Application for a

Section 91 Licence

to harm or pick a threatened species, population or ecological community*, or damage habitat under the *Threatened Species Conservation Act 1995.*

1. Applicant's Name: Botanic Gardens Trust

2. ABN: 22 988 772 206

3. Organization name and position of Applicant: Executive Director, Botanic Gardens Trust (BGT)

4. Postal address: Royal Botanic Gardens, Mrs Macquaries Rd, Sydney NSW 2000

Telephone: B.H. (02) 9231 8035 / 8112 A.H. [redacted]

5. Location of the action *(including grid reference and local government area and delineated on a map).*

Initial disturbance will take place where the flying-foxes are roosting in the Royal Botanic Gardens, Sydney (Latitude: -33° 51' 58", Longitude: 155° 47' 20"), City Of Sydney Local Government Area (Fig. 1). If the flying-foxes move to other inappropriate locations (as defined within the relocation proposal document) within the Sydney metropolitan region, follow-up disturbance will be conducted at these sites also as part of the commitment of the Botanic Gardens Trust (BGT) to ensure that the relocation actually solves the problem of flying-foxes roosting in unsuitable areas, rather than simply shifting it elsewhere.

Maps indicating the location of the Royal Botanic Gardens and preferred alternative campsites are included in the attached Flying-fox Camp Relocation Proposal.

6. Full description of the action and its purpose *(eg, environmental assessment, development etc.).*

A full description of the action and its purpose is contained in the attached Flying-fox Camp Relocation Proposal.

Figure 1. Location of the flying-fox camp in the Royal Botanic Gardens, Sydney in 2007.

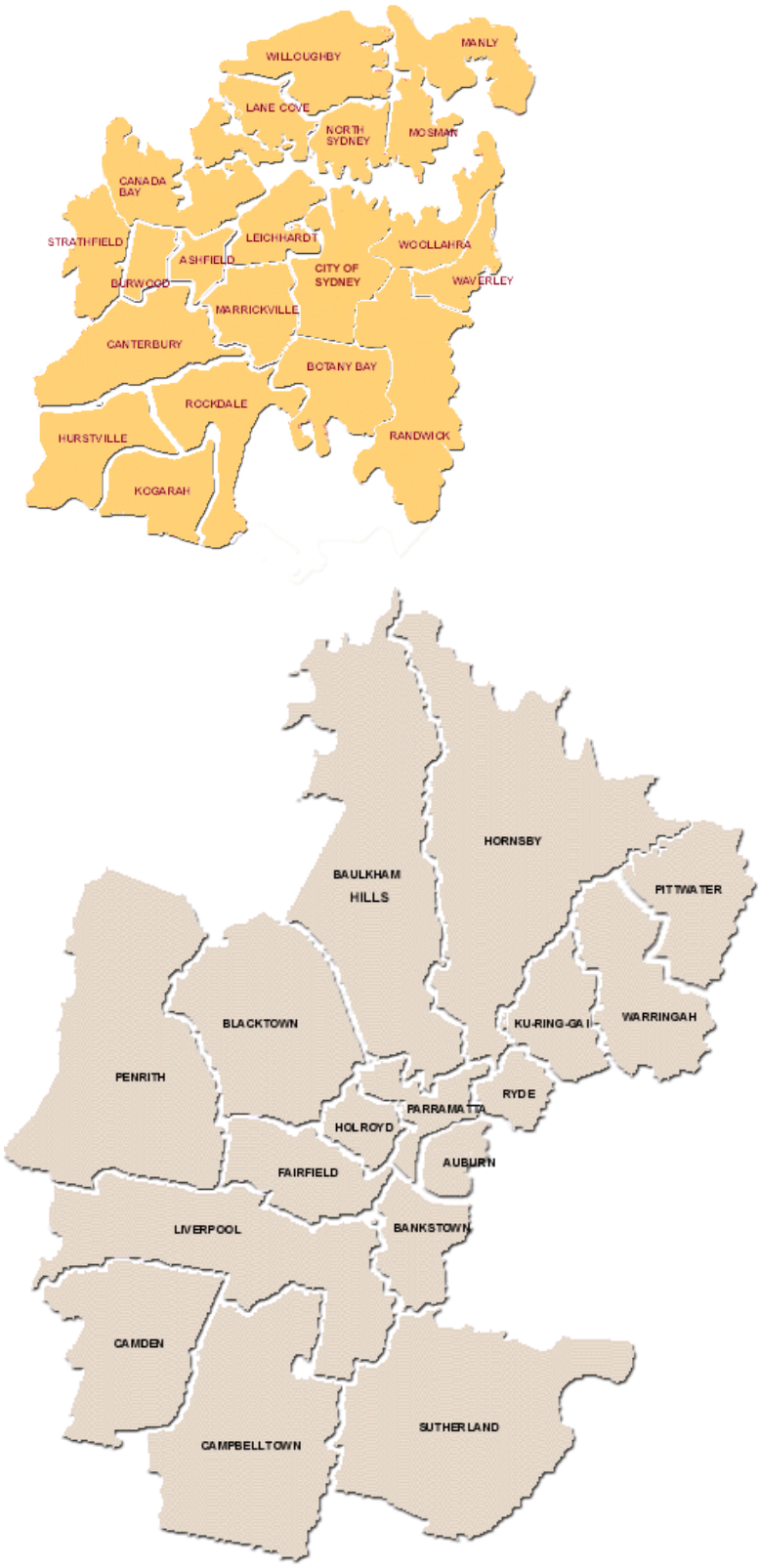

Figure 2. LGAs of the Sydney metropolitan area – Inner Sydney (above) and Outer (below)*

* A threatened species, population or ecological community means a species, population or ecological community identified in Schedule 1, 1A or Schedule 2 of the *Threatened Species Conservation Act 1995.*

7. Details of the area to be affected by the action *(in hectares)*.

The area of vegetation in the Royal Botanic Gardens that the flying-foxes usually occupy is around 3.5 hectares (ha). This may vary depending on the number of flying-foxes present at the time, although recently the colony has tended to vary its density rather than its range as its numbers fluctuate. The area of the entire Royal Botanic Gardens is 30 ha. The adjoining Domain (also managed by the BGT) is 34 ha.

The first stage of the proposed action may also take place anywhere in the Sydney metropolitan region as necessary for follow-up (to ensure the flying-foxes do not remain in inappropriate locations), in consultation with the land managers – this covers an area of approximately 370,000 ha. All potentially suitable alternative campsites will be considered should the flying-foxes choose to roost there during the relocation, however, at the time of writing, one preferred relocation site, Ku-ring-gai Flying-fox Reserve (14.6 ha), has been identified for which BGT has obtained 'in principle' support from land managers.

Further details of the areas to be affected by the action are contained in the attached Flying-fox Camp Relocation Proposal.

8. Duration and timing of the action *(including staging, if any).*

Details of the duration and timing of the action are contained in the attached Flying-fox Camp Relocation Proposal.

9. Is the action to occur on land declared as critical habitat*?

No

10. Threatened species, populations or ecological communities to be harmed or picked.

Scientific Name	**Common Name** ***(if known)***	**Conservation Status** ***(i.e. critically endangered, endangered or vulnerable)***	**Details of no. of individual animals, or proportion and type of plant material** ***(eg. fertile branchlets for herbarium specimens or whole plants or plant parts)***
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	~5,000-20,000 (estimate based on counts at similar times of year in previous years)

* Critical habitat means habitat declared as critical habitat under Part 3 of the *Threatened Species Conservation Act 1995*.

11. Species impact:
(please tick appropriate box)
a) For action proposed on land declared as critical habitat; or
An SIS is attached
b) For action proposed on land not declared as critical habitat.
Items 12 to 25 have been addressed

N.B: Provision of a species impact statement is a statutory requirement of a licence application if the action is proposed on critical habitat.
The provision of information addressing items 12 to 17 is a statutory requirement of a licence application if the action proposed is not on land that is critical habitat. Information addressing any of the questions below must be attached to the application.

12. Describe the type and condition of habitats in and adjacent to the land to be affected by the action.

The type and condition of habitats in and adjacent to the lands to be affected by the action are detailed in the attached Flying-fox Camp Relocation Proposal.

13. Provide details of any known records of a threatened species in the same or similar known habitats in the locality *(include reference sources).*

Apart from the grey-headed flying-fox, the following threatened species, populations and communities have been recorded within five kilometres of the RBG in the past twenty years.

Fauna

Scientific Name	Common Name
Litoria aurea	Green and Golden Bell Frog
Pseudophryne australis	Red-crowned Toadlet
Anseranas semipalmata	Magpie Goose
Burhinus grallarius	Bush Stone-curlew
Haematopus longirostris	Pied Oystercatcher
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat
Myotis adversus	Large-footed Myotis
Ninox strenua	Powerful Owl
Eubalaena australis	Southern Right Whale

None of the threatened fauna species listed above are likely to be affected by the proposal to relocate the flying-fox camp.

As it has been recorded roosting on occasion within the RBG, further consideration of the impact of the proposal on the powerful owl has been provided in Sections 18 onwards.

Flora

Scientific Name	Common Name
Acacia terminalis subsp. terminalis	Sunshine Wattle
Eucalyptus camfieldii	Heart-leaved Stringybark
Eucalyptus nicholii	Narrow-leaved Black Peppermint
Syzygium paniculatum	Magenta Lilly Pilly

None of these threatened flora species occur at the RBG.

Endangered ecological communities

- Eastern Suburbs Banksia Scrub;
- Bangalay Sand Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Sydney Freshwater Wetlands the Sydney Basin Bioregion.

None of these communities occur at the RBG.

In relation to the alternative campsites, the powerful owl and Sydney Turpentine Ironbark Forest (STIF) have been identified as occurring at Ku-ring-gai Flying-fox Reserve. No threatened species, populations or ecological communities are expected to occur at the other sites.

14. Provide details of any known or potential habitat for a threatened species on the land to be affected by the action *(include reference sources).*

The RBG has on occasion been visited by powerful owls (*Ninox strenua*) which have been observed perching amongst the roosting flying-foxes during the day. Given this species is not resident it is considered unlikely that there would be any impact on the powerful owl due to relocation of the grey-headed flying-fox from the RBG.

Ku-ring-gai Flying-fox Reserve supports gallery forest known to be used as a roost site by the powerful owl.

15. Provide details of the amount of such habitat to be affected by the action proposed in relation to the known distribution of the species and its habitat in the locality.

The sites likely to be chosen by the flying-foxes as alternative campsites are detailed in the attached Flying-fox Camp Relocation Proposal.

16. Provide an assessment of the likely nature and intensity of the effect of the action on the lifecycle and habitat of the species.

Pregnant flying-foxes may abort their young under stress, and pups can be separated from panicked mothers. However it is considered that the measures to be implemented as described in point 17 below will be sufficient to ameliorate any effects of the proposed action on the lifecycle of the grey-headed flying-fox.

The 3.5 ha of the Royal Botanic Gardens that is currently utilised as a campsite will effectively be removed as roosting habitat for the grey-headed flying-fox, but will remain as foraging habitat (see point 21 for further details).

The likely nature and intensity of the proposed action on the grey-headed flying-fox are detailed further in the attached Flying-fox Camp Relocation Proposal.

The home ranges of powerful owls have been known to be very large (often larger than 1000 ha) (Soderquist & Gibbons 2007[1]). As this species is only an occasional visitor to the RBG, and does not breed at the site, the proposed action is considered unlikely to affect the life cycle or habitat of this species. Even if the owl happens to be present during the disturbance, and is bothered by it, it can easily move to roost in another part of its territory.

[1] Soderquist, T. & Gibbons, D. Home-range of the Powerful Owl (Ninox strenua) in dry sclerophyll forest. *Emu* 107(3): 177–184.

17. Provide details of possible measures to avoid or ameliorate the effect of the action.

Possible measures to avoid or ameliorate the effect of the action include:

- the timing of the initial relocation to avoid flying-foxes at the most vulnerable stages of their life cycle;
- the timing of the initial relocation to correspond with the time that most flying-foxes leave their Sydney camps each year;
- the adaptive management strategy dependent on flying-fox responses (to be closely monitored) to the disturbance;
- the follow-up disturbance outside the RBG to ensure the flying-foxes find a suitable alternative campsite;
- the quick-action plan to prevent a colony from reforming in the RBG (meaning that any flying-foxes arriving here, if they are dispersed within a day or two, should have no problems leaving, as any pups that were carried in could be carried out again, and males would not be given a chance to establish breeding territories); and
- the reduction of intensity of any required follow-up disturbance during the breeding season (with the level being totally dependent on the observed responses of the flying-foxes present).

These measures are detailed further in the attached Flying-fox Camp Relocation Proposal.

N.B: The Director-General must determine whether the action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats. To enable this assessment the Applicant is required to address items 18 to 25. Information addressing any of the questions below must be attached to the application.

18. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-headed Flying-fox

A recent study (Chan, 2007[2]) found that due to the highly mobile nature of the grey-headed flying-fox there is only one population of the species throughout its range, there being no genetic distinction between sub-populations. The initial relocation would be undertaken outside the breeding season, and any subsequent disturbance would be undertaken according to strict protocols with the utmost sensitivity to the life cycle stage of the flying-foxes present (see the attached Flying-fox Camp Relocation Proposal for further details). This relocation proposal is based on that undertaken at Melbourne RBG during which only one flying-fox death was recorded and this was not believed to have resulted from the relocation programme (S. Toop pers. comm.). Considering that the BGT has taken even more precautions than were taken in Melbourne regarding flying-

[2] Chan, J. (2007) Genetic estimates of dispersal and the implications for conservation management of grey-headed flying-fox *(Pteropus poliocephalus)*. A thesis submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Honours), School of Biotechnology and Biomedical Sciences, University of New South Wales.

fox welfare, it is unlikely that the proposed relocation programme would place the local population at risk of extinction.

Further details regarding consideration of flying-fox welfare are provided in Section 7 of the attached Flying-fox Camp Relocation Proposal.

Powerful Owl

The powerful owl is known to occasionally visit the RBG's flying-fox colony. In addition to the Botanic Gardens colony, powerful owls are also known to roost along the creek line that is present within the Ku-ring-gai Flying-fox Reserve at Gordon, where they have been known to occasionally prey on flying-foxes. Being able to negotiate urban areas and open spaces, and forage over large distances, it is not considered that the relocation of the flying-fox colony from the RBG would have an adverse impact on the powerful owl, such that the viability of its local population would be placed at risk of extinction.

19. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The subject populations of the grey-headed flying-fox and powerful owl are not listed as endangered.

20. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Sydney Turpentine-Ironbark Forest

Sydney Turpentine-Ironbark Forest only occupies a small proportion of Ku-ring-gai Flying-fox Reserve. From vegetation mapping (NPWS, 2002) it is estimated that of the 14.6 hectares of Ku-ring-gai Flying-fox Reserve, one hectare is Sydney Turpentine-Ironbark Forest. A large colony, which averages around 27,000 but has reached more than 60,000 individuals, already inhabits the reserve. It appears from mapping of the species' occupation of the reserve (Smith, 2007; Snoyman, 2008) that most individuals use the lower slopes near a dissecting rather than the Sydney Turpentine-Ironbark Forest, which occurs on the reserve's upper southern slope. It is considered unlikely that occupation of the reserve by those flying-foxes dispersed from the Sydney RBG would reduce the extent of Sydney Turpentine-Ironbark Forest.

The plan of management prepared for the reserve (Ku-ring-gai Municipal Council, 1999) states that nutrient levels have increased as a result of flying-fox occupation (due to faeces and urine) with a resultant shift to more mesic (rainforest-like) vegetation. It is unclear whether there have been shifts in the composition of the reserve's Sydney Turpentine-Ironbark Forest. Nevertheless, given the small area that Sydney Turpentine-

Ironbark Forest occupies in the reserve and the trend of the flying-foxes to use other parts of the reserve, it is considered unlikely that the modification of Sydney Turpentine-Ironbark Forest as a result of increased nutrients from new occupants of the camp would be significant.

