the Ku-ring-gai Flying-fox Reserve Conservation Agreement, entered into between Ku-ring-gai Council and the NSW Government in February 1991, to ensure the continuing protection and preservation of native flora and fauna, in particular the Grey-headed Flying-fox colony and all elements of its habitat, within the Ku-ring-gai Flying-fox Reserve.

This Plan is considered as a plan of management in relation to clause 3.7 of the Conservation Agreement (the "Agreement') and under section 72 (1) (e) of the National Parks and Wildlife Act 1974, and is considered a specific reserve management plan under Council's Bushland Reserves Plan of Management (PoM), prepared under the *Local Government Act 1993* (NSW).

A key action of the KFFR Management Plan 2013 was to develop and implement this 10-year roosting habitat / tree canopy replacement plan that identifies replacement areas and suitable methods and species to establish and maintain understorey vegetation where Flying-foxes can escape extreme heat, that is, temperatures above 40˚. This plan is to inform actions within the Bush Regeneration Site Management Plan.

2.2.4 Other legislation

The major pieces of legislation related to the management of the KFFR are:

Federal:

- *Environment Protection & Biodiversity Conservation (EPBC) Act 1999*

New South Wales:

- *Biodiversity Conservation Act 2016*
- *Rural Fires Act 1997*
- *NSW Biosecurity Act 2015 (the Biosecurity Act) Protection of the Operation of the Environment Act 1997*
- *National Parks and Wildlife Act 1974*
- *Environmental Planning and Assessment Act 1979*

Further details of legislation are provided in Council's Bushland Reserves Plan of Management at http://www.kmc.nsw.gov.au/.

2.3 Technical advisory group

This Management Plan has been prepared in consultation with The Ku-ring-gai Flying-fox Reserve Technical Advisory Group, consisting of members of the Ku-ring-gai Bat Conservation Society, The KFFR Bushcare group, STEP Inc., an independent Flying-fox expert and staff from the Environment and Sustainability and Open Space Services sections of Council.

Ku-ring-gai Municipal Council is the owner of the KFFR and has legal responsibility for the overall management of the Reserve. Implementation of this Plan and management of the reserve will be a joint responsibility of Ku-ring-gai Council and the KBCS. Council will take a lead role, with the KBCS providing support, offering advice and helping with on-ground works, through the Bushcare Program, and educational events, such as bat nights and Flying-fox fly-out viewings.

3. Cultural Heritage

3.1 European

A search of the Commonwealth commonwealth-heritage-list and the Register of National Estate was undertaken on 1 November 2016. There are no recorded European heritage items within the KFFR. Given the lack of any known structures within the reserve, it is considered unlikely that there are any unrecorded items of European heritage and subsequently there are no specific European heritage management considerations.

However, there is potential heritage value from some of the large garden estates adjoining the flying fox reserve, including a patch of Giant Bamboo located on the eastern boundary of 6-10 Edward Street.

3.2 Aboriginal

The KFFR is within the boundaries of the Metropolitan Local Aboriginal Land Council, part of the Kuringgai or Guringai traditional owner area. A search of the Aboriginal Heritage Management Information System (AHIMS) was undertaken on 1 November 2016. No known Aboriginal heritage sites or objects have been recorded on the site, however this may relate to a lack of any survey having been actually undertaken within the reserve. The lack of significant disturbance and residential development within the Ku-ring-gai Flying-fox Reserve, together with the presence of Stony Creek, suggests there is potential for intact sensitive landforms containing archaeological deposits or Aboriginal objects to occur. This archaeological potential should be considered if any ground disturbance is being planned within the reserve. There are no specific Aboriginal heritage management considerations for the reserve.

4. Natural Heritage

4.1 Abiotic Environment

4.1.1 Topography

The KFFR is a steep sided sandstone gully. Most of the KFFR has steep slopes (over 18 degrees) which are potentially susceptible to erosion and slip (see Figure 3). There are also several rock scarps / cliff lines onsite. These areas have implications for site access, work health and safety and reserve management, including bushfire hazard reduction and regeneration practices.

4.1.2 Geology and Soil Landscape

The gully is Triassic Hawkesbury Sandstone that consists of medium to coarse-grained quartz sandstone, minor shale and laminate lenses downslope from caps of Wianamatta group Ashfield shale that consists of black to dark grey shale and laminate. Within the gully and slopes is the erosional Gymea soil landscape downslope from the residual Lucas Heights soil landscape and erosional Glenorie soil landscape to the north east (Chapman and Murphy 1989) .

The KFFR is situated at the intersection of two Mitchell Landscapes: the Pennant Hills Ridges and the Belrose Coastal Slopes (NSW National Parks and Wildlife Service 2002).

The Pennant Hills Ridges consist of rolling to moderately steep hills on horizontal Triassic shales and siltstones. This is what occurs upslope of the valley and is most prominent in the western portion of the KFFR particularly around Edward Street. The Pennant Hills Ridges contain deep red texture-contrast soils on narrow hillcrests, red and brown to yellow texture-contrast soils on slopes becoming slightly harsher in drainage lines (Department of Environment and Climate Change 2008).

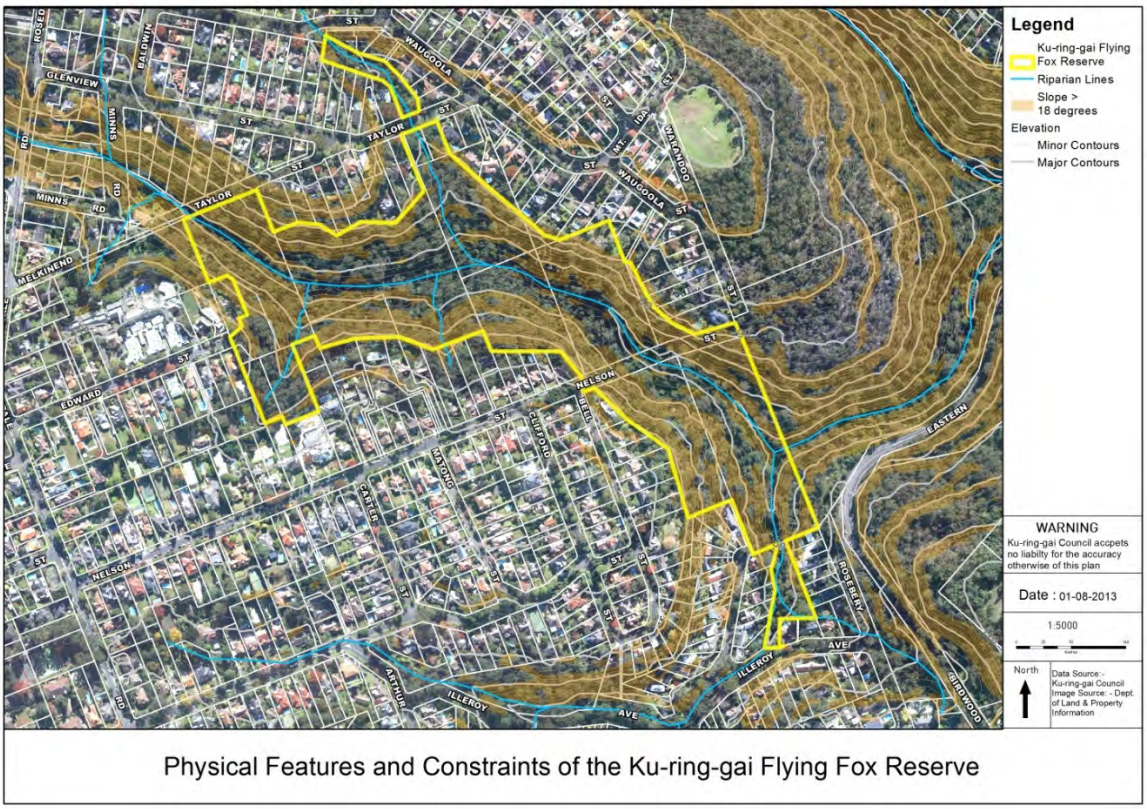


Figure 3. Physical features and constraints of the KFFR

The Belrose Coastal Slopes are benched hill slopes and deep valleys of the coastal fall on horizontal Triassic quartz sandstone, lithic sandstone and shales. The majority of the KFFR is representative of the Belrose Coastal Slopes. There is a high proportion of rock outcrop with discontinuous cliffs to 5m high. The soils are shallow uniform or gradational sands and earthy sands on ridges, deeper sands, loamy sands and organic sands on wet benches, grey or yellow texture-contrast soils on shale benches. Accumulations of deeper sand and occasional podsols in depositional sites and along streams such as Stoney Creek occur. The coastal forest with species including *Eucalyptus saligna*, *Eucalyptus pilularis*, and *Syncarpia glomulifera* indicates the presence of better quality shale soil (Department of Environment and Climate Change 2008).

The soil has increased in phosphorus where the flying-foxes have camped. Wiley (1988) estimated that flying-fox faeces contributed approximately 3kg of phosphorus per hectare per year which is higher than other suburban sources. Treadwell (1996) calculated that 27kg per hectare had been added since 1988. Both studies concluded that the additional nutrients were contributing to weed growth.

4.1.3 Hydrology and Catchment

Ku-Ring-Gai Flying Fox reserve is situated within the Stony Creek Catchment. Downstream of the reserve Stony Creek enters Rocky Creek, which is a tributary of Middle Harbour. Stony Creek is a shallow bedrock/boulder creek that consists of a series of disconnected pools. The surrounding catchment is steep, resulting in sudden high velocity flows following rainfall events. These high

velocity flows increase the potential for erosion and slip throughout the catchment. Despite the high proportion of urban land use in the catchment, Stony Creek appears to be in good ecological condition with a variety of aquatic habitats including overhanging banks and vegetation, instream woody snags, residual refuge pools and instream aquatic macrophytes.

4.1.4 Climate

Data from the Riverview Observatory (station number 66131) (the nearest station with up to date data) indicates that the KFFR has a temperate climate with a hot summer and mild winter. Table 1 outlines the temperature and rainfall data for the KFFR. Figure 4 and Figure 5 show the minimum and maximum temperatures. The lowest daily temperature recorded at the Riverview Observatory was -1.7 ˚C recorded in the month of July. The highest daily temperature recorded was 45.4 ˚C recorded in the month of January. Heat stress is known to affect the Grey-headed Flying-fox (and other Flying-fox species) when temperatures reach 42 ˚C or more. The KFFR can obtain daily temperatures exceeding 40 ˚C from November to April. As such, there is a long season where the Grey-headed Flying-fox needs a reliable heat refuge within the KFFR.

The nearest weather station with daily rainfall data is the Turramurra Kissing Point Rd, weather station (station number 066158) which indicates that the KFFR experiences most rainfall in summer and autumn with a drier winter and spring. Average rainfall for each season is outlined in Table 1. Figure 6 shows the yearly rainfall data.

Table 1. Climate data for the KFFR

Season	Average minimum temp. (˚C)	Average maximum temp. (˚C)	Highest daily temp. (˚C)	Lowest daily temp. (˚C)	Average rainfall (mm)
Spring (September – November)	11.9	22.6	40.5	1.7	93
Summer (December – February)	12.2	26.6	45.4	8.3	138
Autumn (March – May)	12.9	22.6	40.2	3.4	135
Winter (June – August)	7.1	17.5	30.2	-1.7	101

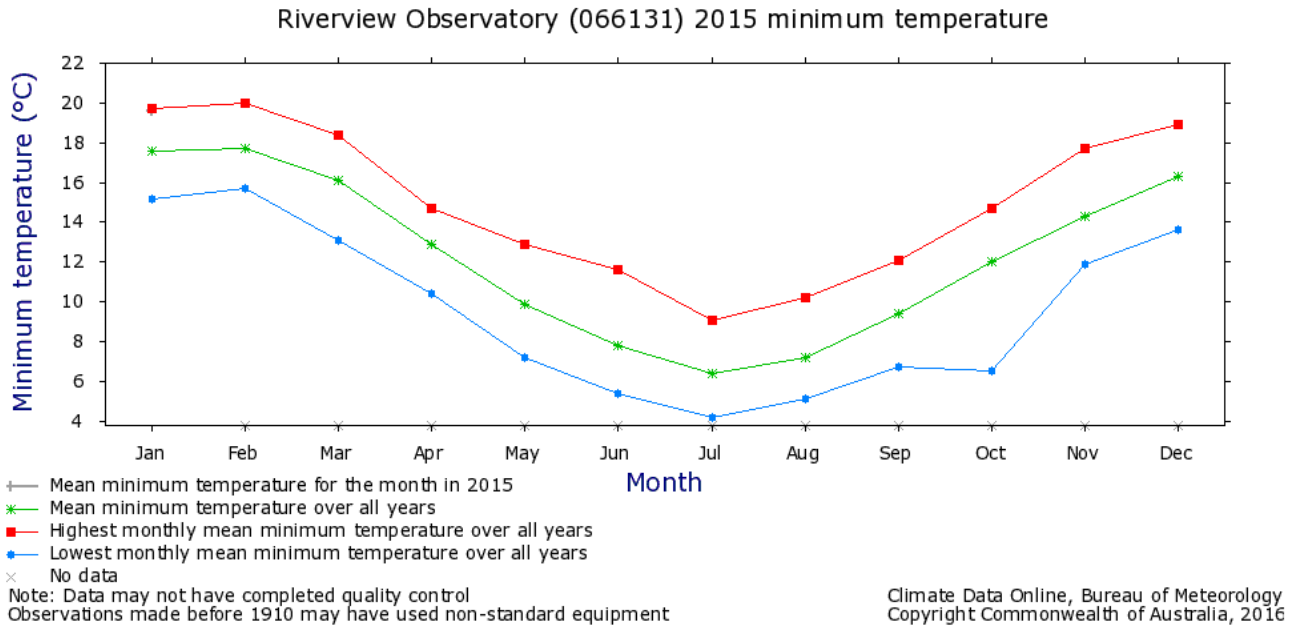


Figure 4. Minimum temperature (degrees Celsius) obtained from the Bureau of Meteorology Riverview Observatory (station number 066131)

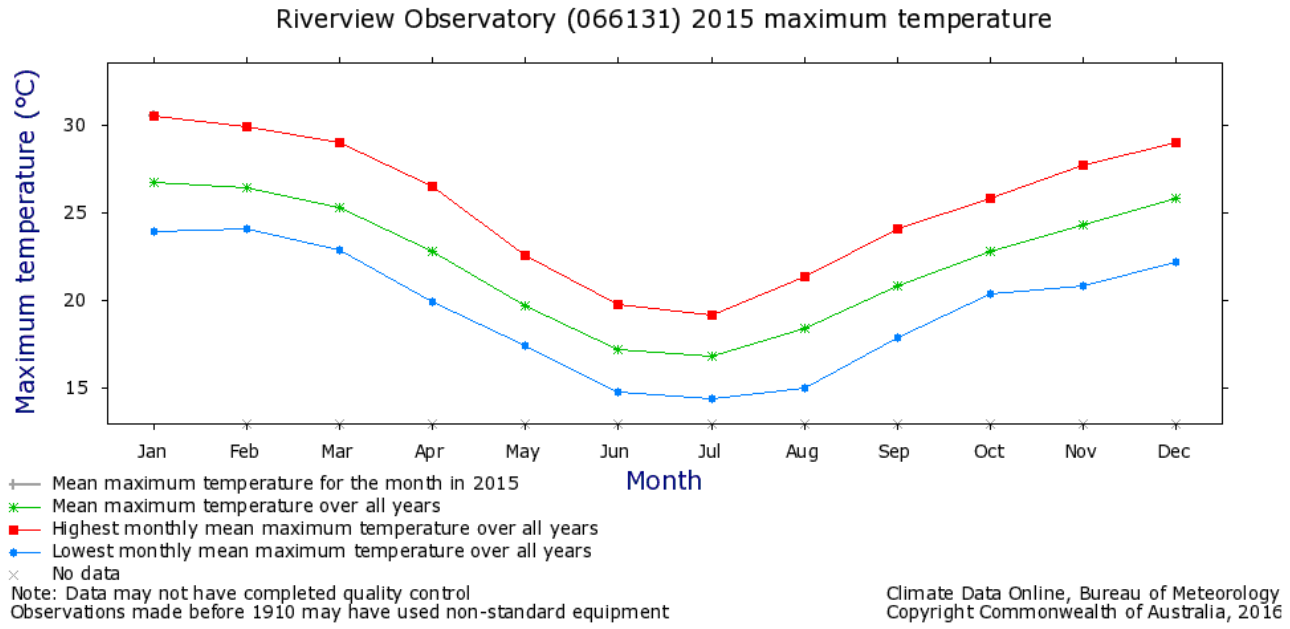


Figure 5. Maximum temperature (degrees Celsius) obtained from the Bureau of Meteorology Riverview Observatory (station number 066131)

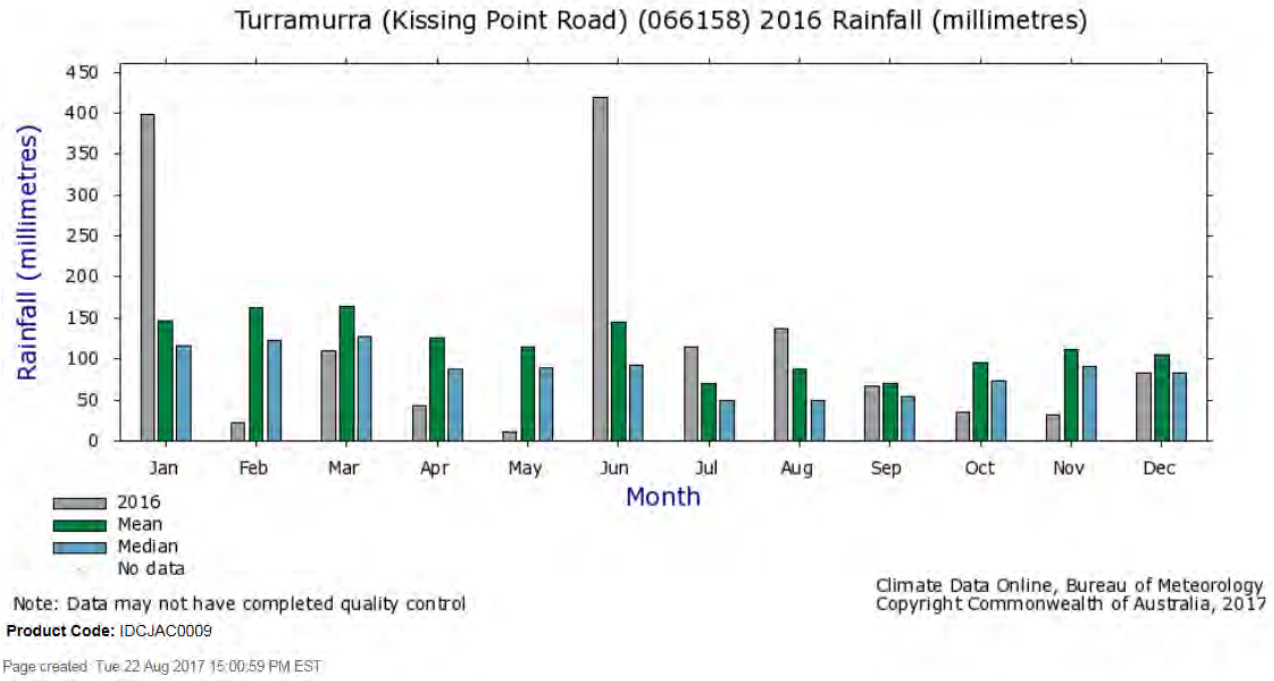


Figure 6. Rainfall (millimetres) obtained from the Bureau of Meteorology Turramurra Kissing Point Rd, weather station (station number 066158)

4.1.5 Microclimate and natural features

A recent study has shown significant differences between the microclimate within Grey-headed Flying-fox camps and the surrounding bushland (Snoyman and Brown 2011). In general, areas within the camps had a greater variance in temperature and humidity than the alternative locations. This suggests that the Grey-headed Flying-fox may specifically set up camps in areas with high microclimate variance to accommodate a range of individual preferences that vary depending on demography (Snoyman and Brown 2011).

The steep gully of the KFFR provides high ridges to the south and the west that protect the valley from the strongest of the southerly and westerly winds (Ku-ring-gai Bat Conservation Society Inc 2011). The KFFR contains a variety of plant community types with different microclimates suitable for use by fauna at various times during the seasons. The variety of vegetation provides a refuge from the hot summer and buffering from the mild winter.

The gallery rainforest along Stony Creek is present due to the water supply, drainage, temperature, and soil nutrient supply. The closed canopy provides a consistently low light regime that protects flora and fauna from the sun year round. Only shade tolerant plant species survive. Within the lower strata of the gallery rainforest, the temperature will be lower than in the canopy by several degrees. The wet sclerophyll forest on the slopes in the western portion of the KFFR has a tall canopy with a layer of lower trees filling the space between the trunks. There is a ground layer of tree ferns and ground ferns. These areas have high moisture levels. The dry sclerophyll forest areas in the east of the KFFR have lower soil-moisture retention and are well drained. The dry sclerophyll forest provides a drier harsher climate than the other habitat types.

The Grey-headed Flying-fox has been observed to use the following features of the vegetation in different conditions (Buchanan 1985):

- During periods of high temperature, the ground layer provides a refuge from desiccating wind.
- The shrub layer provides protection from the sun and wind during hot days and protects form the wind on cold days.
- The small tree layer is the most commonly used during average spring / summer conditions.
- The canopy trees are used as a secondary layer mostly in the early morning when animals warm in the sun and utilise summer breezes.

4.1.6 Recreational features

There are no specific recreational features in the KFFR. There are some informal walking tracks which are used by swamp wallabies and the bush regeneration group.

4.1.7 Site infrastructure

The two main site access points to the KFFR are from Taylor Street and Edward Street. An old gate to the KFFR is located in the reserve off the end of Edward Street but is in disrepair.

There are several easements within the reserve including the Sydney Water Gordon Pymble sewer, which is a gravity fed system that was installed from 1929 to the 1960s. The trunk line follows the route of Stoney Creek from west to east where it joins the Killara trunk line that follows Rocky Creek. A branch of the sewer joins the trunk lines along Rocky Creek in the east. Reticulation lines run to Stoney Creek from Bell Street, Warandoo Street, Waugoola Street, Taylor Street, and behind properties on Edward Street and Nelson Street. Thirteen drainage pits, sixteen sewer fittings (property connection points and customer drain inlets), and 52 sewer structure including maintenance holes, ventshaft educts, and verticals (see Figure 7).

Asset protection zones are present around the perimeter of the KFFR as a fuel reduced zone adjoining housing.