It is considered unlikely that the proposed action would place the local occurrence of Sydney Turpentine-Ironbark Forest at risk of extinction

21. In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Grey-headed Flying-fox

The 3.5 hectares of the RBG that is currently utilised as a campsite will effectively be removed as roosting habitat for the grey-headed flying-fox, but will remain as foraging habitat. The alternative sites have been carefully selected and have only been classed as suitable if they provide a higher quality of habitat than the RBG, and are thus likely to provide the same level of functionality for the flying-foxes as the RBG habitat.

Therefore, the extent to which habitat is removed or modified is negligible as the loss of the RBG as roosting habitat would be compensated by the provision of habitat elsewhere. Flying-foxes will be able to return to the gardens and their other local foraging habitats. Therefore habitat would not be fragmented or isolated. As alternative habitat is available and the aim of the programme is that it is utilised it is considered that habitat at the RBG is not essential to the long-term survival of the species.

Powerful Owl

No habitat available to the powerful owl would be removed. Regeneration of those plants present within the section of RBG affected by the grey-headed flying-foxes would provide additional sheltering opportunities for this nocturnal species.

The powerful owl requires large tracts of forest and/or woodland, though it can also occur in fragmented landscapes. This species is able to traverse open country therefore not being affected by habitat fragmentation and isolation. The proposal would therefore not isolate any currently interconnecting or proximate areas of habitat available for use by this species. Similarly, no barriers between any breeding populations would be erected.

No habitat used by the powerful owl for nesting is to be removed, modified, fragmented or isolated.

Sydney Turpentine-Ironbark Forest

As no Sydney Turpentine-Ironbark Forest would be removed it is unlikely that fragmentation would be increased as a result of the proposed action.

22. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There is no declared critical habitat for the grey-headed flying-fox, powerful owl Sydney or Turpentine-Ironbark Forest. None of the sites contain declared critical habitat for any listed species, population or community.

23. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Amendments to the *Threatened Species Conservation Act* in 2004 removed the mandatory requirement to prepare recovery plans for individual threatened species. Instead, DECC has prepared a Priorities Action Statement[3] to promote the recovery of threatened species and the abatement of key threatening processes in New South Wales. None of the priority actions identified for the grey-headed flying-fox, powerful owl or Sydney Turpentine-Ironbark Forest are particularly relevant to the proposed action.

24. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Thirty one Key Threatening Processes are listed on the *Threatened Species Conservation Act 1995*. The proposed action is not part of any of these key threatening processes, nor is it likely to result in the operation of or increase the impact of, a key threatening process.

[3] http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_recovery_new.aspx

Important information for the Applicant

Processing times and fees

The *Threatened Species Conservation Act 1995* provides that the Director-General must make a decision on the licence application within 120 days where a species impact statement (SIS) has been received. No timeframes have been set for those applications which do not require a SIS.

The Director-General will assess your application as soon as possible. You can assist this process by providing clear and concise information in your application.

Applicants may be charged a processing fee. The Director-General is required to advise prospective applicants of the maximum fee payable before the licence application is lodged.

Therefore, prospective applicants should contact the DECC prior to submitting a licence application.

A $30 licence application fee must accompany a licence application.

Protected fauna and protected native plants*

Licensing provisions for protected fauna and protected native plants are contained within the *National Parks and Wildlife Act 1974.* However, a Section 91 Licence may be extended to include protected fauna and protected native plants when these will be affected by the action.

If you are applying for a licence to cover both threatened and protected species please provide the information requested in Item 10 and a list of protected species and details of the number of individuals animals or proportion and type of plant material which are likely to be harmed or picked.

Request for additional information

The Director-General may, after receiving the application, request additional information necessary for the determination of the licence application.

Species impact statement

Where the application is not accompanied by a SIS, the Director-General may decide, following an initial assessment of your application, that the action proposed is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. In such cases, the *Threatened Species Conservation Act 1995* requires that the applicant submit a SIS. Following initial review of the application, the Director-General will advise the applicant of the need to prepare a SIS.

Director-General's requirements for a SIS

Prior to the preparation of a SIS, a request for Director-General's requirements must be forwarded to the relevant DECC Office. The SIS must be prepared in accordance with section 109 and 110 of the TSC Act and must comply with any requirements notified by the Director-General of the Department of Environment and Climate Change (NSW).

Disclosure of Personal Information in the Public Register of s91 Licences

* Protected fauna means fauna of a species not named in Schedule 11 of the *National Parks and Wildlife Act 1974.*

Protected native plant means a native plant of a species named in Schedule 13 of the *National Parks and Wildlife Service 1974.*

The Public Register provides a list of licence applications and licences granted. A person about whom personal information is contained in a public register may request that the information is removed or not placed on the register as publicly available.
A full copy of licences granted is included on the DECC website at http://www.environment.nsw.gov.au/npws.nsf/content/s91_tsca_register or in a hardcopy available from The Librarian, DECC, 59 Goulburn St, Sydney.
Please contact the relevant Environment Protection and Regulation Division for more details
(Contact details are below)

Certificates
If the Director-General decides, following an assessment of your application, that the proposed action is not likely to significantly affect threatened species, populations or ecological communities, or their habitats, a Section 91 Licence is not required and the Director-General must, as soon as practicable after making the determination, issue the applicant with a certificate to that effect.
N.B: An action that is not required to be licensed under the Threatened Species Conservation Act 1995, may require licensing under the National Parks and Wildlife Act 1974, if it is likely to affect protected fauna or protected native plants.

I confirm that the information contained in this application is correct. I hereby apply for a licence under the provisions of Section 91 of the *Threatened Species Conservation Act 1995.*

Applicant's name, organisation and position *(Please print)* DR. TIM ENTWISLE, EXECUTIVE DIRECTOR, BOTANIC GARDENS TRUST

Applicant's signature Date 8/12/08

For more information or to lodge this form, contact the Climate Change and Environment Protection Group in your nearest DECC office:

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Proposal for the relocation of a flying-fox colony from the Royal Botanic Gardens, Sydney

Introduction

This document has been prepared to fulfil the requirements of chapter 6 of the DECC Flying-fox Camp Management Policy (2007) (hereafter referred to as 'the policy') for developing a flying-fox camp relocation proposal. All steps of the necessary process outlined in Section 6.1 of the policy have been addressed below. This document is to accompany the applications being submitted to the NSW Department of Environment and Climate Change (DECC) and the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) for approval to undertake the action proposed below.

Step 1 Establish a steering committee

A steering committee (Table 1) has been established to oversee the proposed camp relocation project and manage actions under the steps detailed below. Meetings have been held on 4 December 2007 and 7 March 2008 in the RBG, Sydney to discuss the development of this proposal with all steering committee members. An additional meeting was held on 18 April 2008 with the scientific advisors, the committee chair, and two guest flying-fox researchers to discuss the best research strategy to accompany the relocation. The committee has been kept informed, and given the opportunity to comment, at each step of the process. Because of the large size and geographical spread of this steering committee, meetings have been kept to a minimum, and instead e-mail has been utilised as the preferred method of correspondence.

Table 1. The official members of the RBG flying-fox steering committee.

Name	Organization	Position	Role	Joined	Status
Associate Professor David Phalen	University of Sydney (Faculty of Veterinary Sciences)	Director, Wildlife Health and Conservation Centre	Chairperson	27/11/07	Current member
Tim Entwisle	Botanic Gardens Trust	Executive Director	Existing Camp Manager	27/11/07	Current member
Mark Savio	Botanic Gardens Trust	Director, Domain & RBG Branch	Existing Camp Manager	27/11/07	Current member
Vanessa Wilson	Botanic Gardens Trust	Project Officer – Wildlife Management	Relocation Project Manager	27/11/07	Current member
David Bidwell	Botanic Gardens Trust	Senior Arborist	Representing RBG Staff	27/11/07	Current member
Mrs Caro Webster	Friends of the Gardens	President	Representing RBG Volunteers	27/11/07	Current member
Kylie McClelland	DECC (Biodiversity & Threatened Species Section)	A/Senior Project Officer (Threatened Species)	Representing DECC conservation & camp	27/11/07	Current member

Name	Organization	Position	Role	Joined	Status
			management		
Martin Smith	DECC (Parks & Wildlife Group)	Ranger, Coffs Coast Area	Representing DECC conservation & camp management experience	27/11/07	Current member
Ben Coddington	Ku-ring-gai Council	Environment Officer	Representing Local Government Area with existing camp (Gordon)	19/12/07	Current member
Megan Haberley	Fairfield City Council	Environment Officer	Representing Cabramatta Creek Flying-fox Committee and Local Government Area with existing camp	27/11/07	Current member
Andrew Smith	Cabramatta Creek Flying-fox Committee	Member	Previous representative of Cabramatta Creek Flying-fox Camp	19/12/07	Left 20/03/08
Paul Tracey	Centennial Parklands	Manager of Horticultural Estate	Representing Centennial Park as nearby parkland that may be affected by the relocation	27/11/07	Current member
Marjorie Beck	Ku-ring-gai Bat Conservation Society	Deputy Chair	Representing Gordon Flying-fox Camp	27/11/07	Current member
Storm Stanford	Wolli Creek Preservation Society	Member	Representing Wolli Valley Flying-fox Camp	25/07/08	Current member
Jacob Messer	Parramatta Park Trust	Field Services Coordinator	Representing Parramatta Flying-fox Camp	27/11/07	Current member
David O'Shannessy	RSPCA NSW	Chief Inspector	Animal Welfare Advisor	27/11/07	Current member
Ms Ilona Roberts	NSW Wildlife Council	Council Member	Representing NSW wildlife rescue and care groups	24/06/08	Current member

Name	Organization	Position	Role	Joined	Status
Dr Peggy Eby	Consultant	Flying-fox Researcher	Scientific Advisor (shared role)	27/11/07	Current member
Dr Kerryn Parry-Jones	University of Sydney	Flying-fox Researcher	Scientific Advisor (shared role)	27/11/07	Current member
Mr Simon Toop	Department of Sustainability and Environment (VIC)	Manager, Flora and Fauna Utilisation and Management	Technical Advisor (project manager of Melbourne RBG flying-fox relocation, 2003)	27/11/07	Current member
Mr Allen Madden	Metropolitan Local Aboriginal Land Council	A/Chief Executive Officer	Representing the local Aboriginal community	11/09/08	Current member

Each member of this steering committee was engaged under the following terms of reference:

The role of the steering committee will be to guide the relocation project through the planning, implementation and evaluation phases, in order to ensure the best chances of success, and to maintain transparency throughout the entire process. The functions that the committee members are to perform include:

- providing advice and stakeholder input regarding decisions to be made;
- reviewing and providing feedback on the content of documents such as the relocation proposal, operations plans, and reports;
- ensuring that the process follows the relevant procedures for camp relocation as outlined in DECC's Flying-fox Camp Management Policy
- keeping their respective stakeholder groups informed throughout the process, and providing adequate representation of their views at committee meetings;
- reporting to the Director (Domain & RBG Branch) and Executive Director of the Botanic Gardens Trust.

Step 2 Assess characteristics of the existing camp

The camp's 'footprint'

The camp is located in the centre of the RBG (Latitude: -33° 51' 58", Longitude: 155° 47' 20"; see Fig. 1) in the botanical collections surrounding the Gardens Restaurant/Café and the Gardens Shop. This area is known as Palm Grove and contains the oldest and most significant botanical collections in the RBG, with many trees being planted by important historical figures in the mid 1800s. Many of these highly significant trees are being used as roost trees by the flying-foxes and are suffering unsustainable levels of damage as a result.

The Royal Botanic Gardens covers an area of approximately 30 ha, however much of this area does not contain suitable flying-fox habitat (e.g. open lawn, buildings, 'treeless' gardens). The camp is currently centred in the densest (and oldest) area within the RBG (Palm Grove), but the area the camp occupies varies from around 1.5 – 4 ha depending on fluctuations in flying-fox numbers.

Figure 1. Location of the flying-fox camp in the Royal Botanic Gardens, Sydney in 2007.

The structural elements of the vegetation chosen as roost habitat in the RBG varies. The most common feature of chosen roost trees was height – almost all chosen roost trees are over 5 m tall, and all of the preferred roost trees (see Tables 2 and 3) are at least 10 m tall. Apart from this, there is no obvious pattern for choosing trees. Although the colony is centred in the densest vegetation in the RBG, containing a rich understorey of sub-tropical rainforest plants and a creek that runs through the centre, the flying-foxes roost in many different species of trees – both native and exotic, and/or trees with no leaves. Appendix 1 provides a

full species list and indicates those trees in the period 1999 to 2007 for which there are 90 or more records of roosting flying-foxes and those that are recorded as containing 100 or more flying-foxes on average.

The closest waterbodies are the creek that runs through the centre of the RBG to the main pond via the two smaller ponds, the twin ponds to the north west of the camp centre, and Sydney Harbour, which borders almost half of the Domain and RBG.

The camp's role in the life cycle of the flying-foxes

The RBG camp is used as a maternity site and is continuously occupied by flying-foxes. Mating, conception and birth all take place on this site, however the numbers regularly drop after conception (around April), when many flying-foxes leave the camp In line with the general trend of moving north at this time of year.

Frequency of occupation and history of the camp

Flying-foxes were first recorded in the RBG in the mid 1800s. In 1900, large numbers of flying-foxes arrived in the RBG and were shot at, and within a week of their arrival, they had all either left the site or been killed. There were further records of flying-foxes arriving in the RBG in 1916 and 1920, and then none further until 1989 when 200 arrived and were allowed to stay.

By mid 1992, the numbers had increased to about 3200, and due to the resultant damage to the heritage trees, attempts were made to disperse the animals using deep percussive sounds, lights, odours, plastic bags attached to trees, and taped distress calls. Most of these deterrents had limited effectiveness (see Appendix 2), but the noise disturbance was the only method that appeared to have any long term effect, and it was continued from 3 September until 30 September, when all flying-foxes left the Gardens. At this time, there were no new camps known to establish in the Sydney area, so it is assumed that the flying-foxes left the Gardens to join other existing camps.

Between March 1993 and September 1994, there were four recorded occasions where groups of (between three and 1000) flying-foxes returned to the Gardens and were quickly scared off again by noise disturbance. From 1995-1997, intermittent scaring was apparently successful in keeping the colony numbers low (usually less than 1000).