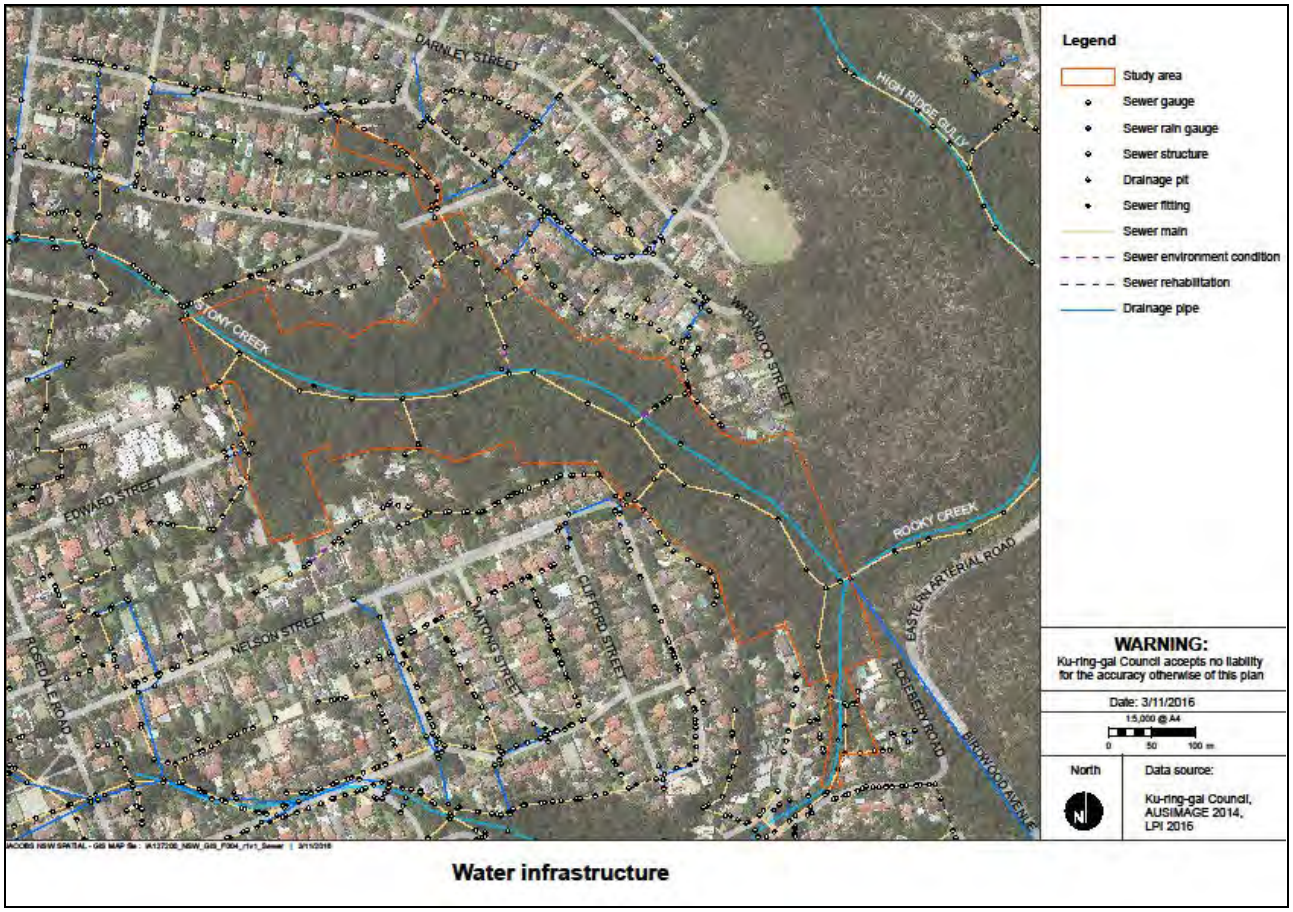


Figure 7. Location of sewer infrastructure and easements

4.1.8 Fire

Records of bush fires are not available prior to 1979 but oral history indicates the whole valley has not been burnt since the 1940s. A fire was reported in the eastern end of the Reserve in 1947. The absence of fire has led to the growth of closed forest with emergent eucalypts. This habitat is favoured by the Grey-headed Flying-fox.

A fire hazard reduction history map of the KFFR is provided in Figure 8 and a bushfire prone lands mapping in the KFFR is provided in Figure 9.

In 1991, as part of habitat restoration, piles of woody weeds that had been manually cleared were burnt. This was found to increase the diversity of native plant species germinating, including *Acacia, Dodonaea,* and *Lasiopetalum* species. This practice has continued occasionally and weed piles are burned by fire agencies in winter when only a small number of Flying-foxes are in the valley. A hazard reduction burn was undertaken in the winter of 2006 near Bell Street, Gordon when most bats had vacated and wind conditions were favourable.

The Conservation Agreement specifically excludes hazard reduction burning from being carried out in the Reserve without written consent from the Director-General of National Parks and Wildlife Service or its equivalent. However, to retain the species diversity of the open forest on the upper slopes fire will need to be used occasionally as directed by identified fire thresholds.

The vegetation within the KFFR varies from rainforest to wet sclerophyll forest (shrubby sub-formation), wet sclerophyll forest (grassy sub-formation), and dry sclerophyll forest (shrubby sub-formation). As such, a variety of recommended fire regimes apply to the vegetation of the KFFR (see Table 2) as outlined in the *Guidelines for Ecologically Sustainable Fire Management: NSW Biodiversity Strategy* (NSW National Parks & Wildlife Service 2004).

Table 2. Recommended fire intervals for vegetation classes in the KFFR

Vegetation class	Recommended fire interval	Recommended intensity
Rainforest	Rainforests are not a fire prone vegetation type and are considered fire sensitive. Fire is generally viewed as destructive within rainforest vegetation but the critical factor is fire frequency. Rainforest will slowly recover from a single fire but most rainforest species will not survive recurrent fires (NSW National Parks & Wildlife Service 2004).	For the purposes of this management plan fire will be excluded from the rainforest.
Wet sclerophyll forest (shrubby sub-formation) Wet sclerophyll forest (grassy sub-formation)	Wet sclerophyll forests are considered a successional stage between open forest and rainforest, leading to differences of opinion regarding management. Frequent fires (c. 15-20 years) will favour the sclerophyllous species over the rainforest elements, with the forest tending towards dry sclerophyll forest or even scrub. Conversely, long fire intervals (c. 100 years) allow encroachment of more rainforest species while suppressing establishment of sclerophyll species, resulting in 'expansion' of rainforest into wet sclerophyll forests (NSW National Parks & Wildlife Service 2004). The dominant eucalypts in wet sclerophyll forest are sometimes fire-sensitive and eucalypt species do not accumulate soil seedbanks, putting these canopy species in the most sensitive category with respect to frequent fire. Thus the minimum inter-fire interval is critical to both the floristic composition and structure of these forests (NSW National Parks & Wildlife Service 2004). Examination of life history data and regeneration strategy (persistence vital attributes) for wet sclerophyll forest indicate that approximately 34% of species are obligate seeders and 54.5% were resprouters (NSW National Parks & Wildlife	Mosaic burning approach. Variable intensity – moderate surface fires separated by patches of lower intensity fire and unburnt patches. Crown fires should be avoided in the lower end of the recommended fire interval range.

Vegetation class	Recommended fire interval	Recommended intensity
	Service 2004). The domain of acceptable fire intervals for wet sclerophyll forest was calculated as 25 to 60 years (NSW National Parks & Wildlife Service 2004).	
Dry sclerophyll forest (shrubby sub-formation)	Demographic models predict that the shrubby understorey component of dry sclerophyll forest (consisting of many serotinus obligate seeders with relatively long primary juvenile periods) is the most at risk from short inter-fire intervals. Numerous studies have supported this prediction, finding reduced abundance or absence of many of these and other species in frequently burnt areas (i.e. inter-fire intervals <7 years). Fuel accumulation is rapid in dry sclerophyll forest, with fuel loads of c. 10 t/ha reached within 2-5 years of low intensity fire (NSW National Parks & Wildlife Service 2004). Examination of life history data and regeneration strategy (persistence vital attributes) for shrubby dry sclerophyll forest indicate that approximately 43% of species are obligate seeders and 52% were seeders (NSW National Parks & Wildlife Service 2004). The domain of acceptable fire intervals for shrubby dry sclerophyll forest was calculated as 7 to 30 years. Some intervals in the higher end of the range (c. 25 years) are desirable (NSW National Parks & Wildlife Service 2004).	Mosaic burning approach. Variable intensity - high intensity surface fires separated by patches of lower intensity fire and unburnt patches.

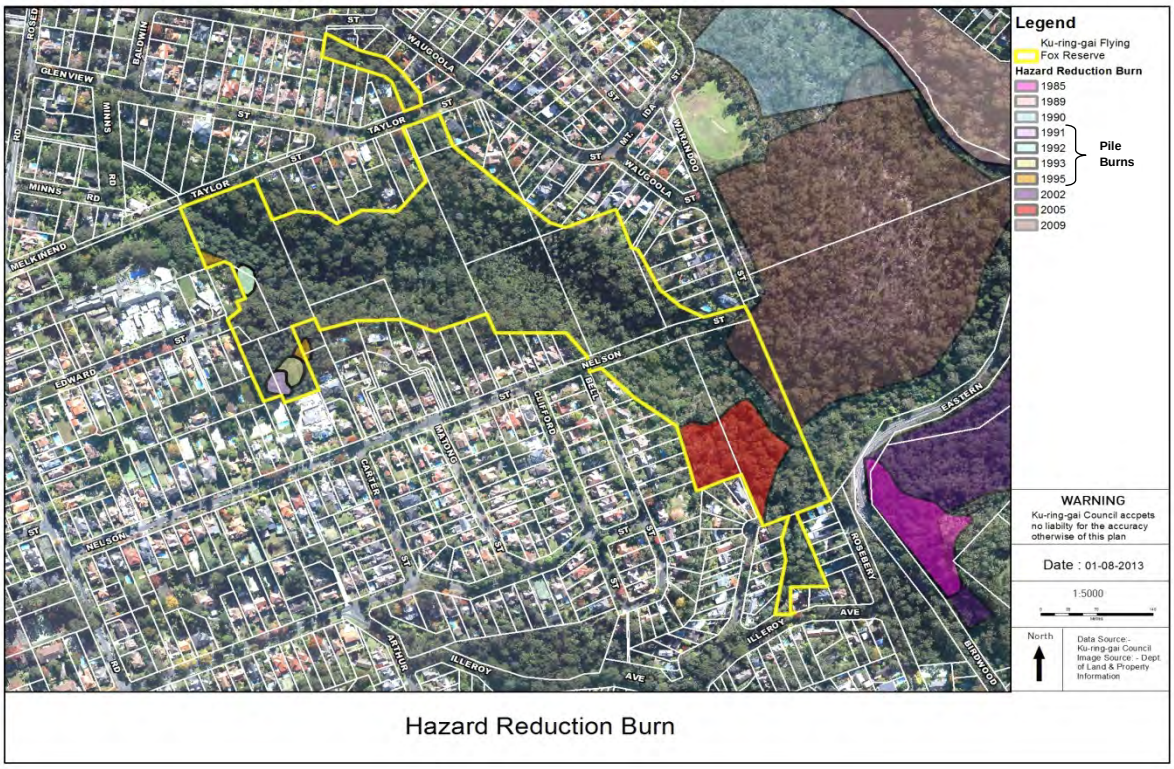


Figure 8. Fire hazard reduction history map of the KFFR

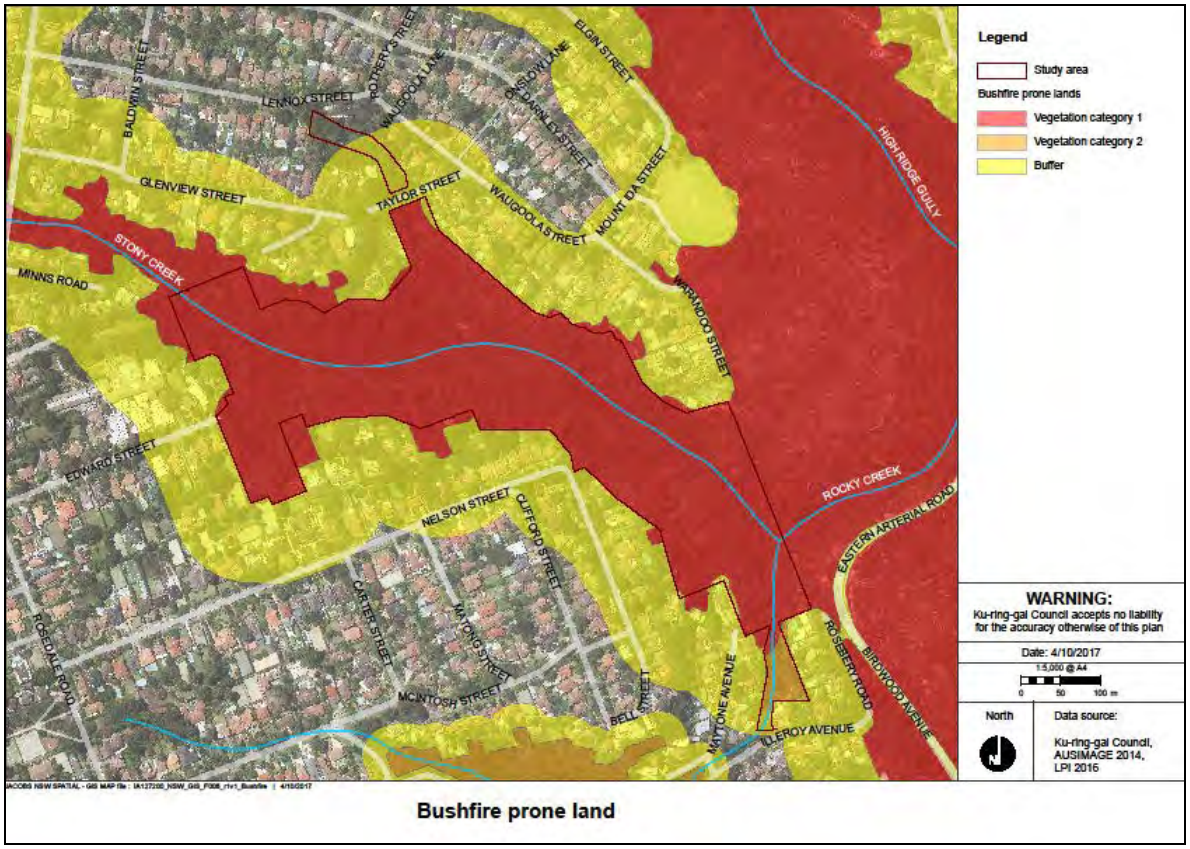


Figure 9. Bushfire prone lands mapping in the KFFR

The Bushfire Environmental Assessment Code for NSW (*Rural Fires Act 1997*) applies to the management of the KFFR, specifically the guidelines for hazard reduction work on land that contains a threatened species or populations and / or an EEC (see Table 3 and Table 4 below).

Future fire management proposals have been determined through thorough assessment of the factors discussed above and consider fire history, legislative framework and policy, and site resilience. Break up of fire management zones incorporates the consideration of operational and logistical constraints as well as the utilisation of natural and manmade features within the site to create the required mosaic burning pattern to best manage the sites overall biodiversity.

Table 3. Threatened Species Hazard Reduction List - Part 2 - Animals

Scientific Name	Common Name	Species specific conditions relating to the use of Fire	Species specific conditions relating to mechanical forms of hazard reduction
Pteropus poliocephalus	Grey-headed Flying-fox	Avoid known roost sites	Avoid known roost sites
Pseudophryne australis	Red-crowned Toadlet	No burning adjacent to streams, and no burning in and around ephemeral drainage lines at the headwaters of creeks	No slashing, trittering or tree removal
Ninox strenua	Powerful Owl	No burning around known nesting sites at any time	No slashing, trittering or tree removal of or around known nesting sites
Ninox connivens	Barking Owl	No burning around known nesting sites at any time	No slashing, trittering or tree removal of or around known nesting sites
Cercartetus nanus	Eastern Pygmy-possum	None	No slashing, trittering or tree removal
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Protect hollows	No removal of trees
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	No fire around known roost sites	No slashing around maternity caves
Miniopterus	Little	No fire around known roost sites	Utilise buffer around

Scientific Name	Common Name	Species specific conditions relating to the use of Fire	Species specific conditions relating to mechanical forms of hazard reduction
australis	Bentwing-bat		known roosts
Mormopterus norfolkensis	Eastern Freetail-bat	None	No slashing, trittering or tree removal
Myotis macropus	Southern Myotis	No fire around known roost sites	No removal of trees

Please note: This list is to be applied with reference to the "Rules and Notes for the Implementation of the Threatened Species Hazard Reduction List for the Bush Fire Environmental Assessment Code".

Table 4. Threatened Species Hazard Reduction List - Part 3 - Endangered Ecological Communities

Name as per the Threatened Species Conservation Act NSW	Conditions relating to the use of Fire	Conditions relating to mechanical forms of hazard reduction
Sydney Turpentine-Ironbark Forest	No fire more than once every 10 years	No slashing, trittering or tree removal

Please note: This list is to be applied with reference to the "Rules and Notes for the Implementation of the Threatened Species Hazard Reduction List for the Bush Fire Environmental Assessment Code"; and if using fire at least 50% of the Endangered Ecological Community within each Local Government Area (LGA) must exist in a state that has been burnt less frequently than the minimum fire interval.

5.1 Biotic Environment

5.1.1 Vegetation Communities

The KFFR contains several plant communities and associations that vary with topography, aspects and soil type. The majority of the site is dominated by sandstone flora associations within Sydney Sandstone Gully communities. Riparian vegetation dominates along the banks of the creek in sheltered areas. The upper and more exposed slopes contain more sclerophyll-dominated vegetation. Where the soils are clay influenced on the upper southwest slopes, Sydney Turpentine-Ironbark Forest occurs.

The Plant Community Types (PCTs) in the KFFR are identified as:

- Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region (PCT 1841)
- Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast (PCT 1776)

- Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin (PCT 1828)
- Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (PCT 1281) (also known as Sydney Turpentine-Ironbark Forest).

A description of each PCT as it occurs within the KFFR is provided below and a map of the PCTs is provided in Figure 10.

Vegetation types

Figure 10. Plant community types within the KFFR

5.1.1.1 Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched **sandstone slopes and gullies of the Sydney region**

The Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region PCT is a tall open eucalypt forest with a mesic shrub and small tree layer. This PCT is also known as Coastal enriched sandstone moist forest, a wet sclerophyll forest (shrubby sub-formation) that belongs to the North Coast Wet Sclerophyll Forests vegetation class.

The canopy is dominated by a combination of eucalypts including *Eucalyptus pilularis, Syncarpia glomulifera, Angophora costata*, and *Eucalyptus saligna*. *Eucalyptus piperita* is also present in the eastern sections of the KFFR. The lower tree layer is dominated by rainforest plants including *Ceratopetalum apetalum* and *Pittosporum undulatum* with *Elaeocarpus reticulatus* and *Allocasuarina torulosa.* The low tree layer is also dominated in some areas by dense stands of weeds including *Ligustrum lucidum* (Broad-leaf Privet), *Ligustrum sinense* (Narrow-leaf Privet), and *Ochna serrulata* (Mickey Mouse Plant). The shrub layer is variable in density and is composed of species including *Glochidion ferdinandi, Dodonaea triquetra, Notelaea longifolia, and Pittosporum revolutum*. The ground layer contains a sparse to dense cover of *Dianella caerulea, Lomandra longifolia, Calochlaena dubia, Pteridium esculentum,* and *Entolasia stricta*. Vines are common.

Photo 1. Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region

5.1.1.2 Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone **slopes around Sydney and the Central Coast**

The Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast PCT is a tall open eucalypt forest with an understorey of dry sclerophyll shrubs with ferns and forbs amongst the ground cover. This PCT is also known as Coastal Enriched Sandstone Dry Forest, a dry sclerophyll forest (shrubby sub-formation) that belongs to the Sydney Coastal Dry Sclerophyll Forests vegetation class. This PCT is very common on the upper slopes and dry gullies of Sydney urban areas.

Within the KFFR, the canopy is dominated by eucalypts including *Angophora costata, Eucalyptus piperita, Corymbia gummifera* and *Eucalyptus pilularis*. A sparse layer of small trees including *Allocasuarina littoralis*, *Banksia serrata* and *Ceratopetalum gummiferum* with *Pittosporum undulatum* and *Elaeocarpus reticulatus* is present. Shrubs including *Acacia* spp.*, Leptospermum trinervium, Lomatia silaifolia, Dodonaea triquetra* are common amongst grass trees (*Xanthorrhoea* sp.). The ground cover is composed of *Dianella caerulea, Lomandra longifolia, Pteridium esculentum,* and *Entolasia stricta*.

Photo 2. Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast

5.1.1.3 Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of **the Sydney basin**

The Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin PCT is a warm-temperate rainforest found along Stoney Creek at the bottom of the sandstone gully system. This PCT is also known as Coastal Sandstone Gallery Rainforest, a rainforest that belongs to the Northern Warm Temperate Rainforests vegetation class.

The community is dominated by *Ceratopetalum apetalum* with *Callicoma serratifolia, Acmena smithii, Tristaniopsis laurina* and *Cyathea australis* forming a dense sub-canopy of small trees under emergent eucalypts including *Eucalyptus pilularis, Eucalyptus saligna Syncarpia glomulifera*, and *Angophora costata*. The ground cover is an open cover of ferns including *Blechnum cartilagineum, Doodia caudata*, *Calochlaena dubia* and *Histiopteris incisa* amongst the sandstone boulders and fallen logs. Vines including *Parsonsia straminea* and *Morinda jasminoides* are common.

Photo 3. Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin

5.1.1.4 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, **Sydney Basin Bioregion (Sydney Turpentine-Ironbark Forest)**

The Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion PCT is a tall open forest found on shale and shale-enriched sandstone soils in the western portion of the KFFR. This PCT is also known as Sydney Turpentine – Ironbark Forest, an endangered ecological community listed under the NSW TSC Act and Turpentine-Ironbark Forest in the Sydney Basin Bioregion, a critically endangered ecological community listed under the Commonwealth EPBC Act. This PCT is a wet sclerophyll forest (grassy sub-formation) that belongs to the Northern Hinterland Wet Sclerophyll Forests vegetation class.

Within the KFFR, the canopy species include *Eucalyptus pilularis, Syncarpia glomulifera, Angophora costata* and *Eucalyptus resinifera*. Ironbarks are not present as is typical of the PCT in the local area. Small trees including *Acacia parramattensis* and *Pittosporum undulatum* are present. The shrub layer contains *Polyscias sambucifolia, Acacia parramattensis, and Breynia oblongifolia*. The ground layer is typified by *Dianella caerulea, Lomandra longifolia, Microlaena stipoides,* and *Pratia purpurascens*.

Photo 4. Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (Sydney Turpentine-Ironbark Forest)

5.1.2 Flora

Within the KFFR, 248 plant species have been recorded (see Appendix C for a species list).

The canopy of the vegetation in all plant community types is dominated by a combination of eucalypts including *Eucalyptus pilularis, Syncarpia glomulifera, Angophora costata*, and *Eucalyptus saligna*. *Eucalyptus piperita* is also present in the eastern sections of the KFFR. *Eucalyptus resinifera* is present in the Sydney Turpentine – Ironbark Forest. These eucalypts are also emergent above the canopy of the Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin PCT along Stoney Creek.

The lower tree layer is typically dominated by mesic rainforest plants including *Ceratopetalum apetalum* and *Pittosporum undulatum* with *Elaeocarpus reticulatus* and *Allocasuarina torulosa.* The low tree layer is also dominated in some areas by dense stands of weeds including *Ligustrum lucidum* (Broad-leaf Privet), *Ligustrum sinense* (Narrow-leaf Privet), and *Ochna serrulata* (Mickey Mouse Plant).

The shrub layer is variable in density and is composed of species including *Glochidion ferdinandi, Dodonaea triquetra, Notelaea longifolia,* and *Pittosporum revolutum*. In the drier sclerophyll forest areas shrubs including *Acacia* spp.*, Leptospermum trinervium, Lomatia silaifolia, Dodonaea triquetra* are common amongst grass trees (*Xanthorrhoea* sp.). The shrub layer of the Sydney Turpentine – Ironbark Forest contains *Polyscias sambucifolia, Acacia parramattensis, and Breynia oblongifolia*.

The ground layer contains a sparse to dense cover of *Dianella caerulea, Lomandra longifolia, Calochlaena dubia, Pteridium esculentum,* and *Entolasia stricta*. Vines including *Parsonsia straminea* and *Morinda jasminoides* are common.

5.1.3 Fauna

Within the KFFR, 91 vertebrate animals have been recorded (see Appendix D for a species list). There have been six mammals, 68 birds, 11 reptiles, five frogs and one fish recorded. There have also been 74 invertebrate species recorded.

5.1.4 Threatened communities, species and populations

The KFFR contains remnants of Sydney Turpentine – Ironbark forest that is listed as an endangered ecological community under the BC Act. This vegetation also meets the criteria to be classified as Turpentine-Ironbark Forest in the Sydney Basin Bioregion, a critically endangered ecological community listed under the Commonwealth EPBC Act. This community is situated in the western portion of the reserve off Edward Street to the south of Stony Creek.

The most significant of the fauna species known to utilise the KFFR as habitat is the Grey-headed Flying-fox which is listed as a vulnerable species under the BC Act and EPBC Act. The KFFR is recognised as a nationally important Grey-headed Flying-fox camp. Statistical data from Grey-headed Flying-fox counts show annual and seasonal variations in camp population size from zero to around 80,000 animals. During winter, the camp is often only a few hundred but may be zero (recorded 9 times, including in May 2017). Numbers are generally around 20,000 - 40,000 during summer peaks in the breeding season (around March). Numbers of 70,000 or more animals have

been recorded only twice - in 2000 and 2009. The data indicates a trend of decreasing average numbers in Grey-headed Flying-fox numbers between 1998 and 2012. This trend is consistent with the increase in the number of camps in the Sydney Basin from seven in 1989 to 22 in 2013. Total population estimates of Grey-headed Flying-foxes in camps in eastern Sydney did not change between 1995 and 2011 (personal comment: Dr Peggy Eby - Flying-fox consultant).

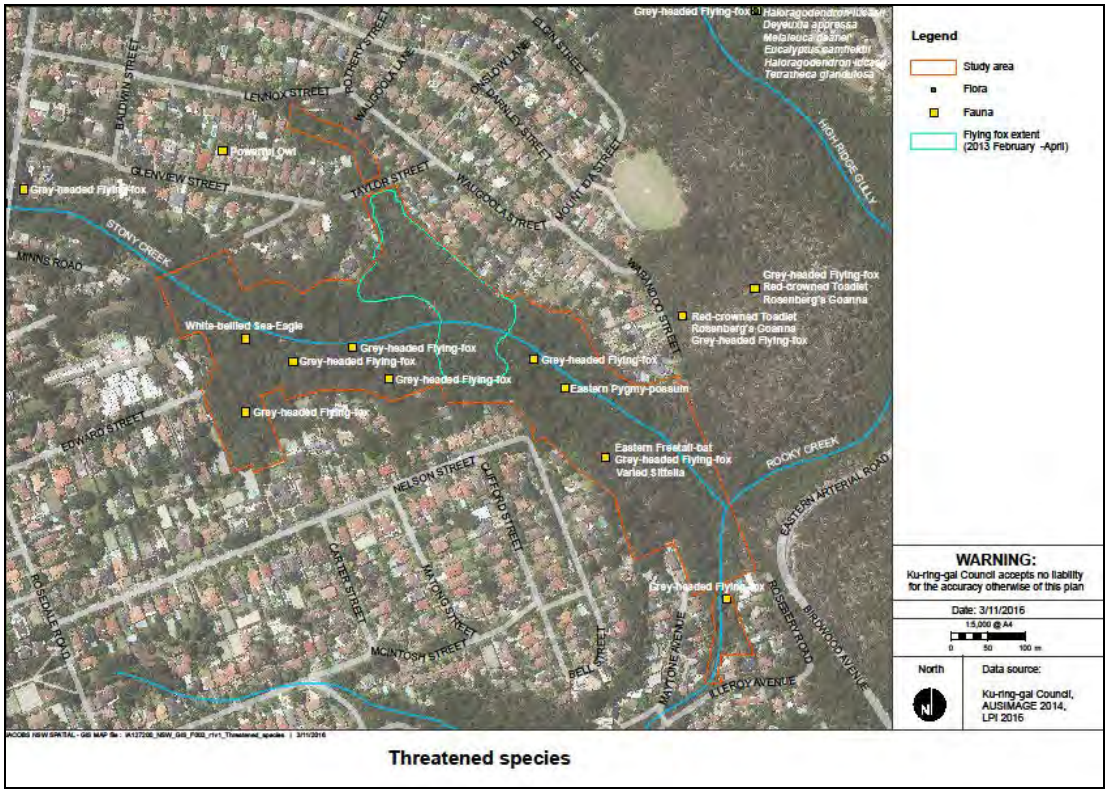
The location of the Flying-fox camp within the KFFR varies annually and seasonally and in response to weather conditions. The periodic shifting of the camp over several years is possibly in response to roost tree damage. Records show the camp was originally in the western end of the KFFR and has slowly shifted to the lower slopes at the centre of the Reserve, near Stoney Creek. In February 2009 Flying-fox numbers peaked at around 70,000 and the camp expanded over a large area of the Reserve, extending to the boundary near Taylor Street. It is expected the camp will shift again in the future as conditions change. The Eastern Freetail-bat (an insectivorous species), listed as vulnerable under the TSC Act, has been recorded in the KFFR and there is suitable roosting habitat (in the form of tree hollows) and foraging habitat available for this species. Other threatened insectivorous bat species known from the Ku-ring-gai LGA include the Eastern Bentwing-bat, Little Bentwing-bat, Southern Myotis and Eastern False Pipistrelle which may also utilise the habitats within the KFFR. The Eastern Pygmy-possum, listed as vulnerable under the TSC Act, has also been recorded in the KFFR. This species is most likely to use the drier sclerophyll forest habitats in the east of the KFFR where foraging resources such as nectar and pollen can be found from banksias, eucalypts and bottlebrushes. Soft fruits and insects found in the wetter forests in the west of the KFFR will also be eaten when flowers are unavailable.

The Red-crowned Toadlet, a species listed as vulnerable under the TSC Act, is known to occur in the KFFR and three male frogs were heard calling from Stony Creek in October 2016 during site inspections for preparation of this management plan. This species may utilise the periodically wet ephemeral drainage lines below the sandstone ridges, and Stony Creek, for breeding.

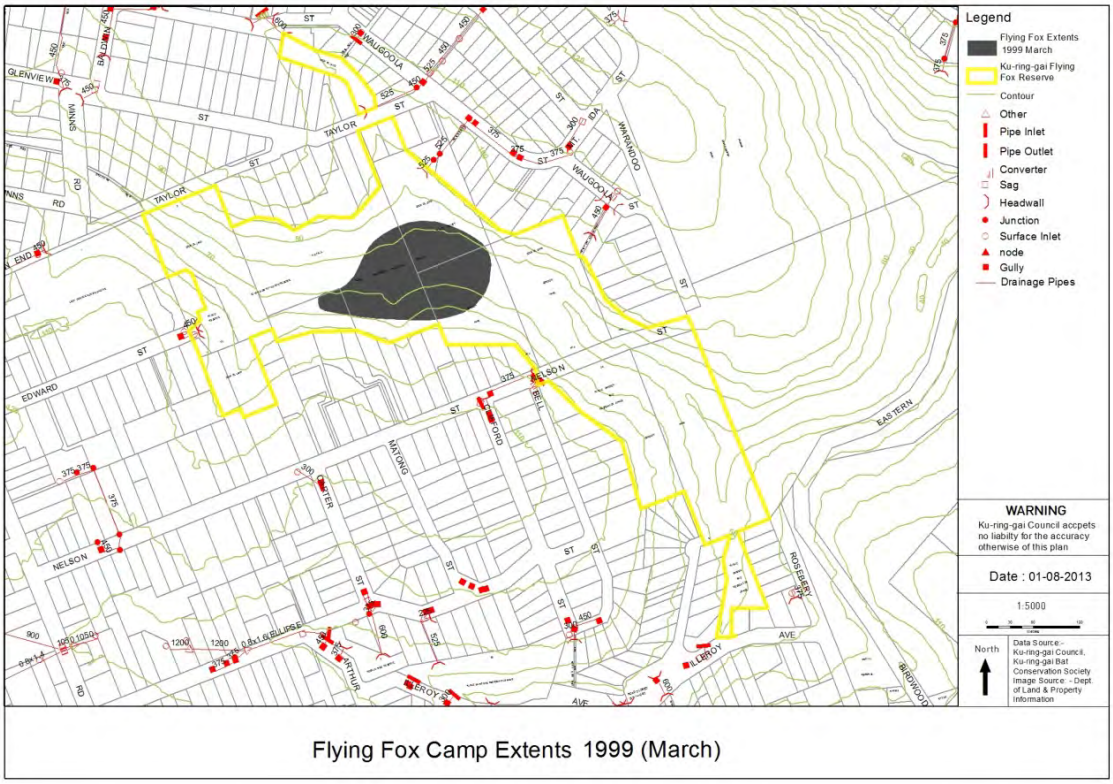
The KFFR is known to provide habitat for the Powerful Owl, which is listed as vulnerable under the BC Act. A nesting site located between Nelson and Edward Street has been used for the last 6 years with mixed breeding success. In the 2017 breeding season, a single owlet successfully fledged. Adults and juveniles are frequently recorded in the KFFR and Grey-headed Flying-fox are an occasional prey item.

The Varied Sittella, listed as vulnerable under the TSC Act has been recorded in the KFFR. The KFFR is a refuge for migratory bird species listed under the EPBC Act including the Rufous Fantail.

The distribution of threatened species records within the KFFR is provided in Figure 11.



Threatened species



Flying Fox Camp Extents 1999 (March)

Figure 11. Location of threatened species sightings and the Grey-headed Flying-fox camp. Top figure shows the Taylor Street roost site. Bottom figure shows Stoney Creek roosting habitat

6. Site History

A detailed history of the Stony Creek Valley can be found on the Sydney Bats website http://sydneybats.org.au/ku-ring-gai-flying-fox-reserve/history-of-stony-creek-valley/. (Ku-ring-gai Bat Conservation Society Inc 2011). A summary of this information is provided here.

In 1962, Grey-headed Flying-foxes were recorded camping near Lady Gowrie Nursing Home and 18 Edward Street Gordon. This is the first recorded instance of Grey-headed Flying-foxes roosting in the valley. Previously camps had been recorded in the Davidson State Recreation Area in 1948 and Browns Waterhole in the Lane Cove River valley from 1950 to 1965.

Research was undertaken in the KFFR by Rhys Puddicombe in 1980 - 1981. As well as studying the Grey-headed Flying-fox camp, he reported on the Little Red Flying-foxes which joined the camp that summer for about 6 weeks. In 1983, Ku-ring-gai Council commissioned Robin Buchanan to survey Council's bushland. She identified Stoney Creek Reserve and the flying-fox camp as one of Ku-ring-gai's Reserves of highest ecological value.

Subdivision of 18 Edward Street, which contained part of the Grey-headed Flying-fox camp was planned in 1983. Following public opposition to the subdivision approval, the Minister for Environment and Planning issued an Interim Conservation Order on the site to permit an investigation by the NSW National Parks and Wildlife Service into the habitat. In January 1985, Ku-ring-gai Council and NSW Government (using Heritage Funding) jointly purchased two lots of the subdivision at 18 Edward Street to protect the Grey-headed Flying-fox camp. In 1985, Robin Buchanan completed an ecological assessment of the area being restored in Stoney Creek Valley that was then used to guide restoration works.

In 1991, the Ku-ring-gai Flying-fox Reserve was protected by a Voluntary Conservation Agreement. The Conservation Agreement is attached to the title of the land and operates in perpetuity. It commits Ku-ring-gai Council to restore and maintain the habitat of the Grey-headed Flying-fox in the reserve and the Minister for Environment to assist with provision of technical advice and financial assistance. In 1995, the NSW National Parks and Wildlife Service provided a grant of $30,000 for research, interpretation and catchment management to Ku-ring-gai Council to assist in managing the reserve. In 1999, the Management Plan for Ku-ring-gai Flying-fox Reserve was adopted by Council. Additional land was added to the KFFR in 2007 when the NSW Government purchased 4,400 m^2 of privately owned steeply sloping land to avoid development.

Community involvement in the management of the Reserve has been ongoing, with members of the Ku-ring-gai Bat Conservation Society (KBCS) providing Council with valuable advice and assistance with on-ground works since 1985. A summary of the works to date is provided by Pallin (2000). In recent years, there have been an increasing number of issues associated with the management of the Reserve, including the impact on local residents caused by the noise, smell and droppings when Flying-foxes are in the Reserve. Council has been managing the camp to provide habitat for flying foxes while addressing community concerns.

On 12 September 2017, funded in part through an Environmental Trust Grant (SL0036) and during a period where no flying-fox were within the reserve, Council Staff conducted an ecological burn on the south side of Stony Creek. The results of the burn will be monitored and the lessons implemented in to the future management of the KFFR and detailed through this plan.

7. Site Assessment and Condition

7.1 Resilience

While the disturbance regimes within the KFFR have been altered from what would have historically occurred, much of the KFFR is considered to have a high resilience with excellent capacity for recovery from disturbance.

The current disturbances within and adjacent to the KFFR such as soil disturbance, changed fire regime, weed infestation, feral animals, and changed soil moisture have had an impact. However, evidence of resilience is present throughout the KFFR. Natural regeneration is present as evidenced by the past successes of Bushcare works. There is evidence of seedling regeneration, plants that form important structural components of the vegetation are flowering and setting seed, and the vegetation largely contains all structural layers (although the midstorey is dominated by woody weeds in some areas). Proteaceous plants such as *Banksia serrata* and grass trees are present in long unburnt areas that would benefit from an ecological burn to encourage germination of seed and flowering.

If the weeds were removed from currently infested areas, there is sufficient natural resilience within the KFFR for native species to re-establish. However, this must be done in a managed and controlled manner so the current habitat is not entirely removed. As such, carefully planned ecological burning using a mosaic approach is a favoured method for use in the KFFR and is a major focus of this management plan. Revegetation is considered a secondary methodology that will be used in areas that display little natural resilience and would benefit from direct planting (i.e. areas where the seed bank is depleted and the natural vegetation cannot regenerate). Specific management actions for each area of the KFFR have been identified in this plan.

7.2 Threats and Impacts

The following Key Threatening Processes (KTP) may apply to the KFFR:

Biodiversity Conservation Act 2016:

- Clearing of native vegetation
- Removal of dead wood and dead trees
- Loss of hollow-bearing trees
- Bush rock removal
- Invasion of native plant communities by exotic perennial grasses
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
- Infection of native plants by *Phytophthora cinnamomi*
- Invasion and Establishment of Exotic vines and Scramblers
- Invasion, establishment and spread of Lantana (*Lantana camara*)
- Predation by the feral cat (*Felis catus*)
- Predation by the European fox (*Vulpes vulpes*)
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

Environment Protection & Biodiversity Conservation Act 1999:

- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
- Dieback caused by the root-rot fungus *Phytophthora cinnamomi*
- Invasion of native plant communities by exotic perennial grasses
- Predation by the European red fox (*Vulpes vulpes*)
- Predation by the feral cat (*Felis catus*)
- Novel biota and their impact on biodiversity
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

8. Management Objectives, Strategies and Implementation

There are three management objectives for the KFFR:

1. Conservation of the Grey-headed Flying-fox colony located in the valley of the KFFR.
2. Management of the Grey-headed Flying-fox colony and its environment in such a manner that the colony and local biodiversity is maintained, while also ensuring that the neighbouring residents are considered.
3. Protection by law of the Grey-headed Flying-fox, other bat species (order Chiroptera), as well as other protected flora and fauna.

The *Best practice guidelines for the Grey-headed Flying-fox* (Department of Environment and Climate Change 2008) and The *Management and Restoration of flying-fox Camps: Guidelines and Recommendations* (SEQ Catchments 2012) outline a set of guidelines for bush managers and regenerators. These best practice guidelines have been used to guide the management actions within the KFFR. Current best practice is also being built upon with this management plan. It is important that the management actions be undertaken in an adaptive manner. While the Grey-headed Flying-fox is currently roosting near Taylor Street, it is likely that over the 10-year duration of this management plan that the animals will move within the KFFR and roost in different areas. As such, adaptive management will be a key strategy and planned works may need to be reassessed depending on the location of the Grey-headed Flying-fox roost at the time and the presence of the animals.

8.1 Maintenance of vegetation structure for habitat conservation

Key to the achievement of these objectives is the maintenance of the vegetation structure within the KFFR as a habitat for the Grey-headed Flying-fox. This includes maintaining the regular roosting habitat in the canopy and the closed forest refuge that is used in extreme weather. The variety of microclimates present within the KFFR must be maintained and improved upon and this will require a variety of management techniques.

To maintain an effective heat refuge for the Grey-headed Flying-fox the habitat needs to have:

- understorey and mid-storey vegetation to act as shelter from heat
- a dense crown cover of vegetation to provide shade
- access to water.

Currently the KFFR has all of the above characteristics, which will be maintained as a main objective of this management plan. This will ensure the conservation of the Grey-headed Flying-fox colony and ensure this species continues to use the KFFR as a roosting site into the future. The canopy weeds (i.e. Privet) will not be removed in the Primary habitats for the Grey-headed Flying-fox. In areas where the seed bank is depleted and the natural vegetative community cannot regenerate, selective revegetation will be utilised to replace the senescent canopy. Carefully planned ecological burning will be a key management action for the KFFR to stimulate the seed bank and help remnant bushland to recover but will be planned carefully to avoid the flying-fox birthing season, and will occur away from the core roosting habitat to ensure the roosting habitat is maintained and that the Grey-headed Flying-fox is not accidentally dispersed. The culling of mature native vines, although a past management recommendation, will not be undertaken as they

are important in native forest succession and provide inter-crown pathways for many canopy-dwelling animals as well as providing vertical trunk cover for flying foxes during extreme heat events. The leaves and flowers also represent food resources for animals, including pollinator communities. The vines influence temperature and humidity fluctuations, moisture levels in the soil, light levels and air movement. While native vines can have a deleterious effect on forest succession, mature native vines should not be culled for the duration of this plan to ensure a structurally complex environment is maintained within the KFFR. If vines are strangling seedlings or small plants that have been planted as part of the revegetation program, they should be culled on a case-by-case basis.

Grey-headed flying foxes are migratory, with their camps interconnected. As such, many non-local Australian plant species have seeded in the KFFR due to natural dispersal from flying-foxes. This is a natural phenomenon and is an important ecosystem process as flying-foxes are crucial to keeping native forests healthy. These animals play an important role in dispersing seeds, pollinating flowering plants and engineering their habitats. Consequently, non-indigenous native species including *Alphitonia excelsa, Cryptocarya glaucescens, Endiandra sieberi, Ficus* spp.*, Melia azedarach, Podocarpus elatus, Dendrocnide excelsa,* and *Elaeocarpus kirtonii* (among others) have established in the KFFR due to natural dispersal from flying-foxes. It is unlikely that these species would become dominant in the vegetation and bush regeneration works should not focus on removing these species, they should be left to naturally establish or die.

8.2 Adapting to climate change

There has been a clear upward trend in the annual global surface temperatures measured since the 19th century and the threat to flying-foxes from extreme heat events is growing. With the frequency and magnitude of extreme heat events predicted to increase through this century it is important that action is taken to build resilience into habitats.

It is vital to maintain an appropriate habitat structure within the KFFR and conserve the dense midstorey vegetation and groundcover that the Grey-headed Flying-fox colony use as a refuge in times of extreme heat. The roosting extent of flying-foxes on days with maximum temperatures of 36°C to 40°C moves south along the Taylor St creek and extends east and west along the steep terrain on the south-facing slope down to Stoney Creek. This dense shady and humid habitat provides consistently favourable conditions in times of extreme heat. The Primary Grey-headed Flying-fox habitat management zone outlined in this plan (see Section 9) has been developed based off the available knowledge on the roosting habitat extents at Taylor Street, Stoney Creek and the use of other areas of the KFFR during extreme heat events. The upward trend in annual global surface temperatures and increase in the frequency and magnitude of extreme heat events is a main driver of increasing the width and canopy cover of the heat refuge habitat within the KFFR. The management actions outlined in this plan are designed to retain and enhance the habitat so that the heat refuge will always be available to the Grey-headed Flying-fox in times of extreme heat.

The non-locally indigenous native plant species brought into the KFFR by the Grey-headed Flying-fox may provide important roosting and foraging resources for the Grey-headed Flying-fox in the future. Additionally, the dense midstorey of woody weeds creates suitable habitat and this must be retained. Building resilience into the habitat of the KFFR and assisting the habitat to adapt to

climate change over the long-term is an important consideration. We know that some species may be lost from their current locations while others will colonise new areas, altering local species assemblages. Allowing the non-indigenous native species dispersed by flying-foxes to establish within the KFFR, and leaving dense stands of woody weeds in place, may help to maximise the adaptive potential of the habitat.

8.3 Bush regeneration areas

The bush regeneration works that have been ongoing within the KFFR since 1985 have played a vital role in protecting the health of the habitat and the current quality of the vegetation is a direct result of valuable community advice and assistance with on-ground works. The construction of small exclosures has shown great success in helping to retain moisture and allow understorey and shrubs to grow by preventing wallabies grazing. It is important that the bush regeneration areas and exclusion zones built since 1985 are maintained throughout the duration of this plan. This management technique is a cheap and effective method to create varied microclimates within the KFFR. The use of these exclosures will continue and will be expanded as required.

In order to maintain an appropriate habitat structure within the KFFR and conserve the dense midstorey vegetation and groundcover that the Grey-headed Flying-fox colony use as a refuge in times of extreme heat, no new primary removal of woody weeds will occur in the KFFR outside of areas that have been traditionally worked by bush regeneration teams or which are identified in this management plan. If the entirety of the dense woody weed mid-storey were to be burnt or removed, the heat refuge could be destroyed and the habitat may no longer be suitable for the Grey-headed Flying-fox colony.

8.4 Targeting high risk weeds

In areas of the KFFR that are currently dominated by a dense mid-storey of woody weeds, no further broad scale primary woody weed removal will occur. This is also appropriate for areas within the KFFR that have been historically worked by bush regenerators and the riparian zone of Stony Creek. The approach to weed control in these areas will be to target Category 1 high-risk weeds only. This approach will maintain the dense midstorey of woody weeds that make the KFFR suitable as habitat for the Grey-headed Flying-fox. The weed species that occur within the KFFR have been ranked in terms of risk (see Appendix B). The weed species of highest risk within the KFFR (Category 1) are outlined in Table 5. These Category 1 species will be specifically targeted.

The Category 1 high risk weeds identified in Table 5 and in Appendix B are not the only weed species present in the KFFR but they are the species identified to be the highest risk. It is likely that other weed species may emerge as higher priority and the list of Category 1 high risk weeds for targeted treatment will be revised annually in consultation with the stakeholder group to ensure appropriate control is taking place.

Table 5. Category 1 high risk weeds in the KFFR for targeted removal

Scientific Name	Common Name	Category	Form
Anredera cordifolia	Madeira Vine	1	Vine
Ipomoea indica	Morning Glory	1	Vine
Ipomoea cairica	Coastal Morning Glory	1	Vine
Macfadyena unguis-cati	Cats Claw Creeper	1	Vine
Asparagus asparagoides	Bridal Creeper	1	Vine
Passiflora suberosa	Corky Passionfruit	1	Vine
Hyparrhenia hirta	Coolatai grass	1	Ground
Equisetum sp.	Horsetail	1	Ground
Paspalum quadrifarium	Blue Paspalum	1	Ground
Salpichroa origanifolia	Pampas Lily of the Valley	1	Ground
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed	1	Shrub
Ludwigia sp.	Water primrose	1	Aquatic
Salvinia molesta	Salvinia	1	Aquatic

8.5 Ecological burning

On 12 September 2017, funded in part through an Environmental Trust Grant (SL0036) and during a period where no flying-fox were within the reserve, Council Staff conducted an ecological burn on the south side of Stony Creek. The results of the burn will be monitored and the lessons implemented in to the future management of the site.

Records of bush fires are not available prior to 1979 but oral history indicates the whole valley has not been burnt since the 1940s. As such, the natural fire regime of the KFFR has been considerably altered. A fire was reported in the eastern end of the Reserve in 1947. In 1991, as part of habitat restoration, piles of woody weeds that had been manually cleared were burnt to good effect and the diversity of native plant species germinating increased. A hazard reduction burn was undertaken in the winter of 2006 near Bell Street, Gordon. The general absence of fire within the majority of the KFFR has led to the growth of a closed forest with emergent eucalypts. This habitat is favoured by the Grey-headed Flying-fox. As such, the application of fire within the KFFR must be carefully managed to retain as much suitable dense closed forest habitat as

possible while still stimulating natural regeneration in order to replace the senescent canopy and perpetuate the tall forest structure.

The *Best practice guidelines for the Grey-headed Flying-fox* (Department of Environment and Climate Change 2008) indicate that fire management strategies in flying-fox habitat needs to take account of the following:

- A high fire frequency will reduce species diversity and must be avoided.
- Weed treatment, both pre-fire and post-fire, is essential.
- Fire history records and maps, within and outside reserves, need to be accurate, detailed and regularly updated.
- Summer and autumn fires are more likely to be favourable for successful regeneration of banksia species than winter and spring burns.
- Fire responses of many flora and fauna according to seasonality are not well known although this information is increasing with further research.
- No construction of additional fire trails or tracks or the widening of existing tracks should be undertaken in bushland remnants.
- Wetting agents or chemical retardants should not be used in remnants, especially near streamlines.