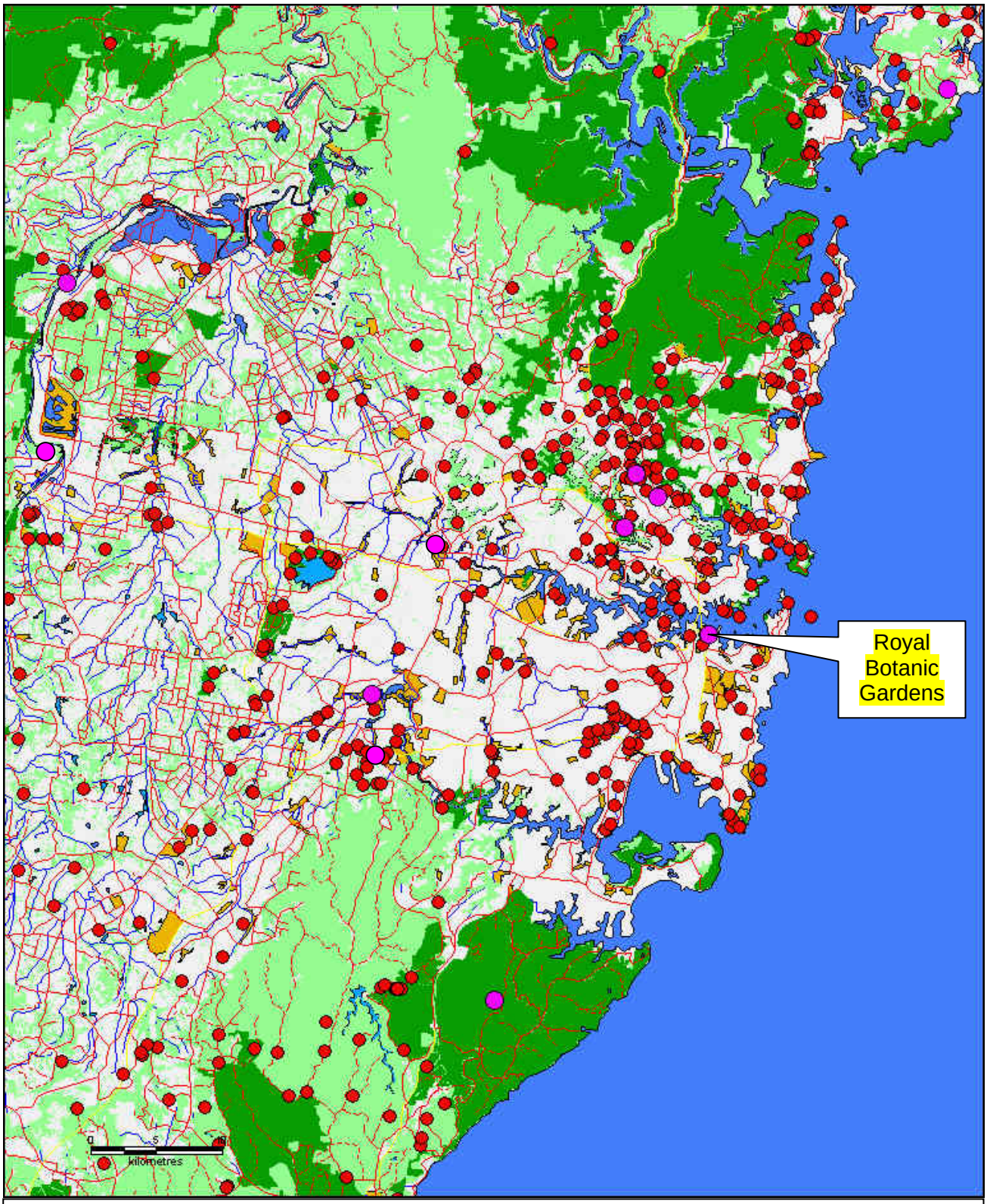
In May 1998, an influx of flying-foxes increased the numbers up to more than 3000. Early morning scares reduced the numbers down to about 1500 by late August, but later that year the disturbance was ceased and the "Bat Club" (a panel of experts and RBG staff) was established in an attempt to find alternative ways of deterring the flying-foxes from particularly significant trees. Numerous methods were trialled (see Appendix 2), but did not prove to have any long-term effects and numbers have continued to show an increasing trend to the present day. The maximum number of flying-foxes recorded as occupying the RBG site at any one time is 34,980 (Smith 2007) on 3/05/07. In the 12 months following this record count, estimates ranged from 4256 (in mid July 2007), to 21,993 (in mid February 2008).

Native food resources within 50 km of the camp

Permanent flying-fox camps are becoming more common in urban areas apparently due to the increasing amount of nearby reliable food resources in well-tended parks, gardens and streets that are now commonly planted with native flying-fox food favourites such as eucalypts, paperbarks, banksias and figs. Such plantings are common around the Sydney region, and studies have shown that the flying-foxes that camp in the RBG most commonly forage in the Eastern suburbs, including Centennial Park, Moore Park, Trumper Park (adjacent to White City Tennis Courts, Edgecliffe), and Randwick Racecourse. Flying-foxes are also known to feed from trees in the RBG, Domain and Hyde Park (particularly the figs), and from backyard trees and street trees in surrounding suburbs. Most foraging sites used by flying-foxes from the RBG are believed to be within 5km of the RBG (Burton 2006), however there are plenty of other similar locations throughout suburban Sydney, where flying-foxes from other nearby camps feed at night.

Significant stands of native vegetation occur within 50km of the camp in large reserves such as Ku-ring-gai Chase National Park, Garigal National Park, Lane Cove National Park, Berowra Valley Bushland Park, Marramarra National Park, Towra Point Nature Reserve, Botany Bay National Park, Wolli Creek Regional Park, Royal National Park and Sydney Harbour National Park. These are generally on sandstone-based soils that were not suited for agriculture. Gullies in these areas are dominated by species such as Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Blackbutt (*E.pilularis*), Grey Gum (*E.punctata*), Red Bloodwood (*Corymbia gummifera*) and Turpentine (*Syncarpia glomulifera*). Red Bloodwood, Yellow Bloodwood (*C.eximia*), Scribbly Gum (*E.haemastoma*) and Sandstone Stringybark (*E.sparsifolia*) dominate ridges. Saw-leaved Banksia (*Banksia serrata*) and Heath-leaved Banksia

Figure 2. Native food resources within 50 km of the camp



Legend

- Grey-headed Flying-fox record
- >1000 Grey-headed Flying-foxes recorded
- NPWS Estate
- Remnant Vegetation outside DECC Estate
- Recreation Areas

(*B.ericifolia*) are common understorey species that produce large, nectar- and pollen-rich inflorescences. Heath-leaved Banksia is also a dominant species of coastal heaths.

There are also smaller scattered areas of remnant bushland on the shales soils of the Cumberland Plain dominated by Forest Red Gum (*E.tereticornis*), Grey Box (*E.moluccana*), Thin-leaved Stringybark (*E.eugenioides*) and Narrow-leaved Ironbark (*E.crebra*). River-flat forests in western Sydney are vegetated with Forest Red Gum, Cabbage Gum and Rough-barked Apple (*Angophora floribunda*), often with an understorey of *Melaleuca linariifolia*. Shale-gravel soils in western Sydney support stands of Grey Box and Broad-leaved Ironbark (*E.fibrosa)* with Parramatta Red Gum (*E.parramattensis*) and *Melaleuca* species along drainage lines. Shale remnants on ridges of the Hornsby Plateau support small remnant stands of Sydney Blue Gum (*E.saligna*), Blackbutt, Turpentine and Grey Ironbark (*E.paniculata*).

Remnant vegetation on coastal alluvium is vegetated with Bangalay (*E.botryoides*), Rough-barked Apple and Swamp Oak (*Casuarina glauca*). Small stands of the winter-flowering Swamp Mahogany (*E.robusta*) occur on alluvium at Narrabeen, Warriewood, Brooklyn and in the Cattai Creek catchment. Paperbark (*Melaleuca quinquenervia*) also occurs at Brooklyn, Towra Point and Kurnell. Cabbage Palm (*Livistona australis*) occasionally occurs in this community and in small coastal rainforest gullies. Stands of this species occur around Pittwater, near Narrabeen, Manly, Kurnell, Port Hacking and the Illawarra, Coast Banksia (*Banksia integrifolia*) is an important winter-flowerer that occurs in the remnants of Eastern Suburbs Banksia scrub and other coastal woodland and scrub communities. Spotted Gum (*Corymbia maculata*) is an irregular winter-flowerer that occurs on the Barrenjoey and Bouddi peninsulas and at Hoxton Park, Prospect and Appin (Benson & McDougall, 1998).

Blossoms of almost all of the above-mentioned species are known to be consumed by Grey-headed Flying-foxes (Eby, 1995 cited in Benson & Howell, 1998). Flying-foxes also consume the fruits of Cabbage Palms, Port Jackson Figs (*Ficus rubiginosa*) and other rainforest species (Eby, 1995 cited in Benson & Howell, 1998; Eby, 1998).

Burton (2006) analysed pollen and other plant material in faecal samples of the RBG flying-foxes between February and July of 2006. Burton found that in summer *Eucalyptus* blossom, figs and *Livistona* blossom were the most important food items with *Melaleuca* and *Banksia* blossom becoming more abundant in autumn and winter and figs consumption reduced.

Smith (2007) studied the dietary characteristics of flying-foxes from a number of camps in the Sydney region during autumn and winter 2007. Smith found that figs (*Ficus* spp.) were the second most important food item after Myrtaceae* (probably primarily Eucalypt) blossom for the RBG flying-foxes. In comparison to other Sydney camps Banksia was also important (Smith, 2007). Coast Banksia (*Banksia integrifolia*) and Heath-leaved Banksia (*B.ericifolia*) are common in the nearby remnants of coastal scrub.

Figure 2 (on the previous page) indicates remnant vegetation, reserves and grey-headed flying-fox records on the Atlas of NSW Wildlife (DECC, 2008) within 50 km of the RBG. Locations that have been used by greater than 1000 individuals are also indicated. Non-national park recreation areas are also indicated as these are in public tenure and may contain vegetation suitable for foraging by the species, though it is noted that some of these are largely cleared areas (eg golf courses) where resources would be limited.

Species-specific history of camp use

The history of flying-foxes detailed above refers to the grey-headed flying-fox *(Pteropus poliocephalus)*. However, in 2006 a black flying-fox *(Pteropus alecto)* was caught and collared in the RBG, and found to stay in the colony for a week (Burton 2006). Since then, the highest number of this species found roosting in the RBG camp was 247 on 27/06/08, and the most recent count on 21/11/08 estimated 144 individuals. This species was first observed to be breeding in the RBG in late 2007 with two dependent young observed and the colony has again produced young in 2008 (Pearson, pers. comm.). To our knowledge, this is now the southernmost known breeding colony of *P.alecto* in Australia. *P.alecto* was listed as a vulnerable species under the *Threatened Species Conservation Act* but was de-listed from the schedules in August 2008.

Other native plants and animals in the camp

The RBG site contains a wide variety of plant species, both native and exotic, cultivated and maintained for the purposes of historic heritage preservation, scientific study, education, and recreation. The BGT is obliged under the *RBG & Domain Act 1980*, Section 7 “to maintain and improve… the collections of living and preserved plant life owned by the Trust”.

* Myrtaceae pollen was only identifiable to family level.

The RBG site is home to a wide variety of native wildlife (see Appendix 3), including the increasingly uncommon water rat, ringtail possum and buff-banded rail, as well as the threatened grey-headed flying-foxes. RBG has also on occasion been visited by powerful owls (*Ninox strenua*) which have been observed perching amongst the roosting flying-foxes during the day. This species is listed as vulnerable under the *Threatened Species Conservation Act 1995*.

Step 3 Assess community attitudes

Community attitudes toward flying-foxes

The BGT is well aware of the strength of the differing views towards flying-foxes, and has received much correspondence over the years expressing these views with regards to the RBG colony. Most of the correspondence has been from people concerned, or even angry, about the damage caused to the trees by the flying-foxes. Such people often demand that the BGT uses whatever means possible to rid the Gardens of what they consider to be pests. The BGT has always made a point of responding to such correspondence in a way that assures the person that the BGT is working towards a solution to protect our valuable collections from damage, whilst also educating the person on the ecological value of the flying-fox in its natural habitat. On the other hand, some people are adamant that the needs of a threatened species should be a higher priority than the protection of some old, exotic trees, and that the colony should be managed *in situ* rather than being expelled. However, there are some that have sympathy for both the RBG collection and the flying-foxes, and realise that the BGT has tried many different ways of *in situ* management, with little success to date. Of this last group of people, some advocate relocation as a possible solution, whereas others doubt its chances of success.

By way of alternative campsites, most people believe that there are not many nearby options for potentially suitable new campsites. It seems that most people would be satisfied if the flying-foxes were to disperse into existing camps, as long as they did not overcrowd those sites and thus cause unsustainable damage to vegetation or expand closer to nearby residences. However some people have expressed concern about the potential impact of increasing the flying distance from the camps to the known foraging sites in the Eastern suburbs.

Community consultation

The BGT has established a process of community consultation via a comprehensive collation of feedback received by the BGT in relation to the flying-foxes and the proposed relocation. Flying-fox feedback forms (Appendix 4) have been produced that are used by the volunteers and staff that work at the 'frontline' interface between the BGT and the public. These forms are used by the BGT volunteer guides, volunteers at the RBG's two information booths, the Friends of the Gardens receptionist, and the BGT's Project Officer – Wildlife Management, to record any verbal feedback received (by phone or in person) by any person regarding the flying-foxes and the proposed relocation. Visitors to the RBG info booths may also choose to fill in their own forms if they wish.

In the past, BGT volunteers kept a tally of what topics visitors asked questions about the most. It was found that the flying-foxes were often the most frequently discussed topic. So, the BGT introduced a scoring system (Appendix 5) to tell us whether the questions and comments being made about various animals in the RBG were generally of a positive, negative, or neutral nature. This system was continued after the introduction of the flying-fox feedback forms, and the results for the flying-foxes will be included with the summary of feedback obtained from the abovementioned forms as well as any written correspondence and relevant media articles.

It is also considered that the composition of the steering committee reflects a range of community interests and that their feedback to drafts of this plan has broadened the range of views expressed in the plan.

Informing the community

As part of the BGT's flying-fox relocation plan, a communication strategy is being developed to ensure that the community is appropriately informed throughout the entire relocation process. The key goals and objectives of the communication activities are to:

- Increase community awareness about the significant heritage, horticultural and scientific importance of areas where flying-foxes roost at Sydney's Royal Botanic Gardens;
- Increase community awareness about flying-foxes; their status as threatened species and their ecological importance;
- Inform the community about the BGT's rationale behind its relocation of the flying-foxes and maintain community and stakeholder support for the project;
- Inform the community about the program by managing their expectations and concerns – what will be done, expected outcomes & progress reports;
- Provide safety messages.
- Provide web links to information currently available on the status of the programme.

Aboriginal community consultation

Allen Madden, the Acting Chief Executive Officer of the Metropolitan Local Aboriginal Land Council represents the local Aboriginal community on our steering committee.

Step 4 Justify exceptional circumstances

Exceptional circumstances: Introduction

The Royal Botanic Gardens is regarded as one of the great botanic gardens of the world. It is one of the earliest surviving colonial botanic gardens in the world and one of the richest most extensive early public cultural landscapes in Australia with substantially intact major precincts and extensive living plant collections that are nationally rare from an historic, scientific, aesthetic and social perspective.

The *Royal Botanic Gardens and Domain Trust Act 1980* is administered by the Botanic Gardens Trust and is subject to the control and direction of the NSW Department of Environment and Climate Change (DECC). The principle functions of the Act, include:

- To maintain and improve the Trust lands; the National Herbarium and the collections of the living and preserved plant life owned by the Trust;
- To increase and disseminate knowledge with respect to the plant life of Australia and NSW in particular; and
- To encourage the use and enjoyment of the Trust lands by the public by promoting and increasing the recreational, historical, educational, and cultural value of those lands;
- When acting in pursuance of its objectives, the Trust shall give particular emphasis to encouraging and advancing the study of systematic botany, and to plant conservation.

There are records of flying-foxes in the Gardens as early as the 1850s. In 1990 there were only 200 but numbers had increased to more than 3,000 by 1992. The Botanic Gardens Trust successfully used noise to discourage roosting and the permanent population reduced to fewer than 100 flying-foxes for much of the time up until 1998, when the numbers rose once again to more than 3,000. Since then, the colony has continued to grow in size, and now more than 6,000 flying-foxes are permanently roosting in the Gardens, with this number occasionally rising to more than 20,000 in the summer months. Damage is severe and widespread in the Palm Grove and among the rainforest trees, with more than 300 trees (10 per cent of the collection) and understorey being affected, with thirteen trees having already died since 1995. It is considered that roosting by the flying-foxes is the major cause of the decline of these trees. Approximately 60 more trees have been severely damaged by the roosting flying-foxes, two thirds of which are unlikely to survive. Nine of these trees are damaged to the point where survival is uncertain, while the remainder should start to recover once the stress from the roosting flying-foxes has been removed, although these trees may never regain the same condition that they had prior to roosting (see Appendix 8). Sydney tree expert, Judy Fakes, has advised us that heritage trees in the Palm Grove will continue to die unless the BGT does something now.

Exceptional circumstances: Significance – Place and Plants

The Royal Botanic Gardens Sydney Conservation Management Plan categorises the Gardens as an exceptional national cultural landscape. The Plan categorises the living collections as significant as they are the largest and most diverse continuously cultivated plant collection in Australia. The living collections are also recognised for their direct association with exploration and plant discovery in the mid 19th century in the South Pacific by Charles Moore, represented by a wide range of broadleaf evergreen trees, Palms, and southern Conifers, the latter including type specimens of Agathis species first studied and published in the scientific literature from these individuals. The living collections are also significant for demonstrating the continuing focus of taxonomy and horticultural botany on Australian native plants, in particular rainforest trees of NSW and Queensland, Eucalypts, and plants from the Sydney region.

The Royal Botanic Gardens has **scientific significance,** as it comprises an eclectic collection of native and exotic plants acquired over almost two centuries, for the purpose of scientific study, including research for agriculture, ornamental horticulture and industry. The Garden has an extraordinary breadth of the living collections, with a richness and diversity of tropical and sub-tropical plants. The living collections are considered as one of the most important collections for botanic science in Australia. These collections have a long standing close and direct link with the study, classification and cultivation of the indigenous plants of New South Wales, Australia and the South Pacific region, which remains a core function of the scientific institution (National Herbarium of NSW) and the Gardens.

The Royal Botanic Gardens Sydney has **historic significance** for the strong and direct associations with prominent early Directors such as Charles Fraser, Richard and Allan Cunningham, Charles Moore and Joseph Maiden, who were largely responsible for the overall form of the Gardens landscape, as well as the 19th century content and organization of the plant collections. The Gardens has a strong and direct association with many distinguished 20th century scientists who have developed and codified knowledge and understanding of Australian plants through their researches using the Garden and Herbarium collections. The study of the Garden's living and preserved collections has formed the basis of much of the contemporary knowledge and understanding of Australian plants. This work built on the extensive work by the 19th century government botanists and the plant acquisitions, whose collections are of notable early botanic explorers and collectors.

The Royal Botanic Gardens Sydney is of **social significance** as it is highly valued by the community and is in high demand from the broad community spectrum. The Gardens fulfil diverse use expectations and attracts four million visitors each year. As from an early date the place developed, and continues to develop, a didactic role of increasing the appreciation and conservation of plants. It performs this important educational role through displays, public lectures, tours and social events based on the living and preserved collections and the landscape setting.

Exceptional circumstances: Living Collections – Background

The Global Strategy for Plant Conservation (GSPC) is a key driver for the development and maintenance of the Trust's living collections. The ultimate and long-term objective of the GSPC is to halt the current and continuing loss of plant diversity. Sub-objectives include:

a. Understanding and documenting plant diversity:

   i. Document the plant diversity of the world, including its use and its distribution in the wild, in protected areas and in *ex situ* collections;

   ii. Monitor the status and trends in global plant diversity and its conservation, and threats to plant diversity, and identify plant species, plant communities, and associated habitats and ecosystems, at risk, including consideration of "red lists";

   iii. Develop an integrated, distributed, interactive information system to manage and make accessible information on plant diversity;

   iv. Promote research on the genetic diversity, systematics, taxonomy, ecology and conservation biology of plants and plant communities, and associated habitats and ecosystems, and on social, cultural and economic factors that impact biodiversity, so that plant diversity, both in the wild and in the context of human activities, can be well understood and utilized to support conservation action;

b. Conserving plant diversity; Improve long-term conservation, management and restoration of plant diversity, plant communities, and the associated habitats and ecosystems, in situ (both in more natural and in more managed environments), and, where necessary to complement in situ measures, *ex situ,* preferably in the country of origin. The Strategy will pay special attention to

the conservation of the world's important areas of plant diversity, and to the conservation of plant species of direct importance to human societies:

c. Using plant diversity sustainably:

   i. Strengthen measure to control unsustainable utilization of plant resources;

   ii. Support the development of livelihoods based on sustainable use of plants, and promote the fair and equitable sharing of benefits arising from the use of plant diversity;

d. Promoting education and awareness about plant diversity: Articulate and emphasize the importance of plant diversity, the goods and services that it provides, and the need for its conservation and sustainable use, in order to mobilize necessary popular and political support for its conservation and sustainable use;

e. Building capacity for the conservation of plant diversity:

   i. Enhance the human resources, physical and technological infrastructure necessary, and necessary financial support for plant conservation;

   ii. Link and integrate actors to maximize action and potential synergies in support of plant conservation.

The tree collection at the Royal Botanic Gardens is of exceptional heritage significance as a dynamic collection; it is one of the great tree collections in the world. The historic significance of the Royal Botanic Gardens is the continuity of planting and thereby the connection with the earliest plantings through the maintenance in the collection of taxa (species, cultivars or other infraspecific categories). The Gardens comprises several historic precincts largely intact, each with distinctive character and defining features and planting composition. There are definite themes or collecting biases evident in the composition of the living collections stretching back to the earliest days of the Botanic Gardens' history. These include NSW rainforest species, southern hemisphere Conifers, Palms, New Caledonia and the Southern Pacific. There are significant extant exceptional or high ranked elements throughout the Gardens' landscape, including the living collections.

The evolving collection of trees in the Gardens represents the horticultural and scientific enthusiasms of both the past and the present. It is not a randomly accumulated assortment of specimens. Planted amongst the original trees, almost all long gone and possibly once habitat for flying-foxes, the extant collection reflects a series of clear phases in the establishment of botanic gardens trees in the state. The original 'scientific' collection of 1816-1925 assembled up until the retirement of Director Joseph Maiden is remarkable for its combination of Australian rainforest trees, palms, southern hemisphere conifers and figs. It is these elements that make the collection at the Gardens unique.

The flying-fox camp impacts on the Middle and Lower Gardens. The Middle Gardens includes many of the tree species planted during 1816 – 1925 and the Palm Grove. The Palm Grove is an assemblage of international significance in terms of its rationale and includes within it some of the oldest surviving planted trees in the Gardens and therefore Australia as well. Many of these trees and Palms are in decline due primarily to the impacts from roosting flying-foxes. Of individual trees, the collection of Kauris, *Agathis* spp. begun by Moore in the 1850s is of exceptional significance, not only being some of the tallest trees in central Sydney but also representative of a major successful experimental introduction of broad-leaved conifers from the Pacific Islands. Even older are rainforest trees dating from the 1820s. Many of these valuable collections have died primarily from the effects of flying-fox roosting or are suffering damage that risks their long-term health (Appendix 8).

The Lower Gardens botanical collections are dominated by large evergreen broadleaved trees and Conifers, a large proportion being of Australian and South Pacific origin and some dating back to the 1820s. Many of these trees are also suffering from the effects of Flying-fox roosting. As additional examples, a bamboo-like plant, *Joinvillea*, growing in the Palm Grove has been used to study floral development in a study with the Jodrell Laboratory at Royal Botanic Gardens Kew. The Brown Silky Oak on the edge of the Palm Grove was used for chromosome counts in some research done by one of the Trust scientists. Several fungal species have been discovered and described from Palms in the Palm Grove so these specimens become what are known as 'type localities' – important scientific reference points, which the BGT has a legislative responsibility to protect.

Exceptional circumstances: Living Collections – Character, Themes and Biases

The Garden comprises several historical precincts largely intact, each with distinctive character and defining features and planting composition. The composition of the living collections displayed in each precinct

strongly defines the visual aesthetic character in each, and this is related to strongly expressed collecting biases evident in the extant collections.

There are definite themes or collecting biases evident in the composition of the living collections stretching back to the earliest days of the Botanic Gardens' history – these including NSW rainforest species, southern hemisphere Conifers, Palms, New Caledonia and the South Pacific and others. There are significant extant Exceptional and High ranked elements of all of the above throughout the Gardens' landscape. Historical themes or biases are mostly incomplete, reduced or fragmented across the site and so are not easily legible.

The various combinations of these elements throughout the Garden have been shown to contribute strongly to the visual aesthetic character of the place and these themes or biases could continue to be used in the future to conserve that character. Whilst individual specimens or trees may not be able to be preserved, individual taxa, groups of taxa, or the themes represented by those groups could continue to be used as a defining feature of the Gardens living collections.

Exceptional circumstances: Senescence

The living plant collection, the defining feature of the botanic garden, cannot be preserved since it is made up of living organisms that eventually die. The Trust generally aims to present plants in healthy condition and presenting each taxon in good form and habit, not as stunted, deformed, or uncharacteristic of the taxon.

Many Exceptional and High ranked plants of the living collections are in only fair or poor condition, have limited durability in the future, and will inevitably fail. The Trust needs to articulate a view regarding the retention of the taxa in the collection especially with regard to its current Collections Policies and Thematic Plan.

Determining a conservation policy and management practices for these particular trees or collections will need to take into account age, state of senescence, evidence of physical decay and stability, Safe Useful Life Expectancy calculation, safety, and relevance and purpose in the collections.

Exceptional circumstances: Managing Impacts and Change

There is evidence of gradual loss of diversity, and extent of tree canopy cover in some areas such as the Lower Garden Farm Cove precincts. The Lower Farm Cove lawns now present the appearance of the spacious park or arboretum; deceptive, since until only fairly recently they were extensively planted in mass planted shrub beds and significantly greater numbers of specimen trees. The Trust needs to prevent further loss of fabric by ensuring replacement of specimen trees and retention where possible of mass planted beds.

The Trust aims to present plants in healthy condition and presenting each taxon in good form and habit, not as stunted, deformed, or uncharacteristic of the taxon. There is considerable evidence across the site of the destructive impact of fauna, especially birds and bats, leading to the loss of Exceptional and High ranked trees. The Trust clearly has difficulty managing wildlife effectively so as to protect the most valuable parts of its living collections. Without strong intervention by the Trust to reduce or eliminate Australian white ibis and grey-headed flying-foxes from the site, the loss of large numbers of trees of such significance will continue to occur.

Exceptional circumstances: Living Collections Constraints

The living plant collections, unlike built objects, cannot be restored or even stabilised. All the botanical specimens have an aesthetic and functional life span resulting in a portion of the collection being continuously turned over and replaced by new material. Over time all of the collection will become senescent and be replaced. In this sense, living collections differ fundamentally from built objects. Large numbers of Exceptional and High ranked elements are in only Fair or poor condition.

Conversely, a large part of the living collection is in Good condition with the expectation of future longevity. If the Trust aims to retain Exceptional and High ranked elements for the future this will necessarily limit the extent to which it can revise and change its Collections Policy and Thematic Plans. These should be formulated to take into account the cultural significance of the extant living collection.

The Trust has to ascertain the continuing relevance and purpose of some parts of the historical collection taking into account the significance ranking, and decide whether these groups of taxa should be retained in the future.

Presence of plant pathogens and disease especially soil-borne fungi will affect the ability of the Trust to conserve the living collection, and also what can be successfully grown and established in the future. The

impact of plant diseases leading to general decline in health and loss of trees and diversity especially from *Armillaria* and *Phytophthora* must also be considered.

Exceptional circumstances: Living Collections Opportunities

The Trust could continue to use some of the main historical groups present as the basis for future plantings. The strongly expressed aesthetic character of the garden could be conserved even though individual specimens may be lost over time.

The Trust where appropriate would propagate from original elements in the collections such as the Fraser trees to ensure the historical continuity of the living collection.

There could also be the opportunity to collect from original locations such as for replacements of Moore's Agathis collection in New Caledonia and for rainforest species from northern rivers of New South Wales as originally described by Moore and Maiden. This would continue the historical practice and lead to the same or similar taxa continuing to be represented in the collections in the future.

Even though some Exceptional and High ranked taxa may not be able to be preserved the opportunity nonetheless exists to continue to develop or maintain the themes.

The Trust could continue to build some parts of the historic collections to ensure the conservation of the theme or collection focus even though the individual trees already extant may not be able to be preserved.

The Trust has the opportunity to conserve extant specimens *in situ* for as long as possible using expert arboricultural advice, demonstrating best practice in the management of heritage trees.

The Trust can educate and interpret the evolving qualities of living landscapes as represented by the Botanic Gardens living collections – this is an opportunity for the Trust to be a leader informing community opinion.

On-site camp management

The flying-foxes have set up camp in the Royal Botanic Gardens at various times since Governor Macquarie had the foresight to set aside this land for a world class botanic garden (they may have visited the area before European settlement, but the landscape and habitat were quite different, though some original trees remain). Large numbers are recorded for 1858, 1900, 1916 and 1920 – in those times, flying-foxes were culled, something the BGT would not contemplate today.

There are then no records of significant numbers for nearly 70 years. In 1989, 200 took up residence, growing to a peak of 3200 in 1992. Other urban camps in Sydney have similarly fluctuated in size and location over the years, and the biggest concentration in Sydney is usually at Gordon where camp size can reach more than 50,000 animals.

Over a number of years the Botanic Gardens Trust has trialled a number of techniques to minimise damage from roosting flying-foxes (Appendix 2). Plastic bags have been tied to branches; mirrors were used to reflect light into trees; sirens and fire alarms were rung; mesh bags of toilet deodorant blocks were hung among leaves; recorded flying-fox distress calls were played; containers of rock carbide were placed high in the tree canopies; a high intensity strobe light was focused on affected trees; containers of raw bullock liver were placed on branches; a synthesised sound on the same wavelength as a street sweeper was introduced; plastic pythons were placed on branches; dog whistles were blown; "shu-roo' an ultrasonic device was trialled and a product named D-Ter applied to leaves. None of these techniques deterred the flying-foxes from roosting for any extended period of time and the size of the camp continued to increase.

Netting has been considered but is not viable. In orchards where netting is installed trees are a uniform height (usually no more than 5m) and planted in straight rows. In the Royal Botanic Gardens netting would need to accommodate the tallest affected trees which are 30m tall and would have to cover the entire Palm Grove as the trees and palms form a single canopy. Netting would be very expensive and some people may consider it inappropriate to the look of the Gardens. In addition, unless the netting were to cover the entire Palm Grove as well as adjoining garden beds where the flying-foxes are roosting, it is likely that the flying-foxes would simply concentrate in the un-netted areas of the Gardens. The BGT wants to save the heritage trees and safely relocate the flying-foxes to an appropriate habitat. Unlike mobile disturbance, netting would not be able to direct the flying-foxes to any particular locations once they had left the Gardens.

There may be some interim measures taken to protect the most significant trees including noise, motion and lights where possible before the relocation begins in May 2009. These actions are permissible under the current section 120 licence (*National Parks and Wildlife Act 1974*), and although they may provide some short-term relief, they are not considered likely to be effective in the long-term. DECC and the public will be kept informed about these measures.

Approximately 60 trees have been severely damaged, 40 of which are unlikely to survive. It is considered that roosting by the flying-foxes is the major cause of the decline of these trees. Nine of these trees are damaged to the point where survival is uncertain, while the remainder should start to recover once the stress from the roosting flying-foxes has been removed, although these trees may never regain the same condition that they had prior to roosting (see Appendix 8).