Fire will be excluded from the Primary Grey-headed Flying-fox habitat and the closed forest / riparian vegetation along Stony Creek and in some areas planting will be needed to maintain emergent eucalypts. For the duration of this management plan fire will be excluded from the gallery rainforest along Stony Creek and ephemeral drainage lines that run downslope from the ridges. Fire will not occur in areas being used as roosts by the Grey-headed Flying-fox. The timing, location and extent of ecological burns will be driven by the presence and location of the Grey-headed Flying-fox to ensure that the species is not significantly disturbed and the monitoring and evaluation of previous burns. This is an important adaptive approach to ensure that the Grey-headed Flying-fox is not accidentally dispersed from the habitat and that the habitat remains suitable.

Within the wet sclerophyll forest vegetation on the slopes in the western portion of the KFFR, and the drier sclerophyll forest in the eastern section of the KFFR, a mosaic burning approach using variable intensity fires (e.g. moderate intensity surface fires separated by patches of lower intensity fire and unburnt patches) will be utilised to encourage a resilient habitat. This is an important approach to retain enough suitable habitat on site for the Grey-headed Flying-fox.

Whilst fire will be the main method of removing weeds and stimulating regeneration of native species in areas that are appropriate to burn, it is important to recognise that it is the absence of fire that has led to the growth of closed forest with emergent eucalypts, the habitat favoured by the Grey-headed Flying-fox. While burning creates conditions favourable for seed germination, high intensity crown fires will be avoided due to the location of the KFFR near housing and the wet nature of the forest. An appropriate fire regime will (Department of Environment and Climate Change 2008):

- increase the amount of sunlight reaching the soil
- increase the diversity of species in communities that require fire for regeneration

- encourage new growth of microbial flora (fungi) that aids in the germination of seedlings
- release nutrients such as nitrogen and phosphorus into the soil which aid in plant growth and vigour.

As the majority of the KFFR has not been burnt since the 1940s, the vegetation is in a long unburnt state and careful reinstatement of fire in small selected areas will be an effective management strategy. Dry sclerophyll forest has a domain of acceptable fire interval of 7 to 30 years while wet sclerophyll forest has a domain of acceptable fire interval of 25 to 60 years. As such, re-instatement of fire is an appropriate management method for these vegetation communities within the KFFR pending the evaluation and ongoing monitoring of previous ecological burns.

8.6 Balancing conservation with the needs of local residents

Another of the management objectives for this plan is balancing management of the Grey-headed Flying-fox colony and its environment with the needs of local residents. In the past Council have undertaken strategic removal of habitat trees close to resident's houses but this approach is no longer considered a viable option for management of the Grey-headed Flying-fox camp.

The focus of this plan is on maintaining and improving the habitats away from the residents to encourage the Grey-headed Flying-fox to utilise other areas of the KFFR as they have done in the past. This is a long-term objective that involves strategically improving sections of the KFFR by removing weeds and encouraging germination of native plant species through re-instatement of fire regimes and revegetation as appropriate in areas that display low resilience. As the habitat is improved, the Grey-headed Flying-fox should occupy a greater area of the habitat and move away from the reserve boundary into the core of the KFFR.

Ku-ring-gai Council recognise the impact the Grey-headed Flying-fox camp can have on residences adjoining the reserve and are actively seeking grant opportunities to subsidise the installation of double-glazed windows for the most affected residents. Double glazed windows have been reported as successful in mitigating the noise impacts of Grey-headed Flying-fox for residents around the KFFR.

8.7 Protection of the Grey-headed Flying-fox and other protected biodiversity

Protection of the Grey-headed Flying-fox, other bat species (order Chiroptera), as well as other protected flora and fauna will be achieved through strategic improvement of areas within the KFFR taking into consideration the individual ecological requirements of threatened biodiversity.

Works will be undertaken in a manner that minimises disturbance to roosting Grey-headed Flying-foxes. Machinery will not be used in Grey-headed Flying-fox habitat. Works will not be undertaken on site during periods of environmental stress (i.e. during extreme weather events) to avoid human disturbance. Small skilled teams of volunteer and professional bush regenerators will undertake the work to ensure disturbance is minimised. To ensure the works will not result in a significant impact to the Grey-headed Flying-fox, works in the direct area of the roosting habitat may only be undertaken during May, June and July each year, when there is no breeding activity, or when the animals are absent. Council must be satisfied that the proposed works will not result in a significant impact.

The works are designed so that the dense mid-storey vegetation that the Grey-headed Flying-fox relies upon is retained and enhanced. This will also benefit the Powerful Owl, as this species requires densely vegetated gullies for roosting and nesting. The retention of the dense mid-storey and work to maintain the resilience of larger trees that may be used as nesting sites is important for the protection of the Powerful Owl. Retaining the Grey-headed Flying-fox within the KFFR will benefit the Powerful Owls within the valley as the Grey-headed Flying-fox is a seasonal food source for this species.

Fire will be excluded from the gallery rainforest along Stony Creek and ephemeral drainage lines running downslope from the ridges. Buffers along drainage lines will be maintained to ensure that the breeding habitat for the Red-crowned Toadlet is protected.

9. Management Zones

The location of the management zones within the KFFR are outlined in Figure 12.

9.1 Primary Grey-headed Flying-fox habitat management zone

The area of roosting habitat to be retained on a continuous basis in the KFFR was set using relationships between population size and roosting extent. Yearly median and third quartile population sizes were calculated from monthly population estimates made from 2002 to 2009. This timeframe was chosen to accommodate any increase in urban flying-fox populations associated with drought; and the potential for recent downward population trends at KFFR to be reversed should the number of neighbouring camps be reduced due to proposed dispersals or developments that may occur during the duration of this management plan. Further details on how the Primary Grey-headed Flying-fox habitat area was defined are provided in Appendix E.

The Grey-headed Flying-fox is known to roost in two areas of the KFFR: Taylor Street and Stoney Creek. When the size of the Grey-headed Flying-fox population is low and when the animals return to the site after a period of absence, they currently roost in a small number of trees behind houses off Taylor Street. The roosting habitat along Stoney Creek was highly stable; it had been occupied in every map of roost extent since the animals commenced roosting in this part of the KFFR in 1990. Flying foxes returned to the Stoney Creek site after a period of absence from the KFFR in April and May 2015, indicating that a level of fidelity to this area had persisted despite ongoing use of the Taylor St roost site prior to departure.

In addition to the Taylor Street and Stoney Creek roosting areas, the Grey-headed Flying-fox also uses other areas of the KFFR in times of extreme heat. The roosting extent of flying-foxes on days with maximum temperatures of 36°C to 40°C were mapped during 2015 and summer 2016. During this time, animals moved south along the Taylor St creek and extended their roosting area east and west along the relatively steep terrain on the south-facing slope. The locations they used on the three days when mapping took place overlapped, suggesting the conditions provided in these areas were consistently favourable. This is confirmed by temperature and humidity readings taken from the site. On 18 January 2013, a day when 358 dead flying foxes were collected or observed within the KFFR the area of habitat occupied extended down the full south-facing slope and across Stoney Creek by approximately 15 m.

The Primary Grey-headed Flying-fox habitat management zone (see Figure 12) has been developed based off the available knowledge on the roosting habitat extents at Taylor Street, Stoney Creek and the use of other areas of the KFFR during extreme heat events. While the post fire recovery zone is within the Primary Grey-headed Flying-fox habitat management zone, this area is treated separately in this plan as it has recently been subject to an ecological burn so has particular management requirements that differ from the Primary Grey-headed Flying-fox habitat management zone. Likewise, the area of the previous ecological burn, is excluded from the Primary Grey-headed Flying-fox habitat management zone for the purposes of this management plan.

9.1.1 Desired habitat conditions

The current habitat condition within the Primary Grey-headed Flying-fox habitat management zone will be maintained and improved. The current vegetation structure consisting of the regular roosting habitat in the canopy and the closed forest refuge that is used in extreme weather will be retained. This will ensure that the variety of microclimates present within the KFFR are maintained and improved upon. To maintain an effective heat refuge for the Grey-headed Flying-fox the habitat needs to have an understorey and mid-storey vegetation to act as shelter from heat (dense ground layer and shrub layer), a dense cover of vegetation in the small tree layer to provide shade, and access to water.

The canopy of *Eucalyptus pilularis, Syncarpia glomulifera, Angophora costata*, and *Eucalyptus saligna* will be retained and replaced as necessary due to senescence. The lower tree layer of species including *Ceratopetalum apetalum* and *Pittosporum undulatum* with *Elaeocarpus reticulatus* and *Allocasuarina torulosa* will be retained. Many plant species present in the KFFR are not naturally occurring and have originated from seed dispersal from the Grey-headed Flying-fox. This is a natural phenomenon and the non-local native plant species are forming part of the habitat but are not dominating it. In many cases, these plants may provide an important roosting and foraging resource in the future. This is important to build resilience into the habitat that will help the habitat adapt to climate change. Where non-local native plant species have germinated from seed brought into site by the Grey-headed Flying-fox, these species will be allowed to grow unless they become invasive. The areas dominated by dense stands of woody weeds including *Ligustrum lucidum* (Broad-leaf Privet), *Ligustrum sinense* (Narrow-leaf Privet), and *Ochna serrulata* (Mickey Mouse Plant) will be retained to provide habitat for the Grey-headed Flying-fox. The ground layer will be retained in its current state to limit moisture and soil loss from the slope.

9.1.2 Management issue

The key management issue for this management zone is the maintenance and enhancement of the vegetation structure and function of the zone as the main area of roosting habitat for the Grey-headed Flying-fox and maintenance of the areas used as a heat refuge during times of extreme heat.

The objective of vegetation management in this zone is to retain and enhance flying-fox roosting habitat and heat refuge habitat in order to provide habitat for the Grey-headed Flying-fox throughout the zone and on a continuous basis by:

1. Maintaining and enhancing vegetation structure and complexity using techniques that are not directly (e.g. disturbance to roosting animals) or indirectly (destruction of roost habitat) disruptive to the animals.
2. Taking tree species preferences shown by flying-foxes within the KFFR into consideration in plant selection.
3. Monitoring the responses of flying-foxes to different practices and using the results to guide ongoing work in an adaptive management approach.

9.1.3 Required actions

The priority actions for this management zone include:

1. Existing canopy, sub canopy, mid storey and ground cover plants will be retained in the current state. The existing vegetation will be retained with structural complexity maintained or enhanced as appropriate using non-destructive rehabilitation methods.
2. Vegetation structure should be enhanced using restoration techniques unlikely to alter microclimate; and the impacts on temperature and humidity should be monitored where needed so that adjustments can be made.
3. No additional primary bush regeneration works (i.e. broad scale removal of woody weeds) is to occur in this management zone.
4. Bushcare regeneration exclosures are maintained to continue effectiveness. Additional exclosures are to be created as the opportunity arises to enhance restoration (this may include small scale clearing of woody weeds).
5. Planting of canopy species (see Appendix A) in canopy gaps as appropriate to plan for canopy senescence.
6. Target weeding of Category 1 high risk weeds (as outlined in Appendix B) is the only weed control method to be used by commercial contractors in this management zone and it must be done in a manner that minimises impacts to microclimate (i.e. limiting weeding to small scattered locations).
7. Mature native vines including *Parsonsia straminea* are retained to maintain habitat structure
8. Non-local native plant species that have germinated from seed brought into the site by the Grey-headed Flying-fox will be allowed to establish to enhance the habitat but will be monitored for invasiveness and removed if deemed to be invasive.
9. Effective vertebrate pest management program implemented (targeting foxes, dogs, and cats).
10. Ecological burning is excluded from this management zone.

9.1.4 Performance criteria

1. Techniques for natural regeneration have been limited to those that are unlikely to alter microclimate and have only been affecting very small scattered spaces in the habitat (as indicated by monitoring of regeneration works).
2. Species planted and retained in this management zone are only those species outlined in Appendix A. Non-local native plant species that have germinated from seed brought into the site by the Grey-headed Flying-fox will be allowed to establish but are removed if they become invasive.
3. Ecological burning is not undertaken within this management zone.
4. No further broad scale primary woody weed removal works are undertaken (removal of small areas of woody weeds is allowed for the establishment of exclosures).
5. No further removal of mature native vines (as indicated by no new evidence of mature vine death).
6. Category 1 high risk weeds are continuously suppressed and all new high risk weed infestations are identified and suppressed.
7. Supplementary planting of canopy species undertaken in canopy gaps as appropriate where the current canopy is senescent.

8. **Incidence of vertebrate pests is lowered.**

9.2 Secondary Grey-headed Flying-fox habitat management zone

This management zone is composed of two differing areas within the KFFR:

- Areas with a dense woody weed mid-storey
- Areas with few woody weeds but lacking appropriate fuel loads for a burn in the next 10 years (future ecological burn zones).

Some habitat maintenance zones in the east of the KFFR may be transferred to ecological burn zones after the completion of this plan in 2028 when this management plan is revised. However, for the life of this plan, these areas will be part of the habitat maintenance zone.

This management zone will act as an important habitat for the Grey-headed Flying-fox offering foraging opportunities and alternative roosting sites to the current location of the camp.

9.2.1 Desired habitat conditions

The current habitat condition within the habitat maintenance zone will be maintained. The current vegetation structure will be maintained to provide for future opportunities for the Grey-headed Flying-fox to move into areas that were previously occupied, or areas that may be occupied in the future. The canopy trees (as appropriate for the vegetation type) will be retained and replaced as necessary due to senescence. The lower tree layer will be retained and the areas dominated by dense stands of woody weeds including *Ligustrum lucidum* (Broad-leaf Privet), *Ligustrum sinense* (Narrow-leaf Privet), and *Ochna serrulata* (Mickey Mouse Plant) will be retained to provide habitat for the Grey-headed Flying-fox and promote varied micro climates. The ground layer will be retained in its current state to limit moisture and soil loss from the slope.

9.2.2 Management issue

The key management issue for this management zone is the maintenance of the current vegetation structure and function of the zone as habitat for the Grey-headed Flying-fox.

Dumping and encroachment is an issue in this management zone at the interface with housing. Vertebrate pest management is another management issue but common to all management zones.

9.2.3 Required actions

The priority actions for this management zone include:

1. Maintain the areas which have been subject to bush regeneration works including existing caged wallaby exclusion plots.
2. No additional primary bush regeneration works (i.e. broad scale removal of woody weeds) is to occur in this management zone so that the dense mid-storey vegetation is retained.
3. Bushcare regeneration exclosures are maintained to continue effectiveness. Additional exclosures are to be created as the opportunity arises to enhance restoration (this may include small scale clearing of woody weeds).
4. Mature native vines including *Parsonsia straminea* are retained.

5. Target weeding of Category 1 high risk weeds (as outlined in Appendix B) is the only weed control method to be used by commercial contractors in this management zone and it must be done in a manner that minimises impacts to microclimate (i.e. limiting weeding to small scattered locations).
6. Planting of canopy species (see Appendix A) in canopy gaps as appropriate to plan for canopy senescence.
7. Effective vertebrate pest management program implemented (targeting foxes, dogs, and cats).
8. Rubbish and debris from encroachment and dumping is reported to Council's regulatory officers and dealt with accordingly.

9.2.4 Performance criteria

1. The dense understorey and mid-storey vegetation (where present) is retained as a refuge for the Grey-headed Flying-fox.
2. No further broad scale primary woody weed removal works are undertaken (removal of small areas of woody weeds is allowed for the establishment of exclosures).
3. No further removal of mature native vines.
4. Category 1 high risk weeds are continuously suppressed and all new high risk weed infestations are identified and suppressed.
5. Supplementary planting of canopy species undertaken in canopy gaps as appropriate where the current canopy is senescent.
6. Impacts from rubbish and debris from encroachment and dumping is lessened and education of residents in relation to potential impacts of rubbish and encroachments is improved.
7. Incidence of vertebrate pests is lowered.

9.2.5 Future ecological burn zones

Some areas of the Secondary Grey-headed Flying-fox habitat management zone have been preliminarily identified as future sites for active management via ecological burns (see Figure 12). These areas display good ecosystem resilience and have not been burnt in the last 25 years. Obligate seeders and species that require fire to flower such as Grass Trees (*Xanthorrhoea* sp.) are present in this zone and need an ecological burn to ensure their persistence. Ecological burning is a key management measure for ensuring resilient native vegetation in the KFFR that will provide an ongoing habitat for the Grey-headed Flying-fox.

The boundaries of these areas have been identified by considering a number of factors such as the presence of natural features including rock outcrops and drainage lines, excluding fire from the Primary Grey-headed Flying-fox habitat and riparian zones, and the maximum size to avoid any negative effects on the Grey-headed Flying-fox colony. Importantly, the entire area of each proposed ecological burn zone will not be burnt at the same time and the burning will be carefully planned and managed so that the Grey-headed Flying-fox is not detrimentally affected.

The results of the 12 September 2017 burn will be used to inform the future management practices within the future ecological burn zones. Importantly, the eight proposed future ecological burn zones illustrated in Figure 12 will not be burnt during the duration of this plan. The need for an

ecological burn to manage these areas will be reassessed in 2028 upon completion of this plan and will be based on the results of monitoring.

The areas identified in this plan for future ecological burns may not be the only areas that would be benefit from a fire and other areas may also be identified upon revision of the plan.

9.3 Post fire recovery zone

On 12 September 2017, funded in part through an Environmental Trust Grant (SL0036) and during a period where no flying-fox were within the reserve, Council Staff conducted an ecological burn on the south side of Stony Creek in the area previously prepared for burning (see Figure 12 for the location). This area was the only zone proposed for burning during the duration of this management plan.

The burn site is now highly sensitive post fire and it is critical that no one enters the zone while initial recovery and regeneration is occurring. It is also imperative that herbivores including the swamp wallaby, are excluded to minimise predation on recruitment of desirable species germinating post fire. Around January 2018 (weather dependant. rainfall, temperature), initial post fire weeding will occur to deal with the flush of annuals and other weeds or non-desirable species that are impacting desirable species recruitment. This will be undertaken by highly skilled, professional bushland regenerators with experience in post fire maintenance. Post fire maintenance works are expected to be intensive for 12 – 18 months post fire at which point the initial flushes of weed competition should be under control and works will be able to become less intensive.

The results of the burn will be monitored and the lessons implemented in to the future management of the site. Ongoing maintenance of the zone will occur into the future until the area stabilises fully. Frequency of these visits will be determined through monitoring and site inspections.

9.3.1 Desired habitat conditions

The current habitat condition within the post fire recovery zone will be improved. The desired habitat state is a shift away from the exotic midstorey vegetation (i.e. privet) to a fully structured native vegetation community. A mix between the drier sclerophyllous shrubs and groundcovers on the higher ground up slope, and more mesic rainforest species towards the riparian zone will be achieved to create a more structurally and species diverse habitat. This will enhance the range of microclimates in the KFFR. The aim is to create a diversity of habitats with a contrast between the more mesic habitat of the Primary Grey-headed Flying-fox habitat and the Stony Creek riparian zone and the dry sclerophyll habitats of the upper gully slopes and benches.

9.3.2 Management issue

The key management issue for this management zone is the careful assistance of native species regeneration post fire. Weed control and exclusion of herbivores is critical. This will ensure that desirable native species establish successfully and that a resilient canopy and complex vegetation structure is maintained and created. This is necessary to ensure that the vegetation in the KFFR remains suitable as habitat for the Grey-headed Flying-fox, and other species, in the long-term. Preventing soil loss and erosion is also a key issue.

9.3.3 Required actions

The priority actions for this management zone include:

1. Maintain the fencing around the post fire recovery zone to exclude wallabies and other herbivores to allow seedlings to establish in an environment free from grazing pressure.
2. Maintain the post fire recovery zone to ensure that desirable native species establish successfully and that weed invasion does not occur.
3. Dry sclerophyll species are encouraged to establish on the southern slope and mesic rainforest species are encouraged to establish on the lower slope towards the drainage line.
4. Erosion and soil loss is prevented.
5. The post fire recovery zone is monitored to gauge success in stimulating germination of target species and these lessons are incorporated into the management approach for future works in the KFFR.

9.3.4 Performance criteria

1. All weeds in the zone are continuously suppressed.
2. Top soil is not lost form the burn area.
3. Native species regeneration is successful and a dense midstorey of native species is established by 2028.
4. A rainforest species midstorey is established on the lower slope adjacent to the riparian zone.
5. If regeneration of native species is poor, supplementary planting of canopy species undertaken in canopy gaps as appropriate.
6. If the burn has poor success, as determined by monitoring, the management of zones identified for future burning will be adapted as required.

9.4 Stony Creek riparian zone

The riparian zone of Stony Creek and its tributaries provide an important heat refuge for the Grey-headed Flying-fox as it provides:

- dense understorey and mid-storey vegetation to act as shelter from heat
- a dense crown cover of vegetation to provide shade
- access to water.

9.4.1 Desired habitat conditions

The gallery rainforest along Stony Creek is present due to the water supply, drainage, temperature, and soil nutrient supply. The desired future habitat condition is for the current rainforest conditions to remain and to be enhanced with a gradual widening of the gallery rainforest vegetation along the creek to increase the heat refuge habitat available to the Grey-headed Flying-fox. The closed canopy provides a consistently low light regime that may protect the Grey-headed Flying-fox during extreme heat events as the temperature is lower than in the canopy by several degrees. The desired conditions are a closed forest of rainforest structure with a dense tree canopy, a sub canopy of small trees, vines, a layer of mesic shrubs and a fern-dominated groundcover.

The dense canopy of *Ceratopetalum apetalum* and the sub-canopy of small trees including *Callicoma serratifolia, Acmena smithii, Tristaniopsis laurina* and *Cyathea australis* will be maintained. The emergent eucalypts including *Eucalyptus pilularis, Eucalyptus saligna Syncarpia glomulifera*, and *Angophora costata* will be maintained and supplemented where decline is present. The ground cover is an open cover of ferns including *Blechnum cartilagineum, Doodia caudata*, *Calochlaena dubia* and *Histiopteris incisa* amongst the sandstone boulders and fallen logs. Areas of *Tradescantia fluminensis* are also common. The groundcover will be maintained in its current state. Vines including *Parsonsia straminea* and *Morinda jasminoides* are common and these will be left in their current state to provide habitat.

9.4.2 Management issue

The key management issue for this management zone is the maintenance of the current vegetation structure and function of the zone as a refuge for the Grey-headed Flying-fox during extreme heat events. Some erosion of the sandy creek banks is evident which will be addressed. The Sydney Water sewer easement is also a management issue. Vertebrate pest management is another management issue but common to all management zones. Fire exclusion is an important consideration for the management of this zone to maintain the closed forest vegetation structure.

9.4.3 Required actions

The priority actions for this management zone include:

1. Maintain the areas which have been subject to bush regeneration works including existing caged wallaby exclusion plots
2. No additional primary bush regeneration works (i.e. removal of woody weeds) is to occur so that the dense mid-storey vegetation is retained.
3. Mature native vines including *Parsonsia straminea* are retained.
4. Target weeding of Category 1 high risk weeds as outlined in Appendix B.
5. Planting of canopy species (see Appendix A) in canopy gaps as appropriate.
6. Consider methods to stabilise the bank of Stony Creek where erosion has occurred.
7. Exclude fire form this management zone and around the sewer infrastructure.
8. Effective vertebrate pest management program implemented to control foxes, dogs, cats and black rats.

9.4.4 Performance criteria

1. The dense understorey and mid-storey vegetation is retained as a refuge for the Grey-headed Flying-fox.
2. No further broad scale primary woody weed removal works are undertaken (removal of small areas of woody weeds is allowed for the establishment of exclosures).
3. No further removal of mature native vines (as indicated by no new evidence of mature vine death).
4. Category 1 high risk weeds are continuously suppressed and all new high risk weed infestations are identified and suppressed.
5. Supplementary planting of canopy species undertaken in canopy gaps as appropriate where the current canopy is senescent.
6. Erosion along Stony Creek is stabilised.

7. Ecological burns are not undertaken within the zone.
8. The sewer easement is not damaged by the works.
9. Incidence of vertebrate pests is lowered.