There are records of flying-foxes in the Gardens as early as the 1850s. In 1990 there were only 200 but numbers had increased to more than 3,000 by 1992. The Botanic Gardens Trust successfully used noise to discourage roosting and the permanent population reduced to fewer than 100 flying-foxes for much of the time up until 1998, when the numbers rose once again to more than 3,000. Since then, the colony has continued to grow in size, and now more than 5,000 flying-foxes are permanently roosting in the Gardens, with this number occasionally rising to more than 20,000 in the summer months. Damage is severe and widespread in the Palm Grove and among the rainforest trees, with more than 300 trees (10 per cent of the collection) and understorey being affected. Thirteen trees have died since 1995 and up to 60 more are so damaged they are expected to die within the next three years. Sydney tree expert, Judy Fakes, has advised us that heritage trees in the Palm Grove will continue to die unless the BGT does something now.

It has been suggested that areas elsewhere in the RBG or The Domain could be suitable alternative campsites or that the lands administered by the Trust could house additional tree plantings that could eventually host flying-foxes. However, there are a number of factors precluding this. The RBG and Domain have over 4 million visitors each year and annual visitation is increasing. They are used for a range of activities and events from those hosting tens of thousands of people to smaller scale functions. There are nearby public facilities such as the Andrew Boy Charlton Pool; the Domain carpark, the NSW Art Gallery and the Government building precinct along Hospital Road. There are also nearby residences in Woolloomooloo Bay. Furthermore, assuming that the flying-foxes would want the same northern aspect to face when roosting (per the current location in the RBG), then the area of the Domain suitable for such habitat plantings is virtually non-existent. Plans of Management for the Domain and RBG do not support such habitat creation as landscape and the trees within both areas have high heritage status as well. Therefore, it is considered that The Domain and alternative locations in the RBG are unsuitable as alternative campsites.

The landscape of the Royal Botanic Gardens is no longer native habitat for the flying-foxes and there is no intention to develop habitat for the flying-foxes. The Garden is considered to be of heritage importance and the composition and design of the Royal Botanic Gardens is carefully planned to maintain its heritage value. The landscape design, plant content and variety have the primary purpose of providing key plant related messages through landscape displays and the use of interpretative information. For educational and aesthetic purposes, many plantings are grouped according to their scientific, geographical, evolutionary, aesthetic and horticulture history and values. Any new plantings take a long time to mature, and with many of our most significant tree specimens now dying, the BGT does not have time to wait. Our thematic plantings may not even suit the requirements of a flying-fox colony, even when they have matured, as they are designed with the purpose of maintaining the heritage, plant science, and aesthetic values of the Gardens in line with our Conservation Management Plan, rather than recreating habitat for wildlife.

Exceptional circumstances: Conclusion

The Royal Botanic Gardens Sydney and the location of the flying-fox camp is not a natural habitat of the flying-fox. The Garden is a largely intact 19th century landscape which has significant historic, scientific, aesthetic and social values.

Professor David Mabberley, in his contribution to the Conservation Management Plan for the Royal Botanic Gardens, identifies the collection of kauris and the only known mature specimen, apparently anywhere in the world, of the palm, *Pritchardia maideniana* as 'trees' of international scientific and conservational significance. Since that report a small population of the Palm has been found in Hawaii, possibly of cultivated origin, but the ex-situ collection remains of high conservation value. The Kauris, in particular, have been greatly affected by the flying-foxes and some significant specimens (including a specimen from the critical 'type collection' of an *Agathis moorei*) have died already.

There are also many other trees which are difficult to collect or may be rare in the wild today and provide representative specimens for scientific study by scientists at the Botanic Gardens Trust and elsewhere.

For the study of plant taxonomy and classification (systematics), in particular, the living collections are a rich resource. Plants grow in similar conditions, their life cycle can be observed, their DNA extracted, their variability in form documented, and so on. Much of the recent research on plant evolution and new DNA bar-coding techniques has relied on samples from botanic garden collections. Several of the kauri pines and trees in the Proteaceae family were sampled –these trees are carefully documented on our database and

from known wild origins. Our Tree Waratah, e.g., was used for DNA extraction, dissection of flowers and studies of wood anatomy, all part of a worldwide study of the family Proteaceae.

There are 48 species of wild-collected palms that are available for scientific study or conservation. A number of these are rare in cultivation – e.g. *Ceroxylon alpinum*, *Howea belmoreana X forsteriana*, *Jubaeopsis caffra*, *Polyandrococos pectinatus* – and our New Caledonian palms are particularly valued by the Palm and Cycad Societies of Australia.

The Gardens' living collections must be protected before they are further damaged beyond repair by roosting flying-foxes. The only way of ensuring this protection occurs is to relocate the flying-fox camp to a more suitable and sustainable landscape. The regular disturbance caused inadvertently by the day-to-day activities of Gardens' staff, visitors, and by special events, is reason enough to argue that the Gardens is not a very suitable location for a flying-fox camp (particularly a maternity camp). Neither is the Gardens a sustainable landscape for a flying-fox camp, for if the current damage continues, eventually the Gardens' remaining significant living collections will be destroyed and the flying-foxes will have to move on to another area, as there will be no roosts remaining. A relocation program will prevent further loss of the living collections by bringing forward in time the eventual movement of flying-foxes to a more suitable environment.

Step 5 Identify options for alternative campsites

Identification of sites that may be attractive to flying-foxes as campsites

Flying-fox camps do not exist as discrete groups of animals, but consist of individuals that are constantly moving and mixing between camps. There is no known way to attract flying-foxes to a particular site, only to discourage them from staying in unsuitable sites. Therefore the BGT does not believe it is useful to identify a single alternative campsite, as it is severely limiting options, where there maybe other suitable sites available. Instead, a comprehensive analysis of potentially suitable campsites within 20 kilometres of the RBG has been undertaken that firstly identified (using aerial photographs and GIS vegetation layers) patches of vegetation that may be potentially suitable as flying-fox camp sites, then scored each site according to the following criteria thought to influence the choice of alternative campsites by the flying-foxes upon relocation from the RBG. All criteria used were based on published and unpublished information from the experts. Some criteria suggested by experts were unable to be used on all sites due to lack of time or available information. It was felt that the criteria covered provided a reasonable guide to predict where the flying-foxes may choose to go upon relocation. We consider that if the flying-foxes choose to roost in a site, then it is reasonable to assume that they consider that site to meet their needs at that particular point in time.

Distance from the original site (RBG).

Previous relocations have demonstrated that flying-foxes often tend to stay close to the original site when disturbed. In Maclean, they settled little more than 500 m away from the original campsite. In Melbourne, most initially dispersed among local parks and public gardens within 5 km of the Gardens, eventually settling (after a bit of 'herding') at Yarra Bend, approximately 5 km away from the original campsite. However, during the Melbourne relocation, over 1,000 flying-foxes unexpectedly extended their species' distribution by settling in Geelong, approximately 65 km south of their original campsite. The BGT has therefore attempted to include most of the Sydney metropolitan region in our analysis.

Table 5. Scores given for the proximity of the alternative site from the original campsite at the Royal Botanic Gardens Sydney.

Score	Distance from RBG (km)*
5	0-5
4	5-10
3	10-15
2	15-20
1	20-25
0	25+

*Calculated from midpoints of each site.

Direction from original site:

Research (Parry-Jones & Augee 2001, Smith 2007) indicates that flying-fox camps are strategically located in convenient locations in relation to food sources. It is believed that flying-foxes from the RBG tend to fly out from the camp in the general direction of their food sources for that night (when not restricted by topographical features). This is supported by the dietary research on flying-foxes in the RBG (Burton 2006), which has shown that they are commonly feeding in areas such as Centennial Park and the eastern suburbs, which corresponds with the directions of the largest fly-out streams from the RBG. Although it varies seasonally, the southerly stream is almost always the largest stream, followed by the easterly stream, and then a smaller scattered stream that flies roughly north. The westerly direction is blocked immediately by tall city buildings. However, flying-foxes have occasionally been observed flying around these buildings and heading west out of the southerly or north-westerly streams. From these observations the BGT has assigned the following scores to the directions of sites from the RBG on the bases that flying-foxes are likely to head in those same directions when disturbed from the RBG (and thus are more likely to settle in sites in those directions), and that direction of fly-out is likely to be an indication of the availability of food resources in that direction:

Table 6. Scores given for the direction of the alternative site from the original campsite at the Royal Botanic Gardens Sydney.

Score*	Direction from RBG
12	S
11	SSE
10	SE
9	ESE
8	E
7	ENE
6	NE
5	NNE
4	N
3	NNW
2	NW
1	WNW
0	W
3	WSW
6	SW
9	SSW

*These scores are divided by 3 in the final analysis to give this criterion a more equal weighting against the others.

Patch size:

This criterion refers to the area of vegetation identified from aerial maps as potentially suitable roost vegetation (confirmed where possible by referring to vegetation type information obtained from relevant GIS layers). Roberts (2005) recommended that the minimum patch size for an alternative site should be 1 hectare, however the DECC flying-fox camp management policy states that the alternative site should: 1) have at least as large an area as the existing camp; and 2) be large enough to support at least an equivalent number of animals as the existing camp. In theory, the larger the site, the more sustainable it will be, because it provides room for the flying-foxes to move around within the site to allow for fluctuations in numbers. However, flying-foxes do not seem to exhibit this preference, often roosting in quite small patches

of remnant vegetation in urban areas rather than in nearby national parks. This is presumably because of convenience of the chosen locations to reliable food sources and other habitat characteristics as selected by flying-foxes. Therefore our scoring system is as follows:

Table 7. Scores given for the vegetation patch size of the alternative site.

Score*	**Patch size (ha)**	**Explanation**
-1	Less than 1	Less than minimum patch size recommended in other relocation reports
0	Less than 3.4	Less than size of current site
1	Less than 5	Unlikely to be able to sustain maximum number of flying-foxes at current site. May be able to sustain lower numbers.
2	More than 5	No higher categories because flying-foxes do not show preference for larger sites.

*These scores are multiplied by 2 in the analysis to give the criterion a more balanced weighting against the others, and to emphasise the importance of patch size as a limiting factor.

Vegetation type:

Although flying-foxes may roost in a variety of vegetation types, they do seem to show some preferences for certain communities, particularly riparian vegetation communities dominated by tall trees or mangroves (Roberts, 2005; Churchill, 1998; Hall & Richards 2000). This analysis scored sites based on the main vegetation types present (from relevant GIS layers) and the condition as apparent from aerial photographs.

Table 8. Scores given for the suitability (for flying-fox roosting) of the vegetation type(s) of the alternative site.

Score	**Description**	**Example Vegetation Types** (after Tozer et al 2007)
5	Almost all of the site consists of moist/riparian forest or mangrove vegetation types known to host flying-fox camps	Hinterland Sandstone Gully Forest Estuarine Mangrove Forest Floodplain Swamp Forest Warm Temperate Layered Forest Estuarine Fringe Forest Cumberland River Flat Forest Temperate Littoral Rainforest River Mangrove Illawarra Gully Wet Forest Coastal Warm Temperate Rainforest
4	Site contains some moist/riparian forest or mangrove vegetation known to host flying-fox camps and some slightly less ideal vegetation, such as slightly drier forests.	Coastal Sandstone Gully Forest Coastal Sand Forest
3	Site contains either a fairly balanced mixture of vegetation types – some preferred, some not, or site contains majority forest types not directly associated with riparian areas or gullies.	Sydney Turpentine Ironbark Forest Castlereagh Ironbark Forest Blue Gum High Forest Sydney Shale-Ironstone Cap Forest
2	Site contains majority dry/open forest or woodland, slightly less exposed than that classed as 1 (below)	South Coast Grassy Woodland

1	Site contains almost all vegetation that is probably unsuitable (due to features such as dryness and exposure)	Coastal Sandstone Ridgetop Woodland

Distance to water:

As mentioned above, flying-foxes seem to have a preference for roosting close to water. This does not necessarily have to be fresh water. Flying-foxes at campsites such as the RBG, have often been observed belly-dipping in estuarine or even salt-water bodies such as the RBG's Main Pond. At other nearby Sydney sites, such as Gordon, the flying-foxes roost adjacent to a creek that the flying-foxes are unable to access to drink from, and that has occasionally been dry for several years at a time. But the flying-foxes remain there nevertheless, and are known to drink from other waterbodies several kilometres away (at golf courses, etc.). An analysis was done to determine which sites were intersected by waterbodies, both intermittent and perennial. A second analysis calculated the minimum distance from the centrepoint of each site to the edge of the nearest waterbody. Sites intersected by waterbodies, particularly fresh or perennial waterbodies, were scored the highest. Sites that did not contain any waterbodies were scored lower, with the lowest scores for those with the greatest distance to water.

Table 9. Scores given for the proximity of the alternative site to water.

Score	**Criteria**	**Reasoning**
7	Added to the score of any site intersected by a waterbody (see below)	To emphasise the importance of having a waterbody within the site, particularly in relation to other criteria such as distance to RBG (also out of 10). To ensure that the score of sites intersected by a waterbody is always higher than those that are not.
3	Site intersected by a 'perennial waterbody'	Most likely waterbody type to provide a permanent source of drinking water
2	Site intersected by a 'shoreline' or a 'tank/dam', but not a 'perennial waterbody'	Permanent water source, but not necessarily as suitable for drinking as that above
1	Site intersected by an 'intermittent waterbody' only	Non-permanent water source may still provide appropriate topography (e.g. gully) on site &/or some drinking water
5	Nearest water is within 50 metres of the site's centre	
4	Nearest water is 50-100 metres from the site's centre	
3	Nearest water is 100-150 metres from the site's centre	
2	Nearest water is 150-200 metres from the site's centre	Roberts (2005) recommends that alternative sites should be located within 200m of water. This was based on a QLD study.
1	Nearest water is 200-500 metres from the site's centre	This distance range was still given a low score because it may be the case that proximity to water is not quite as essential for NSW flying-fox camps as it is for the warmer locations in QLD.
0	Nearest water is more than 500 metres from the site's centre	A site with not even an intermittent water source within 500 metres is not likely to be suitable as a flying-fox campsite

*These scores are divided by 2 in the analysis to give this criterion a more balanced weighting against the others, and to emphasise the importance of proximity to water as an influential factor in roost site choice.

Flying-fox history:

It is believed that some flying-foxes develop affinities or loyalties to particular campsites, or at the very least, hold memories of previously used campsites. The scores below were counted as bonus points, rather than being given equal weighting to the other criteria. This is because opinion is divided as to how likely it is that flying-foxes will choose a site simply because it is familiar, rather than on the merits of the site itself. In light of the fact that several new camps (e.g. Parramatta, Wolli Creek, Clyde) have already self-established in the Sydney metropolitan region over the last decade, the BGT considers that familiarity with a site may slightly increase its chance of being chosen by the flying-foxes, but it is probably not an essential criteria. A higher score is given to those sites that have hosted flying-foxes over winter before, as this indicates that the site has definite potential to act as a future campsite.

Table 10. 'Bonus points' given to alternative sites with a known history of roosting flying-foxes.

Score	Previous use as a roost site
2	Known to host roosting flying-foxes in both winter and summer months
1	Known to host roosting flying-foxes only in warmer months (whether annually or occasionally), but not in winter
0	Not known to have hosted roosting flying-foxes

Long-term security and community acceptance

The purpose of the above scoring system is to provide a rough indication of the suitability of each site for the flying-foxes, not to determine suitability with regards to land use, or any other potential issues of conflict. The BGT felt that this latter suitability assessment would be best done by the land managers responsible for the sites on our list.

A list of 213 sites identified and scored by the process described above was sent to the relevant land managers along with detailed information about the issues that commonly arise for managers of flying-fox camps, as well as the potential benefits of hosting a flying-fox camp. Land managers were asked to make a basic assessment of what kind of flying-fox camp (whether small, large, permanent or temporary), if any, each site could be suitable to host. Some of the reasons suggested to land managers as to why a site (or part of a site) may be deemed unsuitable were:

- Sufficient roost trees (at least 10 metres tall or mangroves) not present.
- Presence of heritage vegetation, endangered ecological communities or other threatened species that are likely to be adversely affected by the presence of a flying-fox camp.
- Incompatible land use – where people's activities on the site will have a substantial negative impact on the flying-foxes or vice versa. e.g. roost trees too close to houses, sports ground, children's playground, aged care facility, etc.
- Incompatible adjacent land use - as above, but for land adjacent to the site. e.g. site too close to residential area and is likely to cause unacceptable noise levels to residents.
- Insecure land use. e.g. site pending clearing/development
- Flying-fox access severely restricted. e.g. by powerlines, aircraft flight paths, etc.
- Other (provide details)

Responses were received and numerous sites were initially identified as potentially suitable for hosting some type of flying-fox camp. A selection was chosen to seek 'in principle agreement' from the land managers, allowing the managers to give *conditional* agreements, dependent on things such as acceptance by the community following consultation, or the camp not being located too close to residents. At the time of writing, one site (Ku-ring-gai Flying-fox Reserve, Gordon) had received such 'in principle agreement', and is hereafter referred to as the 'preferred site' (see Figure 3 overleaf for the location of this site).

Ku-ring-gai Flying-fox Reserve (13km north-nor-west of the RBG) is an area of 14.6 hectares of open space bushland situated within the northern Sydney suburb of Gordon. In 1991, Ku-ring-gai Council entered into a voluntary conservation agreement with the Minister for the Environment to manage the reserve to aid the conservation of the grey-headed flying-fox (Ku-ring-gai Municipal Council 1999). It is estimated that an average of around 27,000 flying-foxes camp in the reserve, with numbers occasionally having reached more

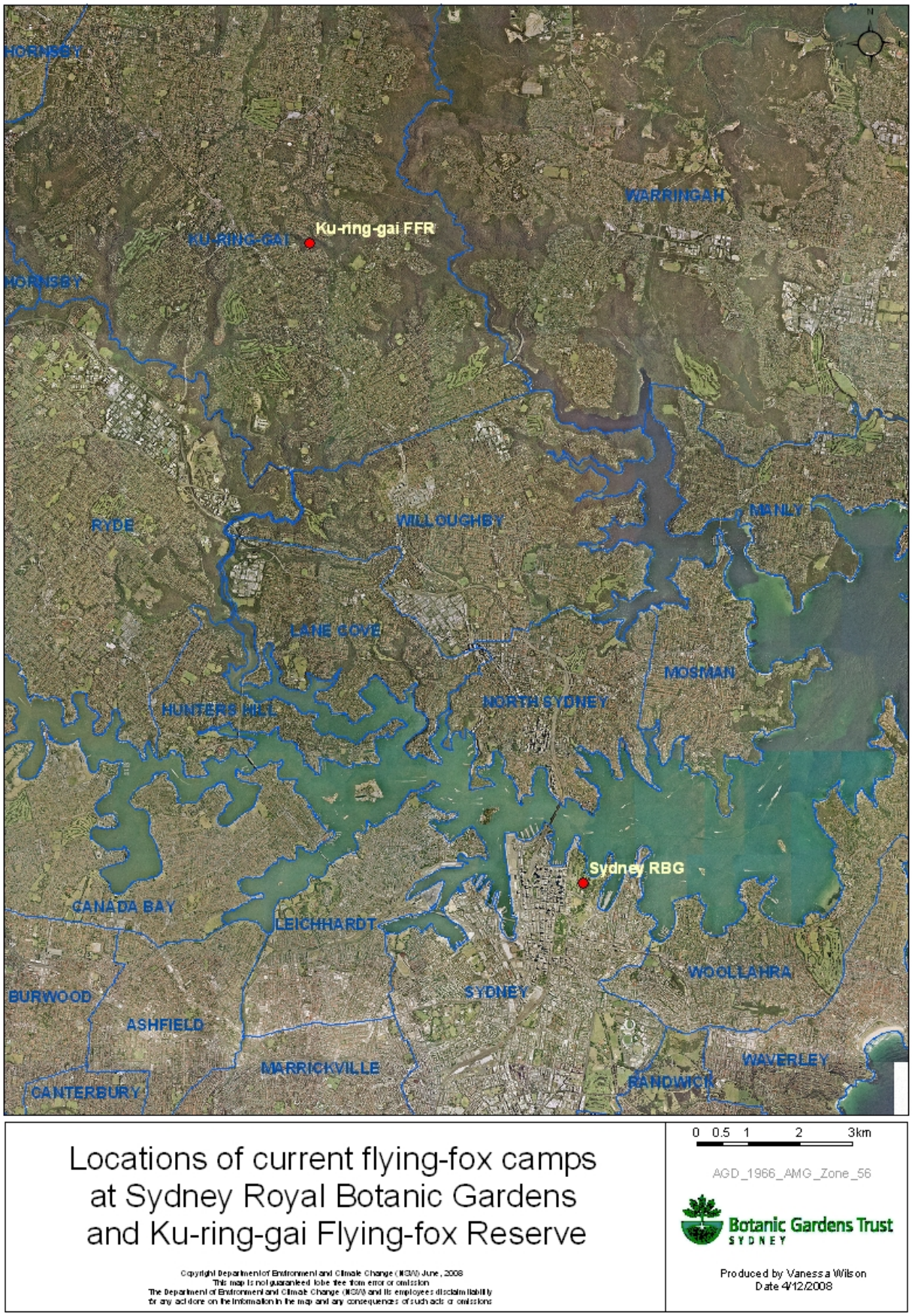


Figure 3. Location of the preferred alternative flying-fox campsite (Ku-ring-gai Flying-fox Reserve) in relation to the current campsite (Royal Botanic Gardens, Sydney).

than 60,000 (www.sydneybats.org.au). Vegetation mapping (NPWS, 2002) indicates that the reserve is vegetated with Western Sandstone Gully Forest and a small area of the endangered ecological community Sydney-Turpentine Ironbark Forest.

The conditions specified by Ku-ring-gai Municipal Council that form part of their 'in principle agreement' include:

- If a camp forms at the bushland interface that causes noise issues for residents then Council will require BGT to move the camp further into the Reserve.
- Assistance from RBG will also be required in notifying residents surrounding the reserve of the relocation project.
- A phone contact would also be useful for residents to contact the RBG if they wish to discuss their concerns.

The BGT has agreed to these conditions and will work closely with Ku-ring-gai Municipal Council to ensure that any other potential issues are identified and addressed as early as possible.

It is considered by BGT and the land managers (Ku-ring-gai Municipal Council) that Ku-ring-gai Flying-fox Reserve is able to provide sufficient roosting habitat for the flying-foxes to be relocated from the RBG without negatively impacting on the existing camp. The evidence for this comes from the comparative counts that have taken place at each site (Ku-ring-gai and RBG) throughout the year. Over the past nine years, the annual peak of flying-foxes recorded at the Ku-ring-gai camp has ranged from around 30,000-70,000 animals, while the RBG camp currently only reaches up to around 20,000-30,000. The flying-foxes from the RBG will be relocated at the time when flying-foxes from all over Sydney are generally starting to head north for the winter. This means that many of the flying-foxes that are initially disturbed from the RBG are likely to continue their normal migration pattern northwards. But it is the usual year-round 'residents' of the RBG, of which there is estimated to be around 4,000-7,000, that will need to find an alternative site for their winter roost. We know that the Ku-ring-gai camp can sustain this many more flying-foxes, particularly during winter, as the camp has fluctuated much more dramatically than that in the past with no problems arising.

Competition for food resources should not be an issue, as the flying-foxes from the RBG are known to forage primarily in urban/suburban parks, gardens and street trees. This site is surrounded by similar suburban areas which would provide a varied and reliable food source for a nearby camp, and are also situated closer to extensive areas of native bushland which would provide large quantities of native food resources during flowering events. Flying-foxes from the Ku-ring-gai site have in fact been known to forage in some of the same locations (e.g. in the eastern suburbs) that flying-foxes from the RBG currently utilise. Additionally, it has been suggested that the food resources in Sydney may actually be under-utilised by the local flying-fox camps (Parry-Jones & Augee 2001).

However, the BGT is aware that there is no guarantee that the flying-foxes relocated from the RBG will go to this preferred site, and is prepared to consider other potentially suitable alternative campsites should the flying-foxes choose to relocate there. While BGT's applications for approval to relocate are being assessed, discussions will continue regarding the results of the land managers' initial site-suitability assessments in order to clarify how their conclusions were reached, ensuring that all potentially suitable sites have been fully considered, and that 'in principle agreement' has been obtained for as many sites as possible.

If the flying-foxes choose to roost in any potentially suitable sites during the relocation, we will immediately commence discussions and negotiations with the land managers to determine the best course of action in each circumstance. If they go to a site that is unsuitable (due to such reasons listed on page 21), we plan to use follow-up disturbance to move them on from that site, provided that the land manager and other relevant authorities have given us permission to do so. As soon as a site (although there could be more than one) where the flying-foxes relocate to is confirmed as being suitable for them to stay in, we will commence discussions with the land managers to see how we may be able to assist with and support them in managing the new (or expanded) colony.

Step 6 Identify relocation methods

Relocation methods

An adaptive management strategy will be employed to allow for any unpredicted results. To help avoid habituation by the flying-foxes, the BGT plans to use a range of random noises (such as whipper-snippers, chainsaws, starters' pistols, banging metallic objects, BirdFrite, man-made & computer generated noises played through loud speakers) and visual cues (such as people waving arms and flags) from mobile sources

(mostly people walking or driving around the Gardens). The disturbance levels will start at a relatively low level, using noises known to disturb them. The BGT is also considering applying for approval to use smoke as one of the evening/dawn dispersal methods. It would not be used for daytime disturbance, as it is believed that this method is likely to trigger the flying-foxes instinct to flee the site, which we do not want them to do during the day. The reactions of the flying-foxes will be monitored and the level and variety of disturbance will be adjusted as necessary to ensure that the flying-foxes do not become desensitised to the noise.

There will be no physical attempts to attract flying-foxes to preferred sites, as there is not enough known about why flying-foxes choose particular sites to roost in. Instead, the BGT will be attempting to train these intelligent animals not to roost in sites considered to be inappropriate by making it unpleasant for them to roost in those locations. Then when they do choose to roost in suitable sites, they will be 'rewarded' by being left in peace, and the BGT will also offer support to land managers wishing to improve the habitat quality of these chosen sites to ensure their long-term sustainability.

During the relocation, if any flying-foxes roost in a location considered suitable to host a camp of up to 30,000 animals, with the approval from the land managers, they will be left undisturbed and any flying-foxes that arrived in unsuitable locations will continue to be disturbed to encourage them to join up with the undisturbed flying-foxes. If any flying-foxes roost in a vegetation corridor that contains a site that is identified as a suitable potential roost site, attempts will be made to carefully nudge the animals along that corridor closer to the suitable site, without scattering them. This will be done using a similar technique to that used in Melbourne, when flying-foxes were pushed along the Yarra River towards the preferred Yarra Bend site using very low levels of disturbance at dawn when they are returning to camp in the area that they left the previous evening, as well as a little further away from the site they are being pushed towards. This will make the flying-foxes nervous about returning to the locations where they have been disturbed, and will encourage them to roost a little closer to the preferred site where there is no disturbance. Alternatively, if considered appropriate and the land manager is agreeable, the animals may be temporarily left in such a location in an attempt to get other scattered flying-foxes to join up with them before nudging them closer to the preferred site.

After the initial relocation, assuming that the flying-foxes leave the RBG, the BGT will require ongoing approval to prevent flying-foxes from returning to roost in the RBG by re-commencing disturbance as soon as any flying-foxes are detected in the RBG during the day. This would give them the flying-foxes the immediate message that this is not a good place to stay, especially if they are heavily pregnant or are carrying young, and so they would be very unlikely to stay more than one day. Any follow-up disturbance to occur between August and April will be the *minimum* amount needed to make the flying-foxes uncomfortable without causing them too much stress (pregnant flying-foxes may abort their young under stress, and pups can be separated from panicked mothers). A management plan will be developed to ensure that this ongoing maintenance program is continued with persistence and sensitivity to the behaviour and life cycle stage of the flying-foxes, with the general principle being to not let any flying-foxes start becoming comfortable roosting in the RBG. Although it is possible that such follow-up disturbance may not be required on an ongoing basis (as was the case following the Melbourne relocation), there is a need to be prepared to maintain the impression (for the flying-foxes) that the RBG is no longer a suitable roost site, in case the colony does attempt to re-form. Flying-foxes will continue to be welcome to feed at night in the RBG – disturbance will only target those attempting to use the RBG as a daytime roost site.

Frequency and timing of disturbance

The initial relocation is planned to commence in May 2009, and conclude by the end of July 2009 or when all flying-foxes in the Sydney metropolitan region are roosting in suitable locations – whichever comes first. This is to avoid the times when young are unable to fly (October – January), when females are lactating (October – April), when conception takes place (late April), and when females are heavily pregnant (August-September). At the completion of this initial disturbance program (including the follow-up disturbance at unsuitable sites), no more disturbance will take place outside of the RBG.

Initially, the flying-foxes will be disturbed in short bursts (no longer than 10 minutes duration) every hour from 9 am until the evening dispersal. The aim of this is to disturb the flying-foxes' sleep throughout the day in order to make the RBG less comfortable than other roost sites – it is not the intention of the BGT to cause them to leave the RBG during the day.

The daytime disturbances will be followed by an evening dispersal, which will take place at dusk, just before the flying-foxes normally leave the camp to feed. This will consist of a coordinated effort to drive them out of the RBG using higher levels of disturbance. Noise generation will start away from the camp on three sides and slowly move towards it, driving the flying-foxes from the RBG via their main exit routes used when leaving to feed (most usually exit south over the Domain, with the second largest stream usually heading

east over Woolloomooloo Bay). The flying-foxes from the RBG camp regularly exit the site earlier than would be expected in a more natural setting. Whereas the nearby Gordon colony predictably exits 20 minutes after sunset each night, the RBG colony usually begins flying out any time from 30 minutes before sunset to 20 minutes after sunset, depending on how large the camp is at the time (usually the larger the camp, the earlier the fly-out start time in relation to sunset). They have even been observed flying out around one hour before sunset when there is a noisy event on all day in the Domain (Wilson 2007, pers. obs.). Because of this variability, on the first evening, the flying-foxes will be pushed out either five minutes before sunset, or if they begin flying earlier, the noise will commence as they start to fly out. On evening two, they will be pushed out ten minutes before sunset (or earlier if they start flying earlier), and so on until they are forced to leave 1 hour before sunset. This will be maintained for each evening thereafter until, in combination with daytime disturbance, all the flying-foxes vacate the site.

If flying-foxes happen to disperse beyond the Garden's boundary and into other inappropriate[†] places within the Sydney metropolitan region, they will also be disturbed throughout the day (pending permission from the land manager) and dispersed in the evening, using the techniques described above, to prevent any preference or affinity for the site being developed. To prevent the flying-foxes from returning to particularly inappropriate sites (such as those that may pose an immediate health or welfare risk to flying-foxes or people) at dawn to roost, daytime disturbance and evening dispersal will be followed by dawn dispersal the following morning. Dawn dispersal will consist of staff being positioned prior to animals returning in the early morning and using noise and potentially smoke (if appropriate approvals are obtained) to prevent roosting and move the animals on to another location. Any dawn dispersal will be ceased by 30 minutes before sunrise to allow time for the flying-foxes to find another site to roost in without being forced to fly during daylight (flying-foxes fly at speeds of approximately 25-30 kilometres per hour).