Legend

- Ku-ring-gai Flying Fox Reserve
- Current bushcare exclosures
- Previous burn
- Future Ecological Burn Zones
- Tree canopy decline/replacement areas
- <all other values>

Mgmt_Zone

- Post fire recovery zone
- Primary GHFF habitat management zone
- Secondary GHFF habitat management zone
- Stony Creek riparian zone

WARNING:

Ku-ring-gai Council accepts no liability for the accuracy otherwise of this plan

Date: 21/11/2017

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North

Data source:

Ku-ring-gai Council, AUSIMAGE 2014, LPI 2016

JACOBS NSW SPATIAL - GIS MAP file : IA127200_NSW_GIS_F002_r1v6_Managment_zones | 21/11/2017

Figure 12. Location of management zones within the KFFR

9.5 Tree canopy decline / replacement areas

There are eight areas within the KFFR where tree canopy decline has been observed and revegetation is needed as a priority restoration technique (see Figure 12). These areas require revegetation to ensure the long-term maintenance of habitat for the Grey-headed Flying-fox and ensure a resilient canopy.

Due to the pattern of canopy decline within the KFFR, the tree canopy decline / replacement areas overlap with other identified management zones. These areas will contain potential candidate sites for planting and establishment of bushcare exclosures.

9.5.1 Desired habitat conditions

The current habitat condition within the revegetation zone will be improved and vegetation structure re-established. The canopy of *Eucalyptus pilularis, Syncarpia glomulifera, Angophora costata*, and *Eucalyptus saligna* will be established on the slopes. The rainforest vegetation along Stony Creek will be expanded. The lower tree layer of species including *Ceratopetalum apetalum* and *Pittosporum undulatum* with *Elaeocarpus reticulatus* and *Allocasuarina torulosa* will be established in areas where it is lacking. The native ground layer will be established where removal of *Tradescantia fluminensis* is suitable without altering the microclimate. The small exclosures as used by the bushcare group are a suitable method to allow for seedling establishment given the high levels of grazing pressure present in the KFFR and the need for low impact planting.

To rapidly establish canopy in these areas that have suffered dieback or decline, early successional stage species appropriate to the plant community type (e.g. *Acacia* spp. *Allocasuarina* spp.) will be planted along with the later successional stage species such as eucalypts. Selection for mesic rainforest species will be prioritised in the riparian areas to provide for a dense shady midstorey and high humidity environment. This will ensure a canopy of at least 5 metres in height is created within the 10 years that this plan will operate and later successional stage species will be sheltered from weed encroachment by the microclimate created by native pioneer species.

The species considered most appropriate for planting within each of the management zones in the KFFR are outlined in Appendix A. The species to be planted will be appropriate for the desired plant community type and vegetation structure. Sclerophyllous species will be planted away from the drainage lines on higher slopes. Rainforest species will be prioritised in riparian zones and lower slopes. Species should be selected from this list with consideration of the desired environmental conditions of the management zone, the plant community type (or desired plant community type), and the planting site to ensure the planting is appropriate. The plantings should primarily aim to re-instate the canopy in areas where it has been lost. A secondary consideration is planting to establish a seedling bank underneath existing canopy that will remain dormant until conditions occur that increase light at the ground level (e.g. tree fall). Canopy gaps should be targeted as the aim is to replace the senescent canopy.

Many species present in the KFFR are not naturally occurring and have originated from seed dispersal from the Grey-headed Flying-fox. This is a natural phenomenon and the non-local native plant species are forming part of the habitat but are not dominating it. These species may provide

an important roosting and foraging resource in the future. This is important to build resilience into the habitat that will help with adaption to climate change. Only exotic species that are brought in by flying-foxes, for example *Solanum mauritianum*, or heavily invasive non local native species, will be targeted for removal.

9.5.2 Management issue

As is typical of all Grey-headed Flying-fox roosting sites, the habitat for the Grey-headed Flying-fox at the KFFR has suffered from defoliation and increased moisture and nutrient loads. As such, the canopy trees have declined in at least eight areas throughout the KFFR (see Figure 12). *Eucalyptus pilularis* has been particularly affected, however other species including *Angophora costata, Eucalyptus saligna* and *Syncarpia glomulifera* appear to be more tolerant of the altered conditions such as impeded drainage and nutrient input from the Grey-headed Flying-fox.

The tree canopy decline / replacement areas illustrated in Figure 12 identify potential canopy replacement areas. Due to the pattern of canopy decline within the KFFR, the tree canopy decline / replacement areas overlap with other identified management zones. These areas will contain potential candidate sites for planting and establishment of bushcare exclosures.

An understanding of which tree species may be more resilient to damage from roosting animals than others has helped guide the revegetation activities outline din this plan. According to SEQ Catchments (2012), resilient roost trees need the following qualities in addition to ecosystem specific attributes:

- resilient to defoliation
- tolerant of high nutrient levels (high phosphorus benefits weeds, but impacts many native species)
- resistant to soil pathogens
- thick bark (resistant to damage from claws)
- avoid species with terminal growth points that are broken off by flying-foxes.

The key management issue for this management zone is the enhancement of existing natural regeneration and active revegetation of native species so that the canopy and midstorey can gradually be replaced over the long term. Herbivory of seedlings by the Swamp Wallaby is an issue within the KFFR and the planned tree canopy decline / replacement areas must be appropriately fenced to exclude native herbivores.

Some of the tree canopy decline / replacement areas are adjacent to housing. As such, any planting or regeneration activities conducted in the areas adjoining private property must consider the impacts of roosting bats on residents. In these areas, replanting roost trees may be considered inappropriate and the focus should be on maintaining a healthy ground and mid storey to act as a buffer from weed invasion to maintain suitable microclimates.

9.5.3 Required actions

The priority actions for this management zone include:

1. The site is prepared appropriately for plantings.

2. Planting of canopy species (see Appendix A) in canopy gaps as appropriate and establishment of exclosures to prevent herbivory. Exclosures are to be created as the opportunity arises to enhance restoration (this may include small scale clearing of woody weeds).
3. Planting of midstorey species and groundcovers in small areas only to ensure that there is limited temporary loss of habitat structure.
4. Maintain the revegetation area to ensure weed invasion does not occur.
5. No additional primary bush regeneration works (i.e. extensive removal of woody weeds) is to occur to allow for revegetation.

9.5.4 Performance criteria

1. Canopy species establish quickly and are well on the way to maturity after the 10-year period of this plan.
2. A closed canopy of at least 5 metres high is established in riparian areas after the 10-year period of this plan.
3. The vegetation is not simplified by inappropriate plantings.
4. The dense understorey and mid-storey vegetation (where present) is enhanced by plantings as a refuge for the Grey-headed Flying-fox.
5. No further broad scale primary woody weed removal works are undertaken (removal of small areas of woody weeds is allowed for the establishment of exclosures).
6. Exclosures are maintained to ensure they are functional.

10. Third party Works within the KFFR

As seen in Figure 7, there are a number of services within the KFFR including sewer. On occasion, contractors require access to the KFFR to complete works. Presently, any request to enter the KFFR is subject to assessment by council with relevant conditions of consent indicated in the completed environmental assessments.

Any works requiring access to the KFFR are to be assessed against the objectives within this management plan and the required actions against the management zones in which the work is proposed. Where actions run contrary to the objectives within a particular management zone, alternatives are to be considered. Where unavoidable, remediation should be carried out in accordance with the management plan and in consultation with Council's Bushland Maintenance team.

11. Monitoring and Evaluation

The success of the management measures in this plan should be monitored to assess its effectiveness and to determine the need for amendments or otherwise to the strategy. This management plan will be reviewed by Ku-ring-gai Council in consultation with key stakeholders. This plan shall remain in force until it is revised and then adopted by Ku-ring-gai Council.

It is important for the conservation of the Grey-headed Flying-fox that this management plan and the management zones outlined within it are reviewed periodically. The Grey-headed Flying-fox does not only roost in one particular area of the KFFR and has used many locations within the reserve as a roost over the years. The current location of the roost camp is likely to change over the next ten years while this management plan is in operation. It is important that the management zones as outlined in this planned are reassessed as the use of the habitat by the Grey-headed Flying-fox varies.

The performance criteria established for each management zone will be reported upon annually to gauge the effectiveness of the management actions. Council will use a simple pro forma to track progress of management actions to record whether each of the performance criteria are being met or otherwise (see Appendix F).

11.1 Photo Monitoring

Photo points will be established in each management zone. Multiple photo points will be established in larger zones. The photo point number, site identifier or description of shots, direction facing and GPS co-ordinates (easting and northing) will be recorded. The photo point location must be marked using a star-picket with safety cap attached to the top. The star-picket must be located in the centre of the photo to provide a reference point. Photos will be taken at the same time of the day each time. The camera lens and angle of the photo should be the same for each photo.

11.2 Quadrat monitoring

Ongoing annual monitoring is to be carried out within the KFFR to track progress. Permanent quadrats will be established in each management zone within which surveys according to the field methodology outlined in the NSW Biodiversity Assessment Method (BAM) will be undertaken. This will allow for monitoring of vegetation composition, structure and function as works progress.

The BAM involves establishing a survey plot based around a central 50m transect. A full floristic survey is undertaken within a 20m X 20m plot (or 400m^2 equivalent area) where the stratum, growth form, species name, foliage cover estimate, and abundance rating are recorded for each species. A 20m X 50m plot is used to record the number of large trees, tree stem size class, tree regeneration, length of logs, and number of trees with hollows. Five 1m^2 sub-plots are used to assess average litter cover (and other optional groundcover components).

Using the field method outlined in the BAM allows for a transparent and repeatable monitoring method and is the standard method used in NSW for the assessment of vegetation composition, structure and function. As the plan is reviewed, alternative monitoring methods such that implemented by the Eastern Alliance for Greenhouse Action Biodiversity Monitoring Framework,

which offers a slightly more in depth measure of vegetation change over time, may be investigated for adoption.

In addition to BAM, a simple pro-former to record management actions has also been incorporated in to the monitoring.

11.3 Monitoring of microclimate variables

In areas outside of the Primary Grey-headed Flying-fox habitat where management measures will be undertaken, monitoring of microclimate variables will be undertaken to provide insights into the effects of the actions on the habitat. To determine whether the management actions will have a detrimental or positive effect on conditions at management sites, portable weather meters (e.g. the Kestrel weather meter or similar) will be deployed at the work sites, and in unworked sites, to monitor any changes in the local environmental conditions. Variables to be recorded that may affect the quality of the habitat can include relative humidity, heat stress index, air temperature, wind chill, and wind speed. This data will guide any future work within the Primary habitat area.

11.4 Fly-out counts and roost extent mapping

Each month, Council in collaboration with KBCS will continue to conduct fly-out counts at strategic locations surrounding the reserve. This data provides a long term indication of the population and fluctuations of the flying-foxes in the camp. Additionally, Council will map where grey-headed flying-foxes are roosting within the camp to better understand how flying-foxes use the Ku-ring-gai Flying Fox Reserve. The data provides population trends and feeds into the National Flying Fox census run by the CSIRO.

11.5 Monitoring weed invasion

The Category 1 high risk weeds identified in Table 5 and Appendix B are the species that pose the highest risk to the KFFR in 2017 and are therefore ranked as the highest priority for control. It is likely that as weed control works progress and other weed species become established in the KFFR the weed risk categories will need to be revised.

Weed species and densities within the KFFR will be monitored by Council and bushcare volunteers and reassessment of weed risk categories will be undertaken annually in consultation with the stakeholder group to ensure appropriate control is taking place.

11.6 Adaptive management approach

Adaptive management is a systematic approach for improving resource management by learning from management outcomes. Ku-ring-gai Council aim to implement the actions outlined in this management plan to learn about which management actions are the most effective at achieving the desired outcome. The aim of this 10 Year Site Management and Roosting Habitat Plan for the Ku-ring-gai Flying-fox Reserve is to assist Council and volunteers to work in a strategic and coordinated manner implementing current best practice in bush regeneration and habitat management with a focus on conservation of the Grey-headed Flying-fox.

In the implementation of the proposed actions within each of the identified management zones, Ku-ring-gai Council aims to ‘learn by doing’. The desired habitat conditions of each management zone

have been outlined and objectives for each management zone have been set. The actions to achieve the objectives have been identified and monitoring to gauge the effectiveness of the actions has been planned. Once the actions for each management zone have been implemented and the results have been identified through analysis of monitoring data, Council will be able to modify the required actions for each management zone and in some cases will be able to modify the boundaries of management zones or apply a different zoning. The information gained from monitoring will guide future management of the KFFR. Annual review of the management zones will be undertaken with the stakeholder group.

The photo monitoring and quadrat monitoring will be integral to determine whether the management actions are successful. Monitoring of microclimate variables will provide some fine scale data on the effect that the works are having on the habitat. It is important for the conservation of the Grey-headed Flying-fox that this data is used to drive future management actions.

12. Licensing and approvals

The proposed works as part of this management plan will be undertaken within habitat for several threatened species (e.g. Grey-headed Flying-fox, Powerful Owl, Red-crowned Toadlet) and within an endangered ecological community listed under state and federal legislation. As such, appropriate approvals and licences need to be sought before works can begin. An overview of the approval pathways and required licenses is provided below.

12.1 *Environmental Planning and Assessment Act 1979 (EPA Act)*

Council has the option of assessing and determining proposed works under Part 5 of the EPA Act.

12.2 *Biodiversity Conservation Act 2016 (BC Act)*

12.2.1 Scientific licence:

Applicants have the option of applying for a Scientific Licence under Part 2 of the BC Act (formerly s132(C) of the *National Parks and Wildlife Act 1974*) to carry out conservation activities. This can be obtained through contacting the NSW Office of Environment and Heritage (OEH), Wildlife Licensing and Management unit on (02) 9585 6406 or email wildlife.licensing@environment.nsw.gov.au), or going to http://www.environment.nsw.gov.au/wildlifelicences/ScientificResearchLicences.htm

Councils current s132C licence (licence number SL100881) is valid from June 2016 - 31 May 2018 and authorises Bush regeneration, seed & propagule collection from EECs, and bushland biodiversity surveys in Ku-ring-gai Council LGA. The project title for the licence is: Bush regeneration, seed & propagule collection from EECs, and bushland biodiversity surveys in Ku-ring-gai Council LGA. This licence authorises the following activities:

- Pick protected plants for identification;
- Harm, trap, release fauna;
- Conduct bush regeneration activities including ecological burns.

The licence applies to the whole of the Ku-ring-gai LGA. Specific licence conditions surrounding the use of fire for ecological purposes include:

- Fire for ecological purposes should only be undertaken where it will stimulate or assist seed germination and regeneration of native vegetation to maintain or improve biodiversity. Ecological Burns must comply with the NSW Rural Fires Services Standards for Pile Burning, with no importation of fuel permitted.
- All burns undertaken must adhere to the Protection of the Environment Operations (Clean Air) Regulation 2010 and the *Rural Fires Act 1997*.
- Burns may not be conducted at sites where Flying-foxes are present.

12.2.2 Voluntary Conservation Agreement:

Clause 3.5, of the Conservation Agreement states:

'Unless prior written consent of the Director is obtained, the Owner shall not undertake or permit controlled burning for bushfire hazard reduction purposes'.

The burns may be licenced through a Hazard Reduction Certificate. Therefore, clause 3.5 of the VCA will apply and prior written consent from the Director must be obtained.

12.2.3 Threatened species licence:

Alternatively, and more commonly, applicants can apply for a Threatened Species Licence under Part 2 of the BC Act (formerly a Section 95(2) Certificate under the now repealed *Threatened Species Conservation act 1995* (TSC Act)). In assessing the application, OEH will evaluate whether the proposal will have a significant impact on threatened species, populations or communities and their habitats according to set criteria. Based on that assessment a decision is then made to either: approve as is; approve with conditions; refuse; or require further assessment if there is likely to be a significant impact to threatened species associated with the work (Species Impact Statement). Conservation focussed camp management proposals are typically approved with conditions.

The previous camp management works which involved selective tree removal near Taylor Street was approved under a Section 95(2) Certificate under the now repealed TSC Act as the OEH determined that the works were unlikely to significantly affect threatened species, populations or ecological communities, or their habitats. As such, a licence was not required under the TSC Act for the works.

Previous burns in the KFFR that have been located close to the Grey-headed Flying-fox roosting area have been small 'pile burns' conducted under a Threatened Species Licence under s91 the now repealed TSC Act. Other burns are generally licences under a Hazard Reduction Certificate (HRC).

Applications and further information is available at http://www.environment.nsw.gov.au/threatenedspecies/S91TscaLicenceForm.htm. Note a processing fee applies.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population

- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline, or
- interfere substantially with the recovery of the species.

Generally, actions which impact on flying-fox colonies may only be undertaken during May, June and July each year, when there is no breeding activity, or when the animals are absent. Council must be satisfied that the proposed works will not result in a significant impact.

13. Future opportunities

The KFFR is subject to a range of disturbances, not all of which can be remedied in the short-term. This section identifies future opportunities to benefit the habitat within the KFFR that could be implemented as funds become available.

13.1 Addressing urban runoff

Urban storm-water discharges that repeatedly disturb sites that have been subject to restoration activities has been identified as an issue that should be addressed in the KFFR (see Pallin 2000). Urban stormwater discharges into the KFFR deliver weed seed, nutrients, sediment, pathogens, toxicants, and gross pollutants from the surrounding streets upslope. Urban runoff and stormwater comes from two sources: point sources and diffuse sources. Discharge from point sources within the KFFR is associated with the on-site sewage management system and discharges from urban stormwater drains. The dense weed plumes within the KFFR are often co-located with the location of the sewer infrastructure. Diffuse sources of runoff occur during storms as water flows over land, particularly impervious surfaces, and picks up pollutants and moves them into waterways.

In the 1990s some gross pollutant traps were installed in street drains to collect material before it enters the KFFR and these have been successful in preventing soil, vegetative matter, plastic bottles and other litter from entering the KFFR but have created other scouring and deposition problems when they become blocked (Pallin 2000).

Addressing urban runoff within the KFFR will involve reducing the velocity and flow of stormwater, as well as reducing pollutant discharges. Water quantity and quality must be addressed. The implementation of LGA wide maintenance strategies such as street sweeping programs and regular cleaning or gross pollutant traps can also be an effective method in improving the quality of urban runoff. Detention facilities including dry ponds, wet ponds and constructed wetlands could be investigated as an option for the KFFR but may be inappropriate due to the location of housing directly adjacent to the reserve boundary and the topography of the valley. Likewise, infiltration systems such as basins and filtration such as bio retention systems are likely to face the same issues for implementation. Ensuring that the sewer infrastructure within the KFFR is maintained and no unplanned discharges occur should also be a priority and Council will need to work with Sydney Water to achieve this. Educational programs can be an effective tool for managing urban runoff and creating a productive discussion on urban runoff can help to encourage environmentally friendly practices among residents.

Soil erosion in creek lines is closely linked with the problem of increased stormwater flow. High velocity water flows can dislodge plant material and transport sediment. Inline engineering solutions can be applied to creek lines significantly affected by erosion but the retention, establishment and maintenance of riparian vegetation should be the main focus within the KFFR as Stony Creek exists in a near natural state and inline engineering solutions are not appropriate in this case.

13.2 Addressing exotic species in the landscape

Pallin (2000) identified that one of the most important challenges to the habitat of the KFFR is that major sources of exotic invasive trees and shrubs still exist in the broader Stony Creek catchment

and are readily redispersed by native fauna. Previously Ku-ring-gai Council has run a pilot 'Backyard, bush-friendly' programme that was conducted in 1995–96 that was funded by the Voluntary Conservation Agreement grant. To address the landscape weed issue, future funding could focus on an education program or subsidies for adjacent residents to replace their exotic gardens with native species.

13.3 Interpretation and education programs

The level of awareness and attitudes towards the KFFR and the Grey-headed Flying-fox is variable within the community. A community attitudes survey undertaken in 2001 (Larsen, Beck et al. 2002) identified that a slight majority of residents neighbouring the KFFR (56%) had a positive attitude to living near the flying-fox colony. This suggests that the past and current education programs being run by Council are succeeding and should be continued. Future education programs should focus on increasing community awareness of flying-fox ecology, increasing knowledge of the methods of disease transmission to reduce public fear, and informing residents of the management plan.

Upgrading the interpretive signage surrounding the camp would promote the conservation status of the reserve and educate the community about Flying-foxes and the role they play in the ecosystem.

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List of Tables and Figures

Table 6. Site vegetation, status and related fire Interval

	Community 1	Community 2	Community 3	Community 4
Vegetation Formation (Keith 2004)	Wet sclerophyll forest (shrubby sub-formation)	Dry sclerophyll forest (shrubby sub-formation)	Rainforest	Wet sclerophyll forest (grassy sub-formation)
Vegetation Class (Keith 2004)	North Coast Wet Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests	Northern Warm Temperate Rainforests	Northern Hinterland Wet Sclerophyll Forests
OEH VIS Plant Community Type	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast	Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin	Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion
Vegetation Community name (SMCMA 2013)	Coastal enriched sandstone moist forest	Coastal Enriched Sandstone Dry Forest	Coastal Sandstone Gallery Rainforest	Sydney Turpentine – Ironbark Forest
Vegetation Community name (Ku-ring-gai Vegetation - Complex 2014 Not provided in SMP refer to Dekho)	Sydney Sandstone Gully Forest	Sydney Sandstone Gully Forest / Other vegetation	Sydney Sandstone Gully Forest	Sydney Turpentine – Ironbark Forest
Specht Vegetation Structural Formation (Specht et al. 1995)	Tall open forest	Open forest	Closed forest	Tall open forest
Threatened Ecological Community name and listing (NSW TSC Act 1995)	Not listed	Not listed	Not listed	Sydney Turpentine – Ironbark Forest (TSC Act)
Threatened Ecological Community name and listing (Federal EPBC Act 1999)	Not listed	Not listed	Not listed	Turpentine Ironbark Forest in the Sydney Basin Bioregion
Minimum Fire Interval (NSW RFS Bushfire Environmental Assessment Code 2006)	30 years Low intensity fire only	10 years	No burning permitted	15 years Low intensity fire only
Minimum Fire Interval for Biodiversity (Guidelines for ecologically sustainable fire management NSW Biodiversity Strategy 2004)	25 years	7 years	Fire exclusion	25 years
Maximum Fire Interval for Biodiversity (Guidelines for ecologically sustainable fire management NSW Biodiversity Strategy 2004)	60 years	30 years	Fire exclusion	60 years

Table 7. Zone Specific Impact Assessment (ZSIA)

ZONE NAME	ISSUE	IMPACT	REQUIRED ACTION	PRIORITY RATING (high 1 to low 3)
Primary GHFF habitat management zone	Weed invasion	Loss of species diversity	Revegetation Works	1
		Introduction of weed seed	Maintenance, target weeding, monitoring	1
		Loss of threatened species abundance	Maintenance	1
		Suppression of Native Flora	Maintenance	1
		Senescent vegetation	Revegetation Works	1
		Loss of vegetation structure	Revegetation Works	1
Stony Creek riparian zone	Unapproved vegetation maintenance works	Erosion	Erosion Control/Stormwater Works	2
			weed mat / jute	2
		Loss of habitat	Monitoring	1
			Target Weeding	1
			Maintenance	1
			target weed – vines	1
			target weed – other	1
	Weed invasion	Loss of species diversity	Revegetation Works	3
		Introduction of weed seed	Maintenance	1
		Loss of threatened species abundance	Maintenance	1
		Sedimentation	Maintenance	1
		Suppression of Native Flora	Maintenance	1
		Senescent vegetation	Maintenance	1
	Stormwater/Drainage	Erosion	Erosion Control/Stormwater Works	2
		Introduction of weed seed	Maintenance	2
		Nutrification	Erosion Control/Stormwater Works	2
		Sedimentation	Erosion Control/Stormwater Works	2