The exception to methods described above for inappropriate places (not those that pose an immediate risk) is if the flying-foxes disperse into areas, such as suburban backyards, where it is considered unlikely that they will want to stay there, they will not be disturbed unless they persist for longer than a couple of days or if there are 50 or more animals present.

Dawn dispersal, as described above, may also be employed in the RBG if the daytime disturbance and evening dispersal techniques are proving ineffective after three weeks.

After the flying-foxes have left the RBG, a management plan and ongoing approvals from relevant authorities will be required to prevent the flying-foxes from returning to roost there. It is important that no flying-foxes are left to roost totally undisturbed in the RBG as that will be likely to cause them to start viewing the RBG as an attractive place to roost again, so that more flying-foxes would be likely to follow. The BGT wants to prevent the situation from ever escalating to the point of colony relocation again. This means that disturbance may have to occur during the breeding season. The basic methods described above for disturbance at inappropriate sites outside the RBG during the initial relocation program (i.e. daytime disturbance, followed by evening dispersal and dawn dispersal if necessary) would be used with slight variations depending on the time of year and the life cycle stage of the flying-foxes present. E.g. The management plan will include instructions for staff to use binoculars to check whether any flying-foxes that arrive are obviously pregnant ('bulging') or carrying young. If so, daytime disturbance is to be kept to very low levels with the aim of keeping the animals 'on edge', rather than causing them to flee their roost tree. Behaviours to watch for will be described in the plan to allow staff to find the right level of disturbance to make the flying-foxes uncomfortable, without causing them stress that may cause them to abort or be separated from their young.

Resources required

Due to the adaptive nature of the program, it is difficult to forecast the exact level of resources required. Therefore, the following resource inventory is indicative only and will be subject to change to meet changing circumstances.

[†] For the purpose of this proposal, an inappropriate site is defined as either: 1) one that is not accepted by nearby neighbours due to proximity within 50m of residences; 2) one that is not accepted by land owners/managers due to incompatible land use on or adjacent to the site; 3) one that contains other threatened species or EECs that will be adversely affected by the roosting flying-foxes; or 4) one that contains vegetation that will not survive permanent occupation by a flying-fox camp (e.g. the site should be large enough to allow the camp to occupy no more than one third of the available roost vegetation at any one time).

Table 11. Personnel required.

Daytime disturbance (RBG only)		
▪ Coordinator	1	
▪ Assistant coordinator	1	
▪ Disturbance personnel	4	
Dusk dispersal (RBG only)		
▪ Coordinator	1	
▪ Assistant coordinator	1	
▪ Dispersal personnel	6	
Off-site disturbance		
▪ Disturbance personnel	4 (More would be allocated on a needs basis)	To disturb animals that may be roosting at inappropriate Sydney sites outside the RBG
Monitoring		
▪ Fly-out counters	Approx. 40 volunteers	Volunteers & researchers located at each known Sydney campsite
▪ Colony mapper/counter	1	To map colony at RBG, and adjacent parks, if required
▪ Other research	3 external researchers + volunteers	Catching, banding, radio tracking, assessing body condition and stress levels, and monitoring flying-foxes

Table 12. Equipment. The following equipment will be needed during the relocation attempt. It will be important to have a range of equipment to draw on to avoid habituation.

Item	Number required	Approx. cost	Comments
Whipper snipper	4	Use existing stock	
Chainsaw (chain and bar removed)	2	Use existing stock	
Spades	10	Use existing stock	
Poly pipe (400mm long)	20	Use existing stock	
Sound systems (consisting of speaker, CD player, generator)	2	$3,000 (already purchased)	Doesn't include maintenance and running costs.
Gaitors	4	Use existing stock	
Utes	2	Use existing stock/hire	
Starters' pistols	10	$1000	

Caps	1000s	$200	
Walkie-talkies	10	Use existing stock	
BirdFrite	100 rounds	$300	
Shotgun	1	$500	
Flying-fox relocation research	6 months	$65,160	Includes researcher's income, all equipment, processing & travel costs

Evidence to support likely success and minimal harm

In 2003, the Royal Botanic Gardens in Melbourne successfully relocated around 30,000 grey-headed flying-foxes to a suitable alternative location at Yarra Bend, with no reports received of flying-foxes being harmed as a result of the relocation, despite the disturbance program beginning much earlier (when pups were still quite young and vulnerable, and conception had not yet taken place) than when the BGT is proposing to relocate the RBG colony. The BGT has received much advice from the project manager of that relocation with regards to what methods are most likely to be effective at performing a similar relocation at the Royal Botanic Gardens in Sydney. This advice, along with corresponding advice from biologists with expertise on flying-foxes in the Sydney region, has been incorporated into the BGT's relocation plan which has been prepared with the welfare of the flying-foxes as a top priority. The timing of the initial disturbance program has been specifically chosen to avoid the times of year when vulnerable flying-foxes such as dependent young, lactating females, and heavily pregnant females, are present, and also allows conception to take place (in April) undisturbed before disturbance begins (in May). This time also corresponds with the natural drop-off of numbers that is usually seen in Sydney colonies around late autumn - early winter, so the disturbance is likely to affect fewer animals than if it were to take place during the warmer months when the colony is much larger. The new colony at Yarra Bend, as well as a smaller camp at Geelong, are now well established, and support annual breeding of the flying-foxes that return each year to these locations, and have so far, not attempted to return to the Melbourne RBG in any substantial numbers. During the Melbourne relocation programme, only one dead flying-fox during was found during the disturbance period, and it was not believed to have died as a result of disturbance (S. Toop pers. comm.).

Follow-up disturbance may be required at the RBG during breeding season in order to prevent a colony from re-establishing. However, in this case, strict protocols (outlined in 'Step 7 - Assess and plan for animal welfare') will be in place to minimise any potential harm to breeding flying-foxes and their young.

Additionally, between 1992-1997, a noise disturbance program similar to that being proposed, took place in the Sydney RBG. This program was not as well planned or resourced as that being currently proposed. Nevertheless, it succeeded in greatly reducing the numbers of flying-foxes roosting in the RBG (see details in Step 2 – Frequency of Occupation). During this time, there were no known new camps established in the Sydney area, no known problems in nearby camps resulting from increased numbers of flying-foxes, and there were no reports received of any harm to flying-foxes as a result of the disturbance program (despite occurring throughout all seasons, including the birthing season). With better planning, consistency and ongoing commitment to improve on the BGT's previous temporary intermittent efforts 15 years ago, the BGT is likely to see equal, if not better, success than then.

Strategies for monitoring success

The BGT will engage expert flying-fox biologists to use a combination of radio-tracking and colour banding to monitor the movements of flying-foxes from the RBG immediately prior to, during and after the initial disturbance program for a total period of six months. This will answer the questions of where the flying-foxes go to roost when dispersed from the RBG, how they interact with other camps they may join, as well as how their foraging habits are affected by the move (e.g. do they have to travel further to feed at night after the relocation?).

Fly-out counts and ground observations will be used at the various Sydney camps (including the RBG) to determine whether there are any unusual fluctuations within these camps, what impacts (if any) any changes in numbers are having on each camp (e.g. damage to vegetation, conflict with neighbours, etc.), and how successful the program has been at removing the flying-foxes from the RBG.

Reproductive success of the Sydney population of flying-foxes (comprising several camps) will also be monitored for a few seasons following the relocation to compare with both the past Sydney results, as well as results from camps in other areas during the same seasons.

Criteria to assess success of relocation

Success will be determined by the reduction of pressure by roosting flying-foxes to the RBG's botanic collection to a level that will allow for increased life expectancy and partial to full recovery of the damaged (as a result of roosting flying-foxes) living specimens. For the relocation to be successful in the long-term, the RBG must be either free of roosting flying-foxes or maintain roosting flying-fox numbers at such low or infrequent levels that no more noticeable damage is caused to the RBG's botanic collections by roosting flying-foxes.

In addition, the relocation will only be considered successful if the relocated flying-foxes have all settled in a site (or sites) that will adequately cater to the flying-foxes' needs, and will not cause unresolvable conflict with people. A truly successful relocation will cause no harm (short-term or long-term) to flying-fox welfare or reproduction.

Strategies to manage the flying-foxes if relocation fails

If the relocation does not succeed in removing the flying-foxes from the RBG, the BGT will explore further alternative options for managing the colony. While this application is being assessed, some new deterrent measures are being trialled (under the BGT's current DECC Section 120 licence under the *National Parks and Wildlife Act 1974*) in an attempt to protect some of the high priority heritage listed trees from dying before the relocation can take place. If any of these prove to be effective, they may be expanded into other areas of the collection.

Physical exclusion (through netting or similar) may be considered only if an appropriate design is able to fit in with the RBG's Conservation Management Plan, and if funding is available. Adopting this strategy would result in the camp having to relocate.

Preliminary trials by the University of Melbourne are soon to be underway on the effectiveness of artificial roosts. If these prove to be successful, they may be explored as a way to provide temporary relief for the RBG's stressed trees, but the BGT imagines that artificial roosts would be unlikely to attract all flying-foxes away from the live trees.

Planting up extra roost trees within the RBG in an attempt to spread the roosting pressure to reduce the damage would require significant and extensive changes to the RBG's Conservation Management plan as well as to its heritage significance. In addition, the time required for the trees to mature would not address the immediate threat and there is also no evidence that flying-foxes will leave their existing roost trees unless discouraged from doing so with some of the methods proposed for the relocation.

The options for the Botanic Gardens Trust are very limited. If the relocation fails, the BGT would take advice from DECC and wildlife experts regarding other options. At this stage, relocation is considered the best option.

Step 7 Assess and plan for animal welfare

Consideration of flying-fox welfare

The steering committee established to oversee the planning and implementation of the relocation includes representatives of both the RSPCA (Royal Society for the Prevention of Cruelty to Animals) and the NSW Wildlife Council (representing licensed wildlife rescuers and carers of NSW), as well as being chaired by the Director of the University of Sydney's Wildlife Health and Conservation Centre. Extensive consultation has occurred with these committee members, as well as with other committee members with experience in flying-fox behaviour, biology and welfare. As a result of this consultation, the decision was made regarding the initial relocation to not only avoid the times of year when dependent young are unable to fly and females are heavily pregnant (as required by the DECC Flying-fox Camp Management Policy), but also to avoid the time of year when conception takes place in late April, so as to minimise any interruption to the breeding cycle. This timing also happens to correspond with the time that many flying-foxes usually leave the Sydney region. This means that the initial relocation will disturb a much lower number of flying-foxes than would be the case at other times of the year.

As mentioned earlier, disturbance during the breeding season may be necessary following the relocation to prevent the flying-foxes from returning to the RBG. The most likely forms of harm that could potentially be caused to flying-foxes through noise disturbance would be the abortion of foetuses, and the separation or dropping of young from panicked mothers. To minimise the chances of such harm occurring, a management

plan will be developed to give detailed instructions to involved staff on how to modify the intensity of the disturbance according to the life cycle stage of the flying-foxes present. Information on how to recognise heavily pregnant females, females with dependent young, as well as stress behaviours, will be included. At any time during the breeding season, but especially if dependent young or heavily pregnant females are present, the intensity (volume &/or frequency &/or duration) of the disturbance will be lowered to the minimum level required to make the flying-foxes uncomfortable (i.e. awake and alert), without causing them stress that could be harmful to them or their young. E.g. If the disturbance causes the flying-foxes to flee their roost tree or to make distress calls, then the intensity will be immediately lowered. If the flying-foxes remain asleep or grooming or mating during the disturbance, then the intensity may need to be slightly raised to wake and alert them. Additionally, by ensuring that any follow-up disturbance is conducted as soon as possible after flying-foxes are detected in the RBG, any flying-foxes that are able to carry young into the site, if dispersed quickly enough, will also be able to carry the young out of the site. If they are left undisturbed for too long, the young will grow too large for the mothers to carry and they would then have to be left until they are old enough to fly themselves. This would then allow time for more flying-foxes to arrive and settle undisturbed, potentially renewing the need for another colony relocation. Thus, minimal levels of disturbance during the breeding season (as described above) are appropriate, not only to prevent the re-establishment of the colony at the RBG, but also to minimise the chances of flying-fox pups being separated from their mothers. Staff involved in these activities will be trained in how to recognise the communication calls between mothers and young, so that they can listen for young that may inadvertently be separated from their mothers. If this happens, disturbance will cease until the calling pup is located, and should not recommence until the pup is either reunited with its mother (preferable) or is rescued by a licensed flying-fox rescuer. When it does recommence it must be at a much lower intensity to avoid the same happening again. Similarly, if any aborted foetuses are found within a few days after such disturbance, then the intensity levels should be immediately reviewed to determine if they should be lowered any further. This determination would consider whether the abortion is likely to be a coincidence rather than a direct result of disturbance, by examining the previous intensity levels, as well as how many foetuses were found in relation to how many flying-foxes were present.

The project manager for the relocation project is both a qualified zoologist and a licensed wildlife rescuer / carer who has been trained in the rescue and care of orphaned and adult flying-foxes, and has taken part in several rescues. The Trust does not expect that any flying-foxes will suffer injury or other forms of debilitation as a result of the relocation attempt, but as a precautionary measure, the BGT will negotiate with the NSW Wildlife Council to ensure that there will be other licensed wildlife carers (in addition to the project manager) on call to assist with rescue and rehabilitation of any flying-foxes that may be found injured or otherwise debilitated during the relocation process. The Trust has also been offered assistance in the form of aviary space at the University of Sydney's Wildlife Health & Conservation Centre, where rescued flying-foxes can have room to recover before release, in the unlikely event that existing flying-fox aviary spaces reach full capacity at the time of the relocation. In this regard, the timing of the relocation is suitable for flying-fox carers as well, because fewer flying-foxes are generally in care around May-July, when young flying-foxes are learning to look after themselves, and many leave the Sydney region looking for more abundant winter food sources.

Consideration of impact of relocation on flying-foxes

To ensure that the welfare of the flying-foxes is adequately monitored throughout the initial relocation process, independent, qualified and experienced researchers will be engaged to monitor the effects that disturbance has on health and welfare indicators such as foraging or roosting behaviour that could affect the health of the animals, e.g. roosting in unsuitable locations, or substantial increase in flying distance from roost site to foraging location (Step 8). The research is also likely to include some stress hormone testing to compare stress levels before, during and after the relocation. Reports on the progress of the research and results to date will be provided to the Trust at regular intervals.

In addition, reproductive success of the Sydney population of flying-foxes (comprising several camps) will be monitored for a few seasons following the relocation to compare with both the past Sydney results, as well as results from camps in other areas during the same seasons.

Step 8 Plan for contingencies

Flying-foxes do not leave the camp, regardless of disturbance

Based on past experiences, the BGT believes this to be an unlikely scenario. However, if a strategically planned combination of disturbance including noise, visual deterrents, and smoke fails to cause most of flying-foxes to leave the camp after four weeks, then disturbance will cease. The Trust will then seek advice from DECC and other wildlife experts regarding the best options for management from that point on (see Step 6: Strategies to manage the flying-foxes if relocation fails).

Flying-foxes only abandon the camp temporarily

Past experience shows that this is a very likely scenario. Once the flying-foxes have left the RBG, the Trust is prepared to maintain vigilance for any returning animals. On return of any number of flying-foxes, a plan will be in place to resume disturbance immediately in order to deter them from settling at this site again. This disturbance will be done using the same methods as those described in Step 6 for inappropriate sites outside the RBG, i.e. regular daytime disturbance, followed by evening dispersal, and follow-up dawn dispersal (if necessary). Approval to conduct this ongoing disturbance will be required into perpetuity to prevent any flying-foxes from re-establishing the RBG campsite.

RBG Melbourne has maintained an effective monitoring program over the last five years to ensure the Melbourne flying-foxes do not return to the Garden. The Garden has not allowed any flying-foxes to return and re-establish a camp.

Flying-foxes occupy sites other than those selected, and occupation of these new sites creates conflict

Although the BGT has selected a preferred site, it is entirely possible that the flying-foxes may relocate to other sites that may or may not have been considered in our initial analysis. This scenario has been planned for in Steps 5 and 6 of this proposal document.

If flying-foxes roost in sites that have already been identified as inappropriate (in Step 5), with the permission of the land owner/manager(s), they will be moved on using the methods described (in Step 6) for inappropriate locations outside the RBG.

If flying-foxes occupy sites that have been overlooked by this proposal, the site will be quickly assessed, in consultation with the land owner/manager, to determine whether it is an ‘inappropriate site’ as defined in this proposal. If it is, the flying-foxes will be moved on as above. Any disturbance outside the RBG will be restricted to the May-July period. If flying-foxes remain in inappropriate sites after this time, disturbance will cease and the BGT will consult with DECC & the land managers to determine the next appropriate course of action. If the site is assessed as being potentially suitable, but conflict still arises, the BGT will negotiate with the land owner/manager and neighbours to see if there is some way that their concerns can be resolved without having to move the flying-foxes on. If the matter is unresolvable, it will be referred to DECC for advice.

Disturbance adversely impacts on the welfare of the flying-foxes occupying the camp.

Although every effort is being made to ensure that the disturbance does not adversely impact the welfare of the flying-foxes, the BGT has put in place feedback mechanisms to ensure that the BGT becomes quickly aware of any unforseen adverse impacts, and the BGT has a contingency plan in place to deal with such a situation. Adverse impact will be defined as a noticeable reduction in the health of one or more flying-foxes that can reasonably be attributed primarily to the relocation activities. Flying-foxes that may appear distressed at the disturbance, but are still capable of flying or are behaving in a way that is unlikely to result in any obvious adverse physical impacts, are not included in this definition.

The Trust intends to support research by independent experts on the health and welfare of the flying-foxes being disturbed throughout the relocation. Part of our agreement with the researchers will state that any adverse effects must be reported to the project manager as soon as they are detected. Any staff or volunteers involved in the on-ground component of the project, as well as local wildlife rescue groups, will also be asked to do the same if they notice anything of concern regarding flying-fox welfare that may be related to the disturbance.

The project manager will then consult with scientific and technical advisers of the steering committee to determine whether there is a way to reduce or eliminate this impact (however minor) within the scope of the project. If the impact is unable to be reduced to an acceptable level (as determined with advice from the researchers and in consultation with DECC), then the disturbance will be ceased, and alternative options as outlined in Step 6 will be considered.

In the unlikely event that adverse impacts result in an increase in the usual number of flying-foxes requiring rescue and rehabilitation, the Trust has received an offer from Sydney University's veterinary department of additional aviary space and vaccinated staff to help care for any 'overflow' of animals resulting from the relocation effort that the usual pool of licensed wildlife carers are unable to cope with. If there is an increase detected, then the BGT would consult with Wildlife Council to ask how the BGT can best support flying-fox carers with this extra load.

Step 9 Design and establish monitoring and feedback mechanisms

Monitoring disturbance techniques

All staff and volunteers involved in the disturbance activities will be required to keep a log of every disturbance, including location, date, time, duration, equipment used, frequency (if applicable), method, names of the people involved, and their roles.

The BGT will negotiate with volunteers regarding the monitoring process and how they can be supported. Additionally, researchers will be engaged by the BGT to co-ordinate monitoring, so the BGT would not be relying solely on volunteers.

Monitoring the number of flying-foxes at the camp when disturbance activities commence

Fly-out counts of the flying-foxes from the RBG are currently being undertaken once or twice a month by trained volunteers. In the months leading up to the relocation, this will increase to weekly counts. Once the relocation starts in May, daily counts will take place at the RBG as well as each location where the flying-foxes from the RBG are known to have gone. Once disturbance stops, the counts in locations where flying-foxes remain will continue nightly for as long as considered necessary in consultation with the landholder, and then will gradually be reduced in frequency.

On any day that post-relocation disturbance occurs at the RBG, a static count will be undertaken before the dusk dispersal.

In the event of any dawn dispersals being carried out, an estimate of flying-fox numbers being dispersed will also be recorded.

Monitoring the response of flying-foxes to the disturbance

As mentioned above, the number of flying-foxes remaining in the RBG will be closely monitored by fly-out counts. In addition to this, independent researchers and trained volunteers will monitor the daytime locations and behaviour of the flying-foxes in the RBG throughout the disturbance. The health and welfare of the animals will be monitored by researchers throughout the program as described in Step 7: Consideration of impact of relocation on flying-foxes.

The Trust intends to liaise closely with local wildlife care groups to ensure that the BGT receives rapid feedback on any significant increase on numbers of flying-foxes coming into care during and immediately after the relocation, and what situations they are found in (e.g. injured on powerlines, malnourished, orphaned young, etc.). For a total of six months, the researchers engaged by the BGT would be monitoring the behaviour and physical appearance of the bats that are the target of disturbance in order to detect any adverse impacts that could potentially occur. This information will be used to adapt or cease the program as necessary, or to report to DECC if disturbance has already ceased.

Monitoring the number of flying-foxes that relocate to suitable alternative campsite(s)

The Trust will support independent research involving colour-banding several hundred flying-foxes to identify that they have been banded at the RBG site. This would need to be started just before the disturbance, and could be continued throughout the disturbance. This would allow at least a proportion of the flying-foxes to

be recognised as coming from the RBG if they turn up in other locations. This research will also involve radio-tracking a small number of flying-foxes to determine accurately where they relocate.

Although there is no definitive way to identify where un-marked, un-collared flying-foxes come from, the regular fly-out counts, both at the RBG and other nearby camps will help to determine whether there are decreases in the RBG numbers that correspond with influxes in the other camps, which would suggest that the fluctuations could be a result of the disturbance at the RBG.

Monitoring the number of flying-foxes that relocate to unsuitable site(s) and how long they remain

The Trust will aim to communicate to as many people within the Sydney metropolitan region as possible (including key stakeholders such as local councils and wildlife care groups), that the BGT wants to know where the flying-foxes have relocated. A 24-hour info/help line will be established for people to inform the Trust if flying-foxes start to roost in sites other than those with established camps. In each case, the BGT will attempt to ascertain details of the site (e.g. roost tree species, land use, etc.) and its location, how many animals are there, what species they are, and how long they remain. Records will be kept of all such sightings, and those reporting them will be contacted to discuss the appropriate next steps. For example, if the site is considered unsuitable and the flying-foxes are either still there after 2 days or if there are 50 or more present, then the Trust will agree to attend the site to move them on (provided it is within the period BGT is licensed to conduct such disturbance). If the site is considered potentially suitable, a site visit may be required to confirm, and if confirmed, negotiations with the landholder and consultation with neighbours will take place.

Monitoring follow-up disturbance at sites other than the RBG

Disturbance at other sites is dealt with in this proposal and associated S91 licence application and Commonwealth referral. Methods are described in Step 6 and monitoring will take place as described at the beginning of this step.

Monitoring the function of the new site(s)

Any new campsites allowed to establish within the Sydney metropolitan region and any existing camps that are recognised as receiving a substantial number of additional flying-foxes as a result of the relocation would be examined to determine whether the new site(s) provide the same (or better) access to food resources. The Trust will support the managers of these camps to ensure that they are monitored during the 2009 breeding season in order to detect any changes in reproductive output from what was previously known at that site (if it was an existing camp), the RBG site, and other sites around Sydney. These results would also be compared to camps outside of Sydney during the same season to determine whether there are any significant differences. This would be repeated for a total of three years, or for as long as required by DECC and/or DEWHA.

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Appendix 1. Identified tree species of the RBG that flying-foxes have roosted in between 1999 and 2007.

Key

R – trees for which there are 90 or more records of roosting flying-foxes between 1999 and 2007.

^ - trees in the RBG that are recorded as containing 100 or more flying-foxes on average between 1999 and 2007:

SPECIES	**COMMON NAME**
Acacia elata	Mountain Cedar Wattle; Cedar Wattle
Afrocarpus falcatus	Outeniqua Yellow-wood
Agathis atropurpurea	Blue Kauri
Agathis lanceolata (prev. *A. ovata)**	Kaori de Montagne
Agathis laurifolia	Laurel-leaved Kauri Pine
*Agathis macrophylla***^**	Large-leaved Kauri Pine
*Agathis moorei** **^**	Moore's Kauri Pine
Agathis robusta	Queensland Kauri Pine
Agathis sp.	Kauri Pine
Ailanthus triphysa	White Bean; White Siris
Aleurites moluccana var. rockinghamensis **R**	Candle Nut
Alloxylon flammeum	Tree Waratah; Red Silky Oak
Alphotonia excelsa	Red Ash
*Araucaria birimulata**	Birimule Araucaria
Araucaria columnaris	New Caledonian Pine
Araucaria cunninghammii	Hoop Pine
Araucaria rulei	Rule araucaria
*Archontophoenix cunninghamiana**	Bangalow Palm
Arytera distylis	Twin-leaved Coogera
Arytera divaricata	Coogera; Rose Tamarind
Backhousea citriodora	Lemon Ironwood; Sweet Verbena Tree
Backhousea myrtifolia	Grey Myrtle; Ironwood
Backhousea sciadophora	Shatterwood
Backhousia citriodora	Lemon Ironwood; Sweet Verbena Tree
Bauhinia X blakeana	Hong Kong Orchid Tree
Beilschmiedia elliptica	Grey Walnut
Bischofia javanica	Javanese Bishopwood
Brachychiton acerifolius	Flame Tree; Illawarra Flame Tree
Brachychiton discolor	Lace Tree; Scrub Bottle Tree; Lacebark Tree
Callitris collumelaris	Port Jackson Pine
Casimiroa edulis	White Sapote

Castanospermum australe	Black Bean; Moreton Bay Chestnut
Casuarina cunninghamiana	River Oak; River Sheoak
Casuarina glauca	Swamp oak
*Cedrela Mexicana**	Mexican Cedar
Chamaecyparis funebris	Chinese Mourning Cypress
Chorisia speciosa **R^**	Floss Silk Tree
Chrysophyllum cainito	Star Apple
*Cinnamomum camphora**	Camphor Laurel
Cinnamomum verum	Cinnamon
Citharexylum montividense	Blanco Grande; Fiddlewood; Taruman
Corymbia maculata	Spotted Gum
Cryptocarya obovata	Pepperberry
Cupressus glabra	Smooth Arizona Cypress
Davidsonia pruriens	Davidson's Plum
Diospyros fasciculosa	Grey Ebony; Clustered Persimmon; Long Tom
Dracena derenensis	-
Drypetes australasica	Yellow Tulipwood
Dysoxylum mollisimum	Red Bean
Elaeocarpus kirtonii	Silver Quandong; White Quandong; Brown hearted Quandong
Endiandra discolor	Rose Walnut; Domatia Tree
Erythrina speciosa	Coral Tree; Mulungu
Eucalyptus microcorys	Tallowwood
Eucalyptus pilularis X globoidea	Blackbutt x White Stringybark
Ficus laurifolia **R**	Fig
Ficus macrophylla	Moreton Bay Fig
Ficus nymphaefolia	Fig
*Ficus virens^*	White Fig
Flindersia schottiana **R**	Cudgerie; Bumpy Ash; Southern Silver Ash
Flindersia xanthoxyla ^	Yellow-wood; Long Jack
Fraxinus ornus	Flowering Ash; Manna Ash
Fraxinus uhdei	Shamel Ash
Funtumia africana **R**	Rubber Tree; False Rubber Tree
Geissois benthamii	Red Carabeen
Ginkgo biloba cv. Fastigiata **R**	Maiden Hair Tree
Harpephyllum caffrum	Kaffir Plum; Wild Plum
Harpullia pendula	Tulipwood
Heritiera actinophylla	Black Booyong; Black Jack
Heritiera trifoliolata	White Booyong; Crowsfoot Elm

Hernandia cordigera	-
*Hovenia dulcis**	Japanese Raisin Tree
Jacaranda mimosifolia	Jacaranda
Jubea chilliensis	Chilean Wine Palm; Coquito Palm
*Juglans hindsii**	Hinds Black Walnut
Keteleeria fortunei **R^**	Keteleeria
Koelreuteria formosana	Chinese Rain Tree
Lagerstroemia sp	Crepe-Myrtle
Lagunaria patersonia	Norfolk Island Hibiscus
Liquidambar formosana	Formosan Gum
Liquidambar styraciflua	Liquidambar; Sweet Gum
Liriodendron tulipifera	Variegated Tulip Tree
Lophostemon confertus	Brush Box
Macadamia tetraphylla	Rough-shelled Queensland Nut
Maclura pomifera	Osage Orange; Bow-wood
Magnolia grandiflora	Bull Bay
*Mallotus discolour**	White Kamala; Yellow Kamala
Melaleuca quinquenervia	Broad-leaved Paperbark
Melaleuca styphelioides	Prickly-leaved Tea Tree
Melicope octandra	Doughwood
Metasequoia glyptostroboides	Dawn Redwood
*Nothofagus moorei**	Antarctic Beech
Pachira aquatica	Guiana Chestnut
Palms (various including *Archontophoenix* spp. & *Phoenix* spp.)	Palms
Phoebe nanmu	-
Phoenix canariensis	Canary Island Date Palm
Phoenix reclinata	African Wild Date Palm
Phytolacca dioica	Bella Sombra; Umbu; Packalacca
Picconia excelsa	-
Planchonella australis **R**	Black Apple
*Planchonella myrsinoides**	Blunt-leaved Coondoo; ;Yellow Plumwood; Axe-handle Wood
Platanus X hispanica	London Plane
Podocarpus elatus **R^**	Plum Pine; Brown Pine
Podocarpus totara	Totara
*Polyscias elegans**	Celery Wood; Silver Basswood; Black Pencil Cedar
*Pouteria lucuma**	Lucumo
Pouteria wakere	-
Pseudobombax grandiflora	-

*Pyrus calleryana**	Callery Pear
Quercus ilex	Holm Oak; Holly Oak
*Quercus macrocarpa**	Bur Oak
Sapium sebiferum	Chinese Tallow Tree
*Schefflera elegantissima**	False Aralia
Schizolobium	Bacurubu
*Serianthes sachetae**	-
Sloanea australis	Maiden's Blush; Blush Alder; Blush Carrabeen
Stenocarpus sinuatus	Firewheel Tree; Fire Tree
Syzygium francissii **R^**	Giant Water Gum
Syzygium panniculatum	Brush Cherry; Daguba (Cadigal)
Tilia X Europaea	Common Lime or Linden
Toona ciliata	Red Cedar
Tristaniopsis laurina	Water Gum; Kanooka; Kanuka
Vitex lucens	Puriri
Washingtonia robusta	Mexican Washingtonia
Waterhousea floribunda **R^**	Weeping Lilly Pilly; Weeping Myrtle

*All trees of these species that were recorded as flying-fox roost trees have now died mostly from damage caused by the flying-foxes and been removed from the Gardens.

Appendix 2. Methods trialled in the past to deter flying-foxes from roosting in areas of the RBG.

When used	What used	Effect
Commenced 7 September 1992	Plastic bags hung in trees	Little effect; slightly more effective in windy weather
Commenced 7 September 1992	Blocks of dichlorobenzene (toilet crystals) in Perspex containers hung in trees	No marked effect
16 September 1992, 3.00am-6.00am	Shu Roo (ultrasonic deterrent)	No marked