ZONE NAME	ISSUE	IMPACT	REQUIRED ACTION	PRIORITY RATING (high 1 to low 3)
Secondary GHFF habitat management zone	Dumping- Soil, Vegetation, Mulch, Rubbish etc	Introduction of dog faeces/nutrient	management of neighbour issues (dumping, encroachment)	2
		Introduction of litter		
		Introduction of unwanted pathogen		
		Introduction of weed seed		
		Nutrification		
	Impact to Threatened/Significant Fauna species	Loss of habitat	Monitoring	1
		Loss of threatened species abundance	Target Weeding	1
	Physical damage to vegetation	Loss of threatened species abundance	Target Weeding	1
		Loss of habitat	Maintenance	1
	Unapproved vegetation maintenance works	Loss of habitat	Target Weeding	1
		Loss of threatened species abundance		
Tree canopy decline / replacement areas	Lack of recruitment/age class range	Mesic Shift	Revegetation Works	2
		Senescent vegetation	Maintenance	1
		Loss of species diversity	Monitoring	1

Table 8. Zone Specific Action Plan (ZSAP)

Zone Name	ACTION NUMBER	ACTION REQIURED	PRIORITY RATING	DETAILED DESCRIPTION OF ACTION	TIMEFRAME/ COMPLETION DATE	RESPONSIBILITY
Primary GHFF habitat management zone	1	Maintenance	1	Undertake a maintenance weed sweep throughout the zone to maintain previously worked areas.	Monthly	Regen Team / community volunteers
	2	Target Weeding	1	Undertake a targeted weeding sweep throughout the zone focusing on all high risk species identified in Appendix B.	Monthly	Regen Team / community volunteers
	3	Revegetation Works	1	In canopy gaps due to tree fall etc., consider revegetation with canopy species where natural regeneration is poor. Species list provided in Appendix A.	To begin within 1st year	Regen Team / community volunteers
	4	Monitoring	1	Monitoring of site is to be carried out as per the management plan guidelines as well as on regular site visits to notify of any issues that require attention.	Monthly	Regen Team
Stony Creek riparian zone	5	Maintenance	1	Undertake a maintenance weed sweep throughout the zone to maintain previously worked areas.	Monthly	Regen Team / community volunteers
	6	Target Weeding	1	Undertake a targeted weeding sweep throughout the zone focusing on all high risk species identified in Appendix B.	Monthly	Regen Team / community volunteers
	7	Erosion Control/Stormwater Works	2	Stabilise eroding bank of Stony Creek with logs / jute mesh. Plant out with shade tolerant groundcovers.	As required over 10-year timeframe	Regen Team
	8	Revegetation Works	3	In canopy gaps due to tree fall etc., consider revegetation with canopy species where natural regeneration is poor. Species list provided in Appendix A.	As required over 10-year timeframe	Regen Team / community volunteers

Zone Name	ACTION NUMBER	ACTION REQIURED	PRIORITY RATING	DETAILED DESCRIPTION OF ACTION	TIMEFRAME/ COMPLETION DATE	RESPONSIBILITY
	9	Monitoring	1	Monitoring of site is to be carried out as per the management plan guidelines as well as on regular site visits to notify of any issues that require attention.	Monthly	Regen Team
Secondary GHFF habitat management zone	10	management of neighbour issues (dumping, encroachment)	2	Zone monitored for dumping and dealt with according to Council procedures. Dumped vegetation and rubbish removed from site as appropriate. Reactive response to remove rubbish/ vegetation dumping within the site and the management of compliance of this matter.	As required over 10-year timeframe	All staff
	11	Target Weeding	1	Undertake a targeted weeding sweep throughout the zone focusing on all high risk species identified in Appendix B.	Monthly	Regen Team / community volunteers
	12	Monitoring	1	Monitoring of site is to be carried out as per the management plan guidelines as well as on regular site visits to notify of any issues that require attention.	Monthly	Regen Team
	13	Maintenance	1	Undertake a maintenance weed sweep throughout the zone to maintain previously worked areas.	Monthly	Regen Team / community volunteers
Tree canopy decline / replacement areas	17	Revegetation Works	2	In canopy gaps due to tree fall, senescence, etc. consider revegetation with canopy species where natural regeneration is poor. Species list provided in Appendix A.	As required over 10-year timeframe	Regen Team / community volunteers
	18	Maintenance	1	Undertake a maintenance weed sweep throughout the zone to maintain previously worked areas.	Monthly	Regen Team / community volunteers
	19	Monitoring	1	Monitoring of site is to be carried out as per the management plan guidelines as well as on regular site visits to notify of any issues that	Monthly	Regen Team

Zone Name	ACTION NUMBER	ACTION REQIURED	PRIORITY RATING	DETAILED DESCRIPTION OF ACTION	TIMEFRAME/ COMPLETION DATE	RESPONSIBILITY
				require attention.		

Appendix A

Table A. 1 Plant species list to guide revegetation within the KFFR

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Canopy species					
Angophora costata	Smooth-barked Apple, Sydney Red Gum, Rusty Gum	MYRTACEAE	Low priority Plant on the slopes to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to perpetuate the canopy. Only plant if natural regeneration is not present and resilience in the area is low.	Adversely affected by elevated soil nutrients; mature trees currently used for roosting *Angophora costata* occurs on sandstone hillsides with deep sandy soils and occasionally on shallow Wianamatta Shale with moderate nutrients from Narrabeen series. They prefer a full sun to light shade exposure.[6] An important tree species supporting nectar-dependent insects. Seed eaten by Crimson Rosella. Host to mistletoe *Dendrophthoe vitellina*.[6] Grey-headed Flying Fox and Little Red Flying Fox feed on nectar and pollen.[1]	Consider for all areas on higher slopes
Corymbia gummifera	Red Bloodwood	MYRTACEAE	Low priority Plant on the slopes in the east of the KFFR to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to perpetuate the canopy. Only plant if natural regeneration is not present and resilience in the area is low.	Adversely affected by elevated soil nutrients; mature trees used for roosting *Corymbia gummifera* occurs on ridges and upper slopes on sandy soil over sandstone with low nutrients. They prefer full sun to light shade exposure.[6] Grey-headed Flying Fox and Little Red Flying Fox feed on nectar and pollen.[1] New Holland and White-cheeked Honeyeaters obtain nectar from flowers. Probably an important source of nectar for	Consider for all areas on higher slopes

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
				insects during late summer. Tiny miner fly *Agromyza* sp. (Agromyzidae) attacks midrib of leaves aborting young foliage. Larvae of moth *Thysarcha ecclesiastis* bore into the stems. Larvae of Longicorn Beetle *Scolecobrotus westwoodi* feed on stems.[6] Invertebrates attract a wide range of small insectivorous birds.	
Eucalyptus pilularis	Blackbutt	MYRTACEAE	High priority Actively plant on the slopes in the west of the KFFR to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to perpetuate the canopy. Only plant if natural regeneration is not present and resilience in the area is low.	*Eucalyptus pilularis* occurs on slopes with sandy soils from sandstone or shale - low to medium nutrients with intermittent moisture supply. A lignotuber is present in dry forest habitat but not in wet forest.[6] Leaves browsed by Koala. Leaves attacked by larvae of Blackbutt Leaf Miner *Acrocercops laciniella*, mines between leaf surfaces. Host-specific to gall-forming psyllid/lerp insect *Glycaspis cyta* and round-lerp-forming *Glycaspis seriata*.[6] Invertebrates attract a wide range of small insectivorous birds. Grey-headed Flying Fox and Little Red Flying Fox feed on nectar and pollen.[1] Aerial nest of termite *Nasutitermes walkeri* on trunk of living tree. Sugar Glider and Feathertail Gliders inhabit large hollows formed in trees aged more than 200 yrs.[6]	A priority canopy replacement species for Area 1, Area 2 and Area 8
Eucalyptus resinifera* subsp. *resinifera	Red Mahogany	MYRTACEAE	High priority Actively plant in the Sydney Turpentine – Ironbark Forest areas to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to perpetuate the canopy. Only plant if natural	Status in KFFR to be confirmed *Eucalyptus resinifera* subsp. *resinifera* occurs in shale forest with clay soils on shale or shale–sandstone transition with medium to high fertility.[6] Fruit reported from pellets of Currawongs.[6] Grey-headed Flying Fox feed on nectar and pollen.[1]	A priority canopy replacement species for Area 1 and Area 8

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			regeneration is not present and resilience in the area is low.		
Eucalyptus saligna	Sydney Blue Gum	MYRTACEAE	High priority Actively plant on the slopes to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to perpetuate the canopy. Only plant if natural regeneration is not present and resilience in the area is low. (2 very large trees occur on banks of Stoney Creek. Trees are present as emergents above the turpentine canopy. Already planted extra in Areas 3ci and catchment of Sandpaper Creek. Consider as a replacement species for *Angophora costata* and *Eucalyptus pilularis* which may die due to increase in nutrients due to flying-foxes.	*Eucalyptus saligna* occurs in sheltered lower slopes and gullies with clay soils on shale (particularly Wianamatta Shale) consisting of medium to high nutrients and a fresh intermittent moisture supply.[6] Host plant of Cerambycid longicorn beetles *Agrianome spinicollis*, *Paroplites australis*, *Tessaromma undatum*. Seed eaten by Crimson Rosella.[6] Grey-headed Flying Fox feed on nectar and pollen.[1] Host to larvae of moth Gum Leaf Skeletoniser *Uraba lugens* and Bentwing Ghost Moth *Zelotypia stacyi* which bore into the stems and branches of saplings. Bell Miner nests in dying trees, leaves eaten by psyllid species.[6] Invertebrates attract a wide range of small insectivorous birds.	A priority canopy replacement species for the lower slopes of Area 2 along Stony Creek
Syncarpia glomulifera	Turpentine	MYRTACEAE	High priority Actively plant in the Sydney Turpentine – Ironbark Forest and wetter slopes in the west of the KFFR to gradually replace the canopy where decline has occurred. Carefully plan revegetation in strategic areas to	*Syncarpia glomulifera* occurs in gullies or shale-forest with mid-shade exposure on clay soils (Wianamatta Shale), shale/sandstone transition, and shales associated with sandstone strata, medium to high nutrients.[6] Major roost tree in Reserve. Appear to cope with high nutrients where bats have camped, although they are relatively slow	A priority canopy replacement species for Area 1 and Area 8

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			perpetuate the canopy. Only plant if natural regeneration is not present and resilience in the area is low.	growing. Provide excellent roosting for bats. Grey-headed Flying Fox and Little Red Flying Fox feed on nectar and pollen.[1] Moth larvae *Plectophila discalis* and *Agriophara horridula* feed in shelter formed between leaves.[6] Invertebrates attract a wide range of small insectivorous birds.	
Midstorey (shrubs and small trees)					
Acacia spp. ***A parramattensis, A. irrorata, A. Schinoides, A. decurrens***	Wattles	FABACEAE	Medium priority Plant in tree canopy decline / replacement areas to quickly establish a dense mid-storey canopy where decline has occurred.	Fast-growing, short-lived, short-term roosting habitat; has regenerated naturally in KFFR; suitable for regenerating areas Many regenerated naturally after burns in 1990s and after clearing *Anredera cordifolia*. Bats roosting in them. These acacia species occur in forests with soils of moderate fertility. Heavy flowering provides resources for a wide range of invertebrates, particularly bees. Seedpods and seeds are eaten by parrots, fallen seeds are eaten by native pigeons. Older trees with borers attract cockatoos (particularly Yellow Tailed Black Cockatoos which feed on larvae of borer's). Foliage attracts a wide range of small insectivorous birds. Sap is eaten by sugar gliders. Gliders also eat insects that this wattle in turn attracts.	Consider for all areas on higher slopes
Acmena smithii	Lilly Pilly	MYRTACEAE	Medium priority	Not observed being used for roosting in KFFR, although used in other sites; refuge	Consider this species for

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			Plant in riparian areas as appropriate to add to the density of the mid-storey and provide a foraging resource.	plant on high temperature days. *Acmena smithii occurs* in sheltered gullies and watercourses on fertile to very fertile soils consisting of clay loams on shale, basalt, alluvium, enriched sandstone.[6] Food plant of Wonga Pigeon, Australian King Parrot, Crimson Rosella, Pied Currawong, Satin Bowerbird.[6] Fruit eaten by Grey-headed Flying Fox.[1] Moth larvae *Agriophara horridula* feed in shelter formed between leaves, moth larvae *Cryptophasa pultenae* bore into stems.[6] Invertebrates attract a wide range of small insectivorous birds.	establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Allocasuarina torulosa ***Allocasuarina littoralis***	Forest Oak	CASUARINACEAE	Low priority Plant in tree canopy decline / replacement areas to quickly establish a dense mid-storey canopy where decline has occurred.	Adversely affected by elevated soil nutrients *Allocasuarina torulosa* occurs on hillsides, possible in response to shale/sandstone transition, clayey soils, with moderate fertility. It prefers a light shade exposure.[4] Growth form to 25 m high with corky, rough bark[4].	Consider for all areas on higher slopes
Alphitonia excelsa	Red Ash	RHAMNACEAE	Low priority Allow for self-seeding in riparian zone. No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a foraging resource.	Not observed being used for roosting in KFFR, although used in other roost sites. *Alphitonia excelsa* is found in sheltered gullies, steep slopes, or along creeks with sheltered, mid shade exposure. Soils on alluvium, shale, medium to high nutrients, well-drained.[8] Several now growing in KFFR. Grows faster than turpentines. Useful addition to	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
				canopy species. Food plant of butterfly larvae *Danis hymetus taygetus*, *Hypochrysops delicia, H. ignita*.[8] Fruit eaten by Grey-headed Flying Fox [1], Brown Cuckoo-dove, Lewin's Honeyeater, Olive-backed Oriole, Pied Currawong, Silvereye, Regent Bowerbird, Brown Pigeons.[8]	
Backhousia myrtifolia	Grey Myrtle	MYRTACEAE	High priority Actively plant in riparian areas and drainage lines where appropriate to replace canopy where there are suitable gaps. Only plant if natural regeneration is not present.	*Backhousia myrtifolia* occurs in rainforest close to streams north from the Bega district. This species has no seed dormancy, seedling recruitment and subsequent death under mature plants observed at Oatley. Growth rate slow and long lived. Coloniser of open sites. Resprouts after fire[6].	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Banksia serrata	Old man banksia	PROTEACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present after ecological burns.	*Banksia serrata* occurs in sandstone heath or woodland with low nutrient, well-drained soils.[8] Small tree to about 10m with warty, rough bark. Due to low nutrient environment, tree may be affected by nutrient rich Flying-fox guano. New Holland and White-cheeked Honeyeaters feed on nectar, Bell Minor, White-cheeked Honeyeater feed on flowers. Native bees, ants, and Rainbow Lorikeet feed on nectar and/or pollen.[8] Grey-headed Flying Fox and Little Red Flying Fox feed on nectar and pollen.[1]	Consider for Area 3 and Area 4 on higher slopes
Brachychiton acerifolius	Flame Tree, Illawarra Flame Tree	STERCULIACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and is not	*Brachychiton acerifolius* occurs on clay soils on basalt, high nutrients, well-drained in sheltered situations.[9] Seeds are dispersed by Currawongs from local gardens. Branches are tough and	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			overly invasive. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	would withstand flying-foxes roosting in them. Food plant of butterfly larvae *Polyura pyrrhus sempronius, Candalides absimilis*.[9]	Stony Creek
Breynia oblongifolia	Coffee Bush	EUPHORBIACEAE	Low priority Plant in appropriate habitat to provide dense lower shrub layer if natural regeneration is not sufficient.	*Breynia oblongifolia* is found along creek banks, slopes, gullies in moist eucalypt forest and woodland. Soils are sandstone derived but generally with additional enrichment, eg from shale.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Callicoma serratifolia	Black Wattle	CUNONIACEAE	Low priority Plant in riparian areas and drainage lines where appropriate to add to the density of the mid-storey.	*Callicoma serratifolia* occurs along banks of perennial creeks, moist gullies & escarpment slopes on Hawkesbury Sandstone and Narrabeen series influenced soils. They prefer a sheltered exposure.[4] Most usual larval food plant of butterfly Eastern Flat *Netrocoryne repandra repandra*; it creates a shelter by rolling the leaf and devours the whole leaf except the midrib. Food plant of moths *Aenetus splendens, Cryptophasa albacosta,* Emperor Moth *Opodiphthera astrophela*.[4] Invertebrates attract a wide range of small insectivorous birds.	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Ceratopetalum apetalum	Coachwood	CUNONIACEAE	High priority Actively plant in riparian areas and drainage lines where appropriate to replace canopy where there are suitable gaps. Only plant if natural	*Ceratopetalum apetalum* occur in gullies, creeks, escarpment slopes, watercourses on fertile soils or locally enriched gullies, on basalt, shale and sandstone, high to medium nutrient soils, and on low nutrient soils where adequate moisture and shelter is available. They prefer a sheltered, mid-shade to full shade exposure. Seedlings	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			regeneration is not present.	intolerant of full sun.[4] In KFFR *Ceratopetalum apetalum* have spread up-slope due to lack of fire. Protect existing young plants from wallabies and plant more; pot up naturally regenerated seedlings found on mossy logs. Food plant of chrysomelid beetles.[4]	
Ceratopetalum gummiferum	Christmas Bush	CUNONIACEAE	Low priority Plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	Unlikely to reach sufficient height for roosting; may be used as refuge during high temperature days *Ceratopetalum gummiferum* occurs on sheltered hillsides, gullies, riverbanks and rocky slopes with deep sandy soils, podsols, on well drained sandstone. They prefer a full sun to light shade exposure.[4] Germination of seed 1–3 months, high percentage of seed viability. Unlikely to be any soil-stored seedbank.[4] Larvae of butterfly *Candalides consimilis* reared on plant.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Cryptocarya glaucescens	Jackwood	LAURACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and may provide a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more	*Cryptocarya glaucescens* is a medium-sized tree, to 30 m high. It occurs in gullies and sheltered sites, escarpment slopes on loamy soils from alluvium, shales, basalt, sand and sandstone, medium to high nutrients and well-drained. They prefer a sheltered, mid to deep shade exposure.[5] Fruits of Lauraceae species are not typically eaten by Flying Foxes possibly because they contain high levels of	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			favoured plant or plant community.	secondary chemical compounds[5] but there is evidence that Grey-headed Flying-fox will eat the fruits of plants in the Lauraceae family during food shortages. Moth larvae *Plectophila discalis* feed in shelter formed between leaves.[5] None known in reserve but they are a sturdy rainforest tree.	
Elaeocarpus kirtonii	Pigeonberry ash White Quandong	ELAEOCARPACEAE	Low priority Plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer.	*Elaeocarpus kirtonii* is a subtropical and warm temperate rainforest tree found on coastal ranges north from Milton. The fruit is likely to be bird dispersed (fruit eaten by Figbird, Green Catbird, Regent Bowerbird, Rose-crowned Fruit-dove, Topknot Pigeon, Wompoo Pigeon)[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Elaeocarpus reticulatus	Blueberry Ash	ELAEOCARPACEAE	Medium priority Plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	Very slow growing *Elaeocarpus reticulatus* occurs in KFFR and typically inhabits creek banks, gullies and moist slopes with clay loams on sandstone and shales (Hawkesbury Sandstone with Narrabeen Series), to sandy loam over sandstone, medium to low nutrients and well-drained. They prefer a sheltered, mid–light shade exposure. Seedlings shade-tolerant.[4] Fruit eaten by Crimson Rosella, Figbird, Olive-backed Oriole, Regent Bowerbird, Wonga Pidgeon, White-headed Pidgeon.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Endiandra sieberi	Hard Corkwood	LAURACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and may	Small to medium-sized tree with hard corky bark usually inhabiting littoral rainforest and eucalypt open-forest. Prefers sandy soil on sandstone with low to medium nutrients in sheltered areas.[5]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			provide a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	Food plant of Eastern Flat butterfly *Netrocoryne repandra repandra*. Fruit eaten by Whiteheaded Pigeon.[5] Fruits of Lauraceae species are typically not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds but may be eaten when other food sources are scarce.[1]	Stony Creek
Ficus coronata	Creek sandpaper fig	MORACEAE	High priority Actively plant in appropriate habitat on the slopes and riparian areas. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer and forgaing resource. Only plant if natural regeneration is not present.	*Ficus coronata* occur on creek banks, in rainforest and or sheltered rocky areas on various substrate from sandstone boulders, clayey to sandy, medium to low nutrient soils. They prefer an intermittent moisture supply and sheltered situations, light shade exposure. Fruits are sweet and edible, eaten by Figbird, Olive-backed Oriole. Fruit eaten by Grey-headed Flying Fox.[2]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Ficus macrophylla	Moreton bay fig	MORACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	Not found in KFFR; used as roost tree elsewhere *Ficus macrophylla* typically occur in dry to moist subtropical rainforest and riparian forest, often as an emergent. They grow in high nutrient soils on sandstone and alluvium.[5] Fruit eaten by Grey-headed Flying Fox.[2]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Ficus obliqua	Small-leaved fig	MORACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and may provide a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	Not found in KFFR; used as roost tree elsewhere *Ficus obliqua* occurs on escarpment slopes and benches, gullies in moist subtropical to warm temperate rainforest and littoral rainforest, commonly as an emergent. They prefer moist high nutrient soils.[5] Fruit eaten by Grey-headed Flying Fox [2], Satin Bower Bird, Lewins Honeyeater.[5]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Ficus rubiginosa	Port Jackson Fig, Rusty Fig	MORACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and may provide a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	*Ficus rubiginosa* occurs in crevices and rocky sides of gullies in eucalypt open-forest or dry, or subtropical rainforest. They prefer well drained sites with sandstone, basalt, quartzite, low nutrients soils.[5] Fruit eaten by Grey-headed Flying Fox.[2] Grows naturally on rock outcrops in valley.[5] Valuable canopy tree. Distance dispersal of seeds by birds. Seeds reported from pellets of Currawongs and also dispersed by Flying Foxes. Germinates and establishes as lithophyte (very rarely epiphytic). Germination evidently light-dependent.[5]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Ficus superba* var. *henneana	Deciduous fig	MORACEAE	Low priority No need to actively plant or cull this species as it adds to the	Not found in KFFR *Ficus superba var.henneana* occurs on rocky creekbanks and slopes in	Consider this species for establishment of a rainforest midstorey

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			density of the mid-storey and may provide a forgaing resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	association with littoral rainforest or dry rainforest, also rocky escarpments in eucalypt forest. They prefer rocky soils on volcanics, sandstone, alluvium, high nutrients with full sun to mid shade exposure.[5] Fruit eaten by birds e.g. Figbird, Lewin's Honeyeater, Regent Bowerbird, White-headed Pigeon and Grey-headed Flying Fox.[5] Several identified by contract bush regenerator Paul Gadsby in Nelson East Management Zone.	on the lower slopes of Area 2 along Stony Creek
Glochidion ferdinandi* var. *ferdinandi	Cheese Tree	EUPHORBIACEAE	High priority Actively plant in appropriate habitat on the wetter slopes in the west and riparian areas. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Glochidion ferdinandi* occurs in moist sheltered gullies, creek and river banks on sandy alluvium, clay soils from Wianamatta Shale, Narrabeen Group. Prefer medium to high nutrients and appear to tolerate low light conditions.[4] Fruit eaten by Brown Cuckoo-Dove, Australian King Parrot, Figbird, Lewins's Honeyeater, Olive-backed Oriole and White-headed Pigeon. Eaten by Pied Currawong and regurgitated. Rainbow Lorikeets feed on young leaves.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Lomatia myricoides	River Lomatia	PROTEACEAE	Low priority Plant in appropriate habitat on the slopes and riparian areas. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	Growth form is a small shrub or small tree 2–7 m high. *Lomatia myricoides* grows in sheltered sites along creeks, watercourses, with permanent moisture on sandy alluvium from sandstone or moist loamy soil - low to high nutrients.[8]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Maytenus silvestris	Narrow-leaved Orangebark	CELASTRACEAE	Low priority Plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Maytenus silvestris* growth form is a shrub to 4.5 m high, or sometimes a small tree. It grows in moist eucalypt forests in gullies, rocky slopes, ridges. Prefers clay soils from Wianamatta Shale or shale-enriched sandstone, medium nutrients and a mid-shade exposure.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Melia azedarach	White cedar	MELIACEAE	Medium priority Consider planting this species as it adds to the density of the mid-storey and provides a foraging resource. If necessary, manage by selectively culling if this species is affecting the health and vigour of a more favoured plant or plant community.	*Melia azedarach* is widely used in landscaping as a shade tree. Seed easily germinates and rapidly spreads. Grows well in riparian forest, subtropical and dry rainforest, rocky slopes and gullies. It prefers a sandy alluvium and clay soils, medium nutrients, intermittent fresh moisture supply and a light shade to full sun exposure.[5] Seed eaten by Sulphur-crested Cockatoo, Australian King Parrot, Crimson Rosella, Emerald Dove, Figbird, Lewins Honeyeater, Pied Currawong, Bowerbirds, Wompoo Fruit Dove, Wonga Pigeon, Olive-backed Oriole, Noisy Friarbird.[5] Fruit eaten by Grey-headed Flying Fox.[2]	Consider for all areas on higher slopes
Myrsine variabilis	Brush Muttonwood	MYRSINACEAE	Low priority Plant in appropriate habitat on the wetter slopes and riparian areas. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Myrsine variabilis* grows in moist forest and rocky gullies, drier slopes in Eucalypt open-forest. It prefers heavy soils on shales, volcanic necks, and enriched gullies on sandstone, medium nutrients. Prefers mid-shade to full sun exposure.[5] Fruit eaten by Lewin's Honeyeater and pigeons. Host plant of Cerambycid beetle *Tessaromma sordidum*.[5]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Notelaea longifolia	Large Mock-olive, Large-leaved Olive	OLEACEAE	Low priority Plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Notelaea longifolia* grows in moist forest with clay soils, alluvium, medium nutrients.[7] Fruit eaten by Brown Cuckoo-dove. Food plant of butterfly Eastern Flat *Netrocoryne repandra repandra*.[7]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Pittosporum revolutum		PITTOSPORACEAE	Low priority Actively plant in appropriate habitat on the slopes. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	Prefers moist open-forest with clay soils on basalt, Narrabeen Shale, Wianamatta Shale, medium to high nutrients.[7] Host plant of Cerambycid beetle *Coptopterus thoracicus*. Birds eat green fruit.[7]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Pittosporum undulatum	Native Daphne, Sweet Pittosporum	PITTOSPORACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a forgaing resource. If necessary, manage by selectively culling if this species has become dominant and simplified the mid-storey.	Mature plants used for roosting; used as heat refuge in understorey *Pittosporum undulatum* occurs in moist forest and sheltered gullies on clay or shale-derived soil, granite, alluvium, basalt; young plants also found on dry sandstone particularly at infrequently burnt urban bushland reserves. It prefers sheltered, mid-shade to light shade exposure.[7] Fruit eaten by Grey-headed Flying Fox.[2] Fruit reported from pellets of Currawongs. Food plant of Crimson Rosella and Silvereye.[7] Female longicorn beetle *Strongylurus thoracicus* deposits eggs in bark of branch which usually dries out and breaks at the point weakened by the boring of the larvae; pupation usually	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
				occurs further into the trunk or lower branches, adults emerging in December. Attacked by sap sucking insects, white and pink wax type. Host plant of Cerambycid beetle *Coptopterus thoracicus*. Leaves, especially new shoots, eaten by caterpillars of *Lamprolina* sp. Larvae of two small miner flies *Phytobia* species (Agromyzidae) form galls on leaves and stems.[7] Invertebrates attract a wide range of small insectivorous birds.	
Podocarpus elatus	Plum pine	PODOCARPACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a forgaing resource. If necessary, manage by selectively culling. Low priority.	Planted in reserve and could be naturally dispersed. Fruit eaten by Grey-headed Flying Fox.[2]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Schizomeria ovata	Crabapple	CUNONIACEAE	Low priority Consider planting this species in the gallery rainforest along Stony Creek if appropriate to provide a foraging resource and dense canopy in areas of decline. Not a high priority species.	*Schizomeria ovata* occurs in moist gullies, creekbanks, escarpment slopes on sandy loam soils from sandstone, enriched with shale runoff, alluvium, medium nutrient soils. Prefers sheltered exposure in mid-shade to full sun.[4] Host plant of Cerambycid beetles.[4] Fruit eaten by Grey-headed Flying Fox. [2] One multi-stem tree in Nelson West MZ; new shoots heavily browsed by wallabies which may explain lack of seedlings elsewhere.	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Synoum	Scentless	MELIACEAE	Low priority	Shrub or small tree to 7 m high – bird	Consider this

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
glandulosum	Rosewood		No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a forgaing resource. Allow if self-seeding in riparian zone.	dispersed seed. Seedling growth is slow and takes approximately 5 years to develop a lignotuber.[5] *Synoum glandulosum* occurs in sheltered gullies, creek banks on sandy loam on alluvium, sandstone with basalt influence, medium nutrients. Prefers light shade to full shade exposure.[5]	species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Syzygium paniculatum	Magenta Lilly Pilly	MYRTACEAE	Low priority Consider planting this species to add to the density of the mid-storey and provide a foraging resource.	Grows on coastal dune sand or creek alluvium, clay loams, low–medium nutrients, well-drained. Tolerates shade but needs light for regeneration. Killed by wildfire but may resprout from base or with epicormic shoots. Fruit reported from pellets of Currawongs. Fruit eaten by Grey-headed Flying Fox[6].	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Trema aspera	Native Peach, Poison Peach	ULMACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Trema aspera* occurs in moist open-forest and open rocky areas e.g. with *Eucalyptus saligna, E. paniculata* in regrowth and margins of rainforest with sheltered exposure. It prefers soils from shale, slates, medium nutrients, well-drained.[9] Fruit eaten by Brown Cuckoo-dove, Figbird, Lewins Honeyeater, Olive-backed Oriole, Brown Pigeon, King Parrot. Larvae of moth *Aenetus splendens* on plant.[9]	Consider for all areas on higher slopes
Tristaniopsis laurina	Water Gum	MYRTACEAE	Low priority Consider planting this species in riparian zones to add to the density of the mid-storey	Occurs in riparian woodland and scrub. A coloniser species, exploits increased light and nutrients following disturbance. Resprouts from epicormic buds or lignotuber after fire.	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Trochocarpa laurina	Tree Heath	EPACRIDACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in strategic areas to perpetuate the mid-storey layer. Only plant if natural regeneration is not present.	*Trochocarpa laurina* occurs in gullies, amongst rocks, creekbanks, escarpment slopes in warm temperate, sub-tropical, riverine, and moist eucalypt forest e.g. with *Eucalyptus saligna, E. pilularis, Ceratopetalum apetalum, Acmena smithii, Syncarpia glomulifera, Backhousia myrtifolia*.[4] It grows in sandy loam to yellow sandy clays from sandstone, shales, possibly on basalt. Low–moderate nutrient soils, well-drained – Hawkesbury Sandstone and Narrabeen Series. It prefers a sheltered exposure in mid-shade. Young plants not able to tolerate full sun.[4] Drupe is bird and water-dispersed. Germination 6–14 months, low germination rate, very slow-growing especially when young. Germination is difficult, may take up to 2 years.[4]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Wilkiea huegeliana	Veiny Wilkiea	MONIMIACEAE	Low priority No need to actively plant or cull this species as it adds to the density of the mid-storey and provides a forgaing resource. Allow if self-seeding in riparian zone.	Male and female flowers often on different trees. Fleshy black fruit adapted for vertebrate dispersal.[5] *Wilkiea huegeliana* occurs in gullies, slopes in subtropical to warm temperate rainforest, dry rainforest and moist tall open-forest e.g. with *Eucalyptus pilularis, Syncarpia glomulifera.*[5] It prefers a sandy loam from the Narrabeen formation with medium nutrients and intermittent moisture supply. It does well in sheltered situations with mid shade.[5]	Consider this species for establishment of a rainforest midstorey on the lower slopes of Area 2 along Stony Creek
Groundcover species					

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Austrostipa pubescens	Tall Spear Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial grass suitable for planting on sandy soils within the KFFR.	Consider for all areas on higher slopes
Centella asiatica	Pennywort	APIACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in strategic areas to perpetuate the ground layer. Only plant if natural regeneration is not present.	A herbaceous perennial groundcover. Roots at nodes. Suitable for planting in wetter situations.	Consider for all areas
Dianella caerulea producta	Flax Lily	PHORMIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Suited to planting in rockier hillside situations in the KFFR.	Consider for all areas
Dianella caerulea caerulea	Flax Lily	PHORMIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Suitable for planting in most situations throughout the KFFR where groundcover is required.	Consider for all areas
Dianella revoluta	Spreading Flax Lily	PHORMIACEAE	Medium priority Consider planting this species as it adds to the density of the ground layer.	Suitable for planting on clay and sandstone.	Consider for all areas
Dichelachne inaequiglumis	Plume Grass	POACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in	Suitable for the areas of enriched soil within the KFFR.	Consider for all areas

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
			strategic areas to perpetuate the ground layer. Only plant if natural regeneration is not present.		
Dichondra repens	Kidney Weed	CONVOLVULACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	A perennial herb with creeping stems, rooting at nodes. Will be suitable for creating groundcover in most situations within the KFFR.	Consider for all areas
Digitaria parviflora	Smallflower Fingergrass	POACEAE	Low priority Plant in appropriate habitat. Carefully plan revegetation in strategic areas to perpetuate the ground layer. Only plant if natural regeneration is not present.	A tufted grass that would be suitable for the KFFR where a grass cover is required.	Consider for all areas
Echinopogon caespitosus	Tufted Hedgehog Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	A tufted grass that would be suitable for the KFFR where a grass cover is required.	Consider for all areas
Echinopogon ovatus	Forest Hedgehog Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	A tufted grass that would be suitable for the KFFR where a grass cover is required.	Consider for all areas
Einadia hastata	Berry Saltbush	CHENOPODIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	A low shrubby perennial suitable for the more enriched soils in the west of the KFFR.	Consider for all areas

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Entolasia marginata	Margined Panic Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Straggling or shrubby wiry rhizomatous perennial suitable for damper areas on sandy soils.	Consider for all areas
Entolasia stricta	Wiry Panic Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Straggling or shrubby wiry rhizomatous perennial suitable for drier areas on sandy soils.	Consider for all areas
Lepidosperma laterale	A Sword Sedge	CYPERACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial sedge. Suitable for planting in areas of sandy soil.	Consider for all areas
Lomandra multiflora	Many-flowered Mat Rush	LOMANDRACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial herb. Suitable for planting throughout the KFFR in the range of habitats available.	Consider for all areas
Lomandra longifolia	Spiny-headed Mat Rush	LOMANDRACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial herb. Suitable for planting throughout the KFFR in the range of habitats available.	Consider for all areas
Lomandra obliqua	Fish Bones	LOMANDRACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Decumbent to scrambling perennial herb. Suitable for planting in areas of sandy soil.	Consider for all areas

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Microlaena stipoides	Weeping Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Slender, tufted perennial grass. Suitable for planting in damper shaded areas within the KFFR.	Consider for all areas
Oplismenus aemulus	Basket Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Weak trailing perennial grass. Suitable for planting in damper shaded areas within the KFFR.	Consider for all areas
Oplismenus imbecillis	Australian Basket Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Weak trailing perennial grass. Suitable for planting in damper shaded areas within the KFFR.	Consider for all areas
Panicum simile	Panic Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial grass suitable for planting in sandier soils within the KFFR.	Consider for all areas
Plectranthus parviflorus	Cockspur Flower	LAMIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Fleshy shrub suitable for planting in rocky areas and drainage lines within the KFFR.	Consider for all areas
Pomax umbellata	Pomax	RUBIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Erect to spreading subshrub suitable for planting in the sandier soils within the KFFR.	Consider for all areas

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Pratia purpurascens	White-root	LOBELIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Perennial herb suitable for planting in wetter shaded areas of the KFFR.	Consider for all areas
Pseuderanthemum variablile	Pastel Flower	ACANTHACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Perennial herb suitable for planting in wetter shaded areas of the KFFR.	Consider for all areas
Schelhammera undulata	Lilac Lily	UVULARIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Prostrate or erect herb suitable for planting in wetter areas of the KFFR.	Consider for all areas
Themeda australis	Kangaroo Grass	POACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Tufted perennial grass suitable for planting in areas of enriched soil within the KFFR.	Consider for all areas
Veronica plebeia	Trailing Speedwell	SCROPHULARIACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Perennial herb suitable for planting in areas of enriched soil within the KFFR.	Consider for all areas
Viola hederacea	Native Violet	VIOLACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Perennial herb suitable for planting in moist shaded areas within the KFFR.	Consider for all areas

Species	Common Name	Family	Action	Notes	Tree canopy replacement area
Wahlenbergia gracilis	Native Bluebell	CAMPANULACEAE	Medium priority Consider planting this species as necessary as it adds to the density of the ground layer.	Perennial tufted herb suitable for planting throughout the KFFR.	Consider for all areas

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Appendix B

Table B. 1 Weed risk categories to guide the targeted weed removal program

Scientific Name	Common Name	Category	Form
Ludwigia sp.	Water primrose	1	Aquatic
Salvinia molesta	Salvinia	1	Aquatic
Equisetum sp.	Horsetail	1	Ground
Hyparrhenia hirta	Coolatai grass	1	Ground
Paspalum quadrifarium	Blue Paspalum	1	Ground
Salpichroa origanifolia	Pampas Lily of the Valley	1	Ground
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed	1	Shrub
Anredera cordifolia	Madeira Vine	1	Vine
Asparagus asparagoides	Bridal Creeper	1	Vine
Ipomoea cairica	Coastal Morning Glory	1	Vine
Ipomoea indica	Morning Glory	1	Vine
Macfadyena unguis-cati	Cats Claw Creeper	1	Vine
Passiflora suberosa	Corky Passionfruit	1	Vine
Myriophyllum aquaticum	Brazilian Milfoil	2	Aquatic
Alstroemeria spp.	Peruvian Lily	2	Ground
Ambrosia sp.	Rag weed	2	Ground
Asparagus sp	Asparagus fern	2	Ground
Bryophyllum spp.	Mother-of-millions	2	Ground
Eragrostis curvula	African Lovegrass	2	Ground

Scientific Name	Common Name	Category	Form
Gloriosa superba	Glory lily	2	Ground
Hydrocotyle bonariensis	Pennywort	2	Ground
Pampas sp	Pampas grass	2	Ground
Pennisetum villosum	White Foxtail Grass	2	Ground
Rubus fruticosus agg. spp.	Blackberry	2	Scrambler
Chrysanthemoides monilifera subsp. *rotunda*	Bitou Bush	2	Shrub
Ailanthus altissima	Tree of Heaven	2	Tree
Olea europaea	African Olive	2	Tree
Araujia sericifera	Moth Plant	2	Vine
Cardiospermum grandiflorum	Balloon vine	2	Vine
Delairea odorata	Cape Ivy	2	Vine
Dipogon lignosus	Dipogon	2	Vine
Hedera helix	English Ivy	2	Vine
Jasminum officinale	Jasmine	2	Vine
Lonicera japonica	Japanese Honeysuckle	2	Vine
Thunbergia alata	Black eyed susan	2	Vine
Thunbergia alata	Black-eyed Susan	2	Vine
Vinca sp	Blue periwinkle	2	Vine
*Vitex vinifera**	Ornamental Grape	2	Vine
Bidens pilosa	Cobblers Pegs	3	Annual
Chenopodium album	Fat Hen	3	Annual

Scientific Name	Common Name	Category	Form
Chrysocephalum spp.	Thickhead	3	Annual
Conyza spp.	Fleabane	3	Annual
Crassocephalum crepidioides	Thick head	3	Annual
Verbena bonariensis	Purple top	3	Annual
Ageratina riparia	Mistflower	3	Ground
Ageratum sp.	Billygoat weed	3	Ground
Andropogon virginicus	Whisky Grass	3	Ground
Apium leptophyllum	Slender Celery	3	Ground
Chlorophytum comosum	Spider Plant, Ribbon Plant	3	Ground
Coreopsis lanceolata	Coreopsis	3	Ground
Crocosmia crocosmiiflora	Montbretia	3	Ground
Cynodon dactylon	Common Couch	3	Ground
Cyperus rotundus	Nut Grass	3	Ground
Ehrharta erecta	Ehrharta	3	Ground
*Erigeron gavinscianrus**	Seaside Daisy	3	Ground
Facelis retusa	Facelis	3	Ground
Hedychium gardnerianum	Ginger Lily	3	Ground
Lilium formosanum	Formosan Lily	3	Ground
Nephrolepis cordifolia	Fishbone Fern	3	Ground
Paspalum dilatatum	Paspalum	3	Ground
Pennisetum clandestinum	Kikuyu	3	Ground

Scientific Name	Common Name	Category	Form
Persicaria capitata	Japanese Knotweed	3	Ground
Phytolacca octandra	Inkweed	3	Ground
Rhynchelytrum repens	Red natal grass	3	Ground
Sporobolus africanus	Parramatta Grass	3	Ground
Tradescantia fluminensis	Trad, Wandering Jew	3	Ground
Vulpia sp.	Ratstail Fescue	3	Ground
Watsonia meriana var. *Bulbifera*	Wild Watsonia	3	Ground
Zantedeschia aethiopica	Arum Lily	3	Ground
Gomphocarpus sp.	Cotton bush	3	Midstorey
Vicia tetrasperma	Vetch	3	Scrambler
Coprosma repens	Mirror Plant	3	Shrub
Polygala japonica	Polygala	3	Shrub
Rhaphiolepis spp.*	Indian Hawthorn	3	Shrub
Senna pendula	Senna	3	Shrub
Acacia baileyana	Cootamundra Wattle	3	Tree
Acacia saligna	Golden Wreath Wattle	3	Tree
Acer negundo	Box Elder	3	Tree
Celtis sinensis	Celtis	3	Tree
Cinnamomum camphora	Camphor Laurel	3	Tree
*Phoenix canariensis**	Canary Island Palm	3	Tree
Pyracantha angustifolia	Firethorn	3	Tree

Scientific Name	Common Name	Category	Form
Passiflora spp.	Passionfruit	3	Vine
Solanum seaforthium	Climbing Nightshade	3	Vine
Amaranthus sp	Amaranth	4	Annual
Anagallis arvensis	Scarlet Pimpernel	4	Ground
Avena fatua	Wild oats	4	Ground
Briza maxima	Blowfly Grass	4	Ground
Briza minor	Shivery Grass	4	Ground
Bromus catharticus	Prairie Grass	4	Ground
Centaurium erythraea	Common Centaury	4	Ground
Digitaria sanguinalis	Summer Grass	4	Ground
Eleusine ovatus	Crows foot Grass	4	Ground
Epilobium hirtigerum	Flick weed	4	Ground
Euphorbia peplus	Petty Spurge	4	Ground
Euphorbia pulcherrima	Petty Spurge	4	Ground
Fumaria muralis	Fumitory, Smoke Weed	4	Ground
Galinsoga parviflora	Galinsoga	4	Ground
Hypochoeris radicata	Cats Ear	4	Ground
Lolium sp.	Rye grass	4	Ground
Medicago polymorpha	Burr Medic	4	Ground
Nothoscordum gracile	Onion Weed	4	Ground
Pavonia hastata	Pavonia	4	Ground

Scientific Name	Common Name	Category	Form
Plantago lanceolata	Plantain	4	Ground
Poa annua	Winter Grass	4	Ground
Romulea rosea var. australis	Onion Grass	4	Ground
Senecio madagascariensis	Fireweed	4	Ground
Setaria sp	Pigeon Grass	4	Ground
Solanum nigrum	Blackberry Nightshade	4	Ground
Sonchus oleraceus	Sow thistle	4	Ground
Stachys arvensis	Stagger Weed	4	Ground
Stellaria media	Chickweed	4	Ground
Stenotaphrum secundatum	Buffalo Grass	4	Ground
Taraxacum officinale	Dandelion	4	Ground
Trifolium repens	Clover	4	Ground
Tropaeolum majus	Nasturtium	4	Ground
*Viola odorata**	European/English Violet	4	Ground
Schefflera actinophylla	Umbrella Tree	4	Midstorey
Strelitzia spp.*	Bird of Paradise	4	Midstorey
*Murraya paniculata**	Murraya	4	Shrub
Solanum mauritianum	Wild Tobacco Plant	4	Shrub
Cissus rhombifolia	Cissus	4	Vine

Appendix C

Table C. 1 Flora recorded in the Ku-ring-gai Flying-fox Reserve

Scientific name	Family	Common name
Trees and tall shrubs		
Acacia irrorata	Fabaceae	Green Wattle
Acacia parramattensis	Fabaceae	Parramatta Green Wattle
Acacia schinoides	*Fabaceae*	
Acacia decurrens	*Fabaceae*	*Sydney Green Wattle*
Acmena smithii	*Myrtaceae*	*Lilly Pilly*
Allocasuarina littoralis	Casuarinaceae	Black she-oak
Allocasuarina torulosa	Casuarinaceae	Forest Oak
Alphitonia excelsa	Rhamnaceae	Red Ash
Angophora costata	Myrtaceae	Sydney Red Gum
Backhousia myrtifolia	Myrtaceae	Grey Myrtle
Banksia serrata	Proteaceae	Old Man Banksia
Callicoma serratifolia	Cunoniaceae	Black Wattle
Callitris rhomboidea	Cupressaceae	Port Jackson Cypress
Ceratopetalum apetalum	Cunoniaceae	Coachwood
Ceratopetalum gummiferum	Cunoniaceae	Christmas Bush
Corymbia gummifera	Myrtaceae	Red Bloodwood

Scientific name	Family	Common name
Cyathea australis	Cyatheaceae	Rough Tree Fern
Dendrocnide excelsa	Urticaceae	Giant Stinging Tree
Elaeocarpus reticulatus	Elaeocarpaceae	Blueberry Ash
Elaeocarpus kirtonii	Elaeocarpaceae	Pigeonberry Ash
Eucalyptus globoidea	Myrtaceae	White Stringybark
Eucalyptus pilularis	Myrtaceae	Blackbutt
Eucalyptus resinifera	Myrtaceae	Red Mahogany
Eucalyptus saligna	Myrtaceae	Blue Gum
Eucalyptus haemastoma	Myrtaceae	Scribbly Gum
Ficus coronata	Moraceae	Creek Sandpaper Fig
Ficus fraseri	Moraceae	Sandpaper Fig
Ficus macrophylla	Moraceae	Moreton Bay Fig
Ficus rubiginosa	Moraceae	Port Jackson or
Glochidion ferdinandi	Euphorbiaceae	Cheese Tree
Livistona australis	Arecaceae	Cabbage Palm
Melia azedarach	Meliaceae	White Cedar
Pittosporum undulatum	Pittosporaceae	Sweet Pittosporum
Podocarpus elatus	Podocarpaceae	Plum Pine

Scientific name	Family	Common name
Polyscias elegans	Araliaceae	Celery Wood
Rapanea variabilis	Myrsinaceae	Variable Mutton wood
Syncarpia glomulifera	Myrtaceae	Turpentine
Syzygium oleosum	Myrtaceae	Blue Lilly Pilly
Syzygium paniculatum	Myrtaceae	Magenta Lilly Pilly
Trema aspera	Ulmaceae	Poison or Native
Tristaniopsis laurina	Myrtaceae	Water Gum
Shrubs		
Acacia linifolia	Fabaceae	Flax-leaf Wattle
Acacia longissima	Fabaceae	Narrow-leaf Wattle
Acacia longifolia	Fabaceae	Sydney Golden Wattle
Acacia terminalis	Fabaceae	Sunshine Wattle
Acacia floribunda	Fabaceae	Sally Wattle
Acrotriche divaricata	Epacridaceae	Ground-berry
Astrotricha floccosa	Araliaceae	Native Tobacco
Austromyrtus tenuifolia	Myrtaceae	Narrow Leaf Myrtle
Banksia spinulosa	Proteaceae	Hairpin Banksia

Scientific name	Family	Common name
Banksia ericifolia	Proteaceae	Heath-leaf Banksia
Bauera rubioides	Baueraceae	Dog Rose,
Boronia pinnata	Rutaceae	Pinnate Boronia
Breynia oblongifolia	Euphoribaceae	Breynia
Comesperma volubile	Polygalaceae	
Conospermum taxifolium	Proteaceae	Small-leaf Smoke Bush
Crowea saligna	Rutaceae	Crowea
Dampiera stricta	Goodeniaceae	Blue Dampiera
Dillwynia retorta	Fabaceae	Eggs and Bacon
Dodonaea triquetra	Sapindaceae	Hop Bush
Epacris longiflora	Epacridaceae	Native Fushia
Gompholobium latifolium	Fabaceae	Golden Glory Pea
Grevillea buxifolia	Proteaceae	Grey Spider Flower
Grevillea linearifolia	Proteaceae	White Spider Flower
Grevillea sericea	Proteaceae	Pink Spider Flower
Grevillea speciosa	Proteaceae	Red Spider Flower
Hakea salicifolia	Proteaceae	Willow-leaf Hakea
Hakea sericea	Proteaceae	Needle Bush, Silky

Scientific name	Family	Common name
Hakea teretifolia	Proteaceae	Dagger Hakea
Hibbertia aspera	Dilleniaceae	Rough Guinea Flower
Hibbertia empetrifolia	Dilleniaceae	Trailing Guinea Flower
Kunzea ambigua	Myrtaceae	Tick Bush
Lambertia formosa	Proteaceae	Mountain Devil
Lasiopetalum ferrugineum var. ferrugineum	Rutaceae	Rusty Petals
Leptospermum polygalifolium	Myrtaceae	Lemon Scented Tea
Leptospermum trinervium	Myrtaceae	Flaky-barked Tea Tree
Leucopogon juniperinus	Epacridaceae	Prickly Beard-heath
Lomatia myricoides	Proteaceae	Long-leaf Lomatia
Lomatia silaifolia	Proteaceae	Crinkle Bush
Micrantheum ericoides	Euphorbiaceae	
Mirbelia rubiifolia	Fabaceae	Red Mirbelia
Notelaea longifolia	Oleaceae	Large Mock Olive
Notelaea venosa	Oleaceae	Native Olive
Olearia microphylla	Asteraceae	Bridal Daisy Bush
Omalanthus nutans	Euphorbiaceae	Bleeding Heart

Scientific name	Family	Common name
Opercularia aspera	Rubiaceae	Stinkwort
Ozothamnus diosmifolius	Asteraceae	Dogwood
Persoonia linearis	Proteaceae	Narrow-leaf Geebung
Persoonia pinifolia	Proteaceae	Pine-leaf Geebung
Persoonia levis	Proteaceae	Broad-leaf Geebung
Petrophile pulchella	Proteaceae	Cone sticks
Phebalium dentatum	Rutaceae	
Phyllanthus gasstroemii	Euphorbiaceae	
Phyllanthus hirtellus	Euphorbiaceae	
Pimelea linifolia	Thymelaeaceae	Slender Rice Flower
Pittosporum revolutum	Pittosporaceae	Yellow Pittosporum
Platylobium formosum	Fabaceae	Handsome Flat Pea
Platysace linearifolia	Apiaceae	Narrow-leaf Platysace
Platysace lanceolata	Apiaceae	Lance-leaf Platysace
Polyscias sambucifolia	Araliaceae	Elderberry Panax
Pomaderris elliptica	Rhamnaceae	Smooth Pomaderris
Pultenaea daphnoides	Fabaceae	Large-leaf Bush Pea
Pultenaea flexilis	Fabaceae	Graceful Bush Pea

Scientific name	Family	Common name
Solanum laciniatum	Solanaceae	Kangaroo Apple
Solanum prinophyllum	Solanaceae	Forest Night Shade
Stenocarpus salignus	Proteaceae	Scrub Beefwood
Tetratheca thymifolia	Tremandraceae	Black-eyed Susan
Zieria smithii	Rutaceae	Sandfly Zieria
Zieria pilosa	Rutaceae	
Ferns		
Adiantum hispidulum	Adiantaceae	Rough Maiden Hair
Adiantum aethiopicum	Adiantaceae	Common Maiden Hair
Blechnum cartilagineum	Blechnaceae	Gristle Fern
Calochlaena dubia	Dicksoniaceae	Soft Bracken
Christella dentata	Thelypteridaceae	Binung
Davallia pyxidata	Davalliaceae	Hare's Foot Fern
Diplazium australe	Athyriaceae	Austral Lady Fern
Doodia aspera	Blechnaceae	Rough Rasp Fern
Doodia caudata	Blechnaceae	Small Rasp Fern
Gleichenia dicarpa	Gleicheniaceae	Pouched Coral Fern

Scientific name	Family	Common name
Histiopteris incisa	Dennstaedtiaceae	Bat's Wing Fern
Hypolepis muelleri	Dennstaedtiaceae	Harsh Ground Fern
Lindsaea linearis	Lindsaeaceae	Screw Fern
Lindsaea microphylla	Lindsaeaceae	Lacy Wedge Fern
Pellaea falcata	Sinopteridaceae	Sickle Fern
Pteridium esculentum	Dennstaedtiaceae	Bracken Fern
Pteris tremula	Pteridaceae	Jungle Brake
Pteris umbrosa	Pteridaceae	Tender Brake
Schizaea dichotoma	Schizaeaceae	Branched Comb Fern
Schizaea rupestris	Schizaeaceae	
Sticherus flabellatus	Gleicheniaceae	Umbrella Fern
Understorey Species		
Acianthus exsertus	*Orchidaceae*	Gnat Orchid
Acianthus fornicatus	Orchidaceae	Pixie Orchid
Alocasia brisbanensis	Arecaceae	Cunjevoi, Spoon Lily
Alternanthera denticulata	Amaranthaceae	Lesser Joyweed
Agrostis avenacea	avenacea	Poaceae Blown Grass

Scientific name	Family	Common name
Blandfordia nobilis	Blandfordiaceae	Christmas Bell
Burchardia umbellata	Colchicaceae	Milkmaids
Caladenia catenata	Orchidaceae	White Fingers
Carex breviculmis	Cyperaceae	
Caustis flexuosa	Cyperaceae	Grandfather's Beard
Centella asiatica	Apiaceae	Pennywort
Chamaesyce drummondii	Euphorbiaceae	Flat Spurge, Caustic
Cotula australis	Asteraceae	Common Cotula
Cryptostylis erecta	Orchidaceae	Hooded Orchid
Cyperus gracilis	Cyperaceae	Slender Sedge
Cyperus laevis	Cyperaceae	
Cyperus leiocaulon	Cyperaceae	
Cyperus mirus	Cyperaceae	
Dendrobium speciosum	Orchidaceae	Rock Orchid
Dianella caerulea producta	Phormiaceae	Flax Lily
Dianella caerulea caerulea	Phormiaceae	Flax Lily
Dianella revoluta	Phormiaceae	Spreading Flax Lily
Dichelachne inaequiglumis	Poaceae	Plume Grass

Scientific name	Family	Common name
Dichondra repens	Convolvulaceae	Kidney Weed
Digitaria parviflora	Poaceae	Small flower Fingergrass
Dipodium punctatum	Orchidadeae	Hyacinth Orchid
Dracophyllum secundum	Epacridaceae	
Echinochloa colona	Poaceae	Awn less Barnyard Grass
Echinopogon caespitosus	Poaceae	Tufted Hedgehog Grass
Echinopogon ovatus	Poaceae	Forest Hedgehog Grass
Einadia hastata	Chenopodiaceae	Berry Saltbush
Entolasia marginata	Poaceae	Margined Panic Grass
Entolasia stricta	Poaceae	Wiry Panic Grass
Epilobium billardierianum	Onagraceae	Willow Herb
Geranium homeanum	Geraniaceae	Native Geranium
Geranium solanderi	Geraniaceae	Native Geranium
Gonocarpus tetragynus	Haloragaceae	Poverty Rasp wort
Gonocarpus teucrioides	Haloragaceae	Germander Rasp wort
Goodenia heterophylla	Goodeniaceae	Variable-leaf Goodenia
Hydrocotyle laxiflora	Apiaceae	Stinking Pennywort
Hydrocotyle peduncularis	Apiaceae	Pennywort

Scientific name	Family	Common name
Imperata cylindrica	Poaceae	Blady Grass
Isolepis inundatus	Cyperaceae	Swamp Club-rush
Juncus homalocaulis	Juncaceae	
Juncus planifolius	Juncaceae	Broad-leaf Rush
Juncus prismatocarpus	Juncaceae	Branching Rush
Juncus usitatus	Juncaceae	Common Rush
Lepidosperma laterale	Cyperaceae	A Sword Sedge
Lepyrodia scariosa	Restionaceae	Scale Rush
Lobelia alata	Lobeliaceae	Angled Lobelia
Lomandra multiflora	Lomandraceae	Many-flowered Mat Rush
Lomandra longifolia	Lomandraceae	Spiny-headed Mat Rush
Lomandra obliqua	Lomandraceae	Fish Bones
Microlaena stipoides	Poaceae	Weeping Grass
Opercularia aspera	Rubiaceae	Stinkwort
Oplismenus aemulus	Poaceae	Basket Grass
Oplismenus imbecillis	Poaceae	Australian Basket Grass
Oxalis perennans	Oxalidaceae	Yellow Sucking Clover
Panicum simile	Poaceae	Panic Grass

Scientific name	Family	Common name
Patersonia sericea	Iridaceae	Silky Purple Flag
Persicaria decipiens	Polygonaceae	Slender knotweed
Persicaria lapathifolia	Polygonaceae	Pale Knotweed
Persicaria strigosa	Polygonaceae	Spotted Knotweed
Plantago debilis	Plantaginaceae	Native Plantain
Plectranthus parviflorus	Lamiaceae	Cockspur Flower
Pomax umbellata	Rubiaceae	Pomax
Poranthera microphylla	Euphorbiaceae	Small Poranthera
Prasophyllum sp.	Orchidaceae	
Pratia purpurascens	Lobeliaceae	White-root
Pseuderanthemum variablile	Acanthaceae	Pastel Flower
Pseudognaphalium luteoalbum	Asteraceae	Jersey Cudweed
Pterostylis nutans	Orchidaceae	Nodding Greenhood Orchid
Ptilothrix deusta	Cyperaceae	
Scaevola calendulacea	Goodeniaceae	Scented Fan Flower
Schelhammera undulata	Uvulariaceae	Lilac Lily
Schoenus apogon	Cyperaceae	Fluke Bog Rush
Selaginella uliginosa	Selaginellaceae	Swamp Selaginella

Scientific name	Family	Common name
Senecio hispidulus	Asteraceae	Hill Fireweed
Sigesbeckia orientalis	Asteraceae	Indian-weed
Stipa pubescens	Poaceae	Tall Spear Grass
Stylidium graminifolium	Stylidiaceae	Trigger Plant
Themeda australis	Poaceae	Kangaroo Grass
Tricoryne simplex	Anthericaceae	Yellow Rush Lily
Veronica plebeia	Scrophulariaceae	Trailing Speedwell
Viola hederacea	Violaceae	Native Violet
Wahlenbergia gracilis	Campanulaceae	Native Bluebell
Xanthorrhoea sp	Xanthorrhoeaceae	Grass Tree
Xanthosia pilosa	Apiaceae	Hairy Xanthosia
Xanthosia tridentata	Apiaceae	Rock Xanthosia
Youngia japonica	Asteraceae	
Vines		
Billardiera scandens	Pittosporaceae	Common Apple berry
Cassytha pubescens	Cassythaceae	Devil's Twine
Cayratia clematidea	Vitaceae	Slender Grape

Scientific name	Family	Common name
Cissus hypoglauca	Vitaceae	Five-leaf Water Vine
Clematis aristata	Ranunculaceae	Clematis
Clematis glycinoides	Ranunculaceae	Clematis
Convolvulus erubescens	Convolvulaceae	Blushing Bindweed
Desmodium rhytidophyllum	Fabaceae	Rusty Tic-trefoil
Desmodium varians	Fabaceae	Variable Tic-trefoil
Eustrephus latifolius	Luzuriagaceae	Wombat Berry
Geitonoplesium cymosum	Luzuriagaceae	Scrambling Lily
Glycine clandestina	Fabaceae	Twining Glycine
Glycine tabacina	Fabaceae	Love Creeper
Hardenbergia violaceae	Fabaceae	False Sarsaparilla
Hibbertia dentata	Dilleniaceae	Twining Guinea Flower
Kennedia rubicunda	Fabaceae	Dusky Coral Pea
Marsdenia rostrata	Asclepiadaceae	Twining doubah
Marsdenia suaveolens	Asclepiadaceae	Sweet Marsdenia
Morinda jasminoides	Rubiaceae	Jasmine Morinda
Pandorea pandorana	Bignoniaceae	Wonga Vine
Parsonsia straminea	Apocynaceae	Common Silk pod

Scientific name	Family	Common name
Polymeria calycina	Convolvulaceae	Swamp Bindweed
Smilax glyciphylla	Smilaceae	Native Sarsaparilla
Stephania japonica	Menispermaceae	Snake Vine
Tylophora barbata	Asclepiadaceae	Bearded Tylophora
Native Epiphytes		
Asplenium australasicum	Aspleniaceae	Bird's Nest Fern
Cymbidium suave	Orchidaceae	Snake Orchid
Platycerium bifurcatum	Polypodiaceae	Elkhorn Fern
Pyrrosia rupestris	Polypodiaceae	Rock Felt Fern

Source: This list is based on those compiled by Indigenous Regeneration Co (Madeleine Schofield, Gordon Limburg and Melissa Medo) with contributions from Robin Buchanan, Nancy Pallin & Sally Fisher. List maintained by Nancy Pallin since 1998.

Appendix D

Table D. 1 Fauna recorded in the Ku-ring-gai Flying-fox Reserve

Scientific Name	Common Name
Mammals	
Antechinus stuartii	Brown Antechinus
Cercartetus nanus	Eastern Pygmy Possum
Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus morio	Chocolate Wattled Bat
Miniopterus australis	Little Bentwing-bat
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat
Mormopterus norfolkensis	Eastern Freetail-bat
Pseudocheirus peregrinus	Common Ringtail Possum
Pteropus alecto	Black Flying-fox
Pteropus poliocephalus	Grey-headed Flying-fox
Pteropus scapulatus	Little Red Flying-fox
Tachyglossus aculeatus	Short-beaked Echidna
Trichosurus vulpecula	Common Brush tail Possum
Vespadelus vulturnus	Little Forest Bat
Wallabia bicolor	Swamp Wallaby
Rattus Rattus	Black Rat

Scientific Name	Common Name
Canis familiaris	Domestic Dog
Vulpes Vulpes	European Red Fox
Felis catus	Domestic Cat
Birds	
Alectura lathami	Australian Brush Turkey
Pelecanus conspicillatus	Australian Pelican
Phalacrocorax varius	Pied Cormorant
Phalacrocorax sulcirostris	Little Black Cormorant
Ardea novaehollandiae	White-faced Heron
Anas superciliosa	Pacific Black Duck
Anas castanea	Chestnut Teal
Elanus notatus	Black-shouldered Kite
Accipiter fasciatus	Brown Goshawk
Accipiter novaehollandiae	Grey Goshawk
Haliaeetus leucogaster	White-bellied Sea Eagle
Vanellus miles	Masked Lapwing
Macropygia amboinensis	Brown cuckoo-dove

Scientific Name	Common Name
Leucosarcia melanoleuca	Wonga Pigeon
Columba leucomela	White-headed Pigeon
Ocyphaps lophotes	Crested Pigeon
Calyptorhynchus funereus	Yellow-tailed Black Cockatoo
roseicapilla yes	Galah Cacatua
Cacatua galerita	Sulphur-crested Cockatoo
Trichoglossus haematodus	Rainbow Lorrikeet
Alisterus scapularis	Australian King Parrot
Platycerus eximius	Eastern Rosella
Platycerus elegans	Crimson Rosella
Cuculus pallidus	Pallid Cuckoo
Cuculus pyrrhophanus	Fan-tailed Cuckoo
Eudynamis scolopacea	Common Koel
Scythrops novaehollandiae	Channel-billed Cuckoo
Ninox strenua	Powerfull Owl
Ninox novaeseelandiae	Southern Boobook

Scientific Name	Common Name
Podargus strigoides	Tawny Frogmouth
Dacelo Novaeguinae	Laughing Kookaburra
Hacyon sancta	Sacred Kingfisher
Eurystomus orientalis	Dollar Bird
Pitta versicolour	Noisy Pitta
Menura novaehollandiae	Superb Lyrebird
Hirundo neoxena	Welcome Swallow
Cecropis ariel	Fairy Martin
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Zoothera lunulata	White's (Ground)Thrush
Petroica rosea	Rose Robin
Eopsaltria australis	Eastern Yellow Robin
Pachycephala pectoralis	Golden Whistler
Pachycephala rufiventris	Rufous Whistler
Colluricincla harmonica	Grey Shrike-thrush
Rhipidura rufifrons	Rufous Fantail

Scientific Name	Common Name
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
Psophodes olivaceus	Eastern Whipbird
Malurus cyaneus	Superb Fairywren
Malurus lamberti	Variegated Fairywren
Sericornis frontalis	White-browed Scrubwren
Gerygone mouki	Brown Gerygone
Acanthiza lineata	Striated Thornbill
Cormobates leucophaeus	White-throated Treecreeper
Daphoenositta chrysoptera	Varied sittella
Anthochaera carunculata	Red Wattlebird
Anthochaera chrysoptera	Brush (Little) Wattlebird
Philimon corniculatus	Noisy Friarbird
Manorina melanocephala	Noisy Miner
Meliphaga lewinii	Lewin's Honeyeater
Lichenostomus chrysops	Yellow-face Honeyeater

Scientific Name	Common Name
Lichenostomus penicillatus	White-plumed Honeyeater
Phylidonyris novaehollandiae	New Holland Honeyeater
Philidonyris nigra	White-cheeked Honeyeater
Acanthorhynchus tenuirostris	Eastern Spinebill
Pardalotus punctatus	Spotted Pardalote
Zosterops lateralis	Silveryeye
Emblema temporalis	Red-browed Firetail
Oriolus sagittatus	Olive-backed Oriole
Dicrurus hottentottus	Spangled Drongo
Ptilonorhynchus violaceus	Satin Bowerbird
Grallina cyanoleuca	Magpie Lark
Strepera graculina	Pied Currawong
Cracticus torquatus	Grey Butcherbid
Gymnorhina tibicen	Australian Magpie
Corvus coronoides	Australian Raven
Columba livia	Feral Pigeon

Scientific Name	Common Name
Streptopelia chinensis	Spotted Turtle-dove
Pycnonotus jocosus	Red-whiskered Bulbul
Passer domesticus	House Sparrow
Sturnus bulgaris	Common Starling
Acridotheres tristis	Common Mynah
Reptiles	
Morelia spilota	spilota Diamond Python
Varanus varius	Lace Monitor (Goanna)
Pogona barbata	Bearded Dragon
Physignathus lesueurii	Eastern Water Dragon
Phyllurus platurus	Southern Leaf-tail Gecko
Ctenotus taeniolatus	Copper-tailed Skink
Tiliqua scincoides	Eastern Blue-tongue Lizard
Spehomorphus quoyii	Eastern Water Skink
Saiphos equalis	Three-toed Skink
Pseudechis porphyriacus	Red-bellied Black Snake
Rhinoplocephalus nigrescens	Eastern Small-eyed Snake

Scientific Name	Common Name
Amphibians	
Pseudophryne australis	Red-crowned Toadlet
Litoria phyllochroa	Leaf- Green Tree Frog
Crinia signifera	Common Eastern Toadlet
Limnodynastes peronii	Brown-striped Marsh Frog
Fish	
Anguilla reinhardtii	Long finned Eel
Invertebrates	
Cherax destructor	Yabby
Euastacus spinifer	Sydney Spiny Cray
Triboniophorus graessei	Red Triangle Slug
Helicarion sp.	
Missulena bradleyi	Eastern Mouse Spider
Arigiope aetheria	St Andrews Cross Spider
Nephila spp.	Golden Orbweaving Spider
Phonognatha graeffei	Leaf curling Spider
Dinopis subrufa	Common Netcasting spider

Scientific Name	Common Name
Isopoda sp.	Large huntsman Spider
Atrax robusus	Sydney Funnelweb Spider
Misgolas rapax	Sydney Brown Trapdoor Spider
Pholcus phalangioides	Daddy-longlegs Spider
Ixodes holocyclus	Paralysis Tick
Scolopendra morsitans	Common Centipede
Aeshna brvistyla	Dragonfly
Orthodera mimistralis	Green Mantid
Gryllotalpa australis	Mole Cricket
Caedicia major	Katydid
Idiopterus nephrelepidis	Maidenhair Fern Aphid
Abricta curvicosta	Floury Baker Cicada
Cyclochila australasiae	Greengrocer, Yellow Monday
Macrotristria anularis	Cherrynose Cicada
Psaltoda moerens	Redeye Cicada
Psaltoda plaga	Black Prince cicada
Thopha saccata	Double Drummer Cicada
Lestonia haustorifera	Shield Bug

Scientific Name	Common Name
Lestonia grossi	Shield Bug
Ctenarytaina thysanura	Bluegum Psyllid
Pristhesancus papuensis	Assassin Bug,
Havinthus rufovarius	Assassin Bug
Myrmeleon acer	Common Antlion
Anoplognathus viriditarsis	Christmas Beetle
Cephalodesmius armiger	Scarab Beetle
Boreoides subulatus	Stratiomyid fly
Syrphus viridiceps	Macq. Hover Fly
Lamprolonchaea brouniana	Metallic-green Tomato Fly
Dacus tryoni	Queensland Fruit Fly
Dirioxa pornia	
Procecidochares utilis	Crofton Gall "Wasp"
Phytobia pittosporphylli	Pittosporum leafminer
Euschemon rafflesia	Regent Skipper
Doratifera casta	Black Slug Cup
Doratifera vulnerans	Mottled Cup Moth
Leptocneria reducta	White Cedar Moth

Scientific Name	Common Name
Graphium sarpedon	choredon Blue Fanny Butterfly
Papilio aegus	Orchard Butterfly
Anaphaeis java	teutonia Caper White Butterfly
Pieris rapae	Cabbage white butterfly
Danaus plexippus	Wanderer Butterfly
Euploea core	Common Crow
Heteronympha merope	Common Brown Butterfly
Tisiphone abeona	Sword-grass Brown Butterfly
Phaedyma shepherdi	Common Aeroplane Butterfly
Vanessa kershawi	Painted Lady
Aenetus ligniveren	Splendid Ghost Moth
Psilogramma menephron	Australian privet Hawk Moth
Coequosa trangularis	Geebung Hawk Moth
Apis mellifera	Honey Bee
Trigona carbonifera	Native Stingless Bee
Nasuititermes walkeri	Nigger Head Termite
Camonotus consobrinus	Sugar Ant
Anonychomyrma nitidiceps,	(Syn iridomyrmex nitidiceps)

Scientific Name	Common Name
Myrmecia nigrocincta	Jumping Ant
Myrmecia forficata	Bull Ant
Rhytidoponera "metallica"	Greenhead Ant
Leptomyrmex erythrocephalus	Spider Ant
Netelia producta	Orange Caterpillar parasite
Echthromorpha intricatoria	Cream Spotted Ichneumon
Perga affinis	affinis Steelblue Sawfly
Cryptocheilus sp.	Spider-killing Wasp
Exeirus lateritius	Cicada-killer Wasp
Sphecius pectoralis	Cicada-killer Wasp
Diamma bicolor	Metallic Blue Wasp

Source: Initially compiled by Gordon Limburg in 1993, including information from Martyn Robinson. Win Filewood provided a bird list in 1989. A small mammal survey with live traps was conducted for 4 nights in January 1989 by Ray and Anne Williams of the Royal Zoological Society of NSW. Additional records contributed by Madeleine Schofield, Nancy Pallin and other bush regenerators.

Appendix E

Advice on roosting habitat for Grey-headed Flying-foxes from Dr Peggy Eby

Appendix F

Example monitoring pro-formas

KFFR Monitoring and Evaluation

Assessor: _____ **Date:** _____

Management zone: _____

Required actions for this management zone as listed in 10yr plan

-
-
-
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-
-
-

Performance criteria as listed in 10yr plan

-
-
-
-
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-
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-

Photo point monitoring: (photos to be taken in the morning. Photo points to be marked with star pickets for a frame of reference)

Photo point number:	GPS Coordinates:		Photo reference

Additional photos from Zone: (e.g. of specific work sites)

Additional photo	GPS Coordinates:		Photo reference

Actions completed in this zone this monitoring period

Action (description of works)	Comments on work including area impacted:

Works are mapped on Council GIS:

Comments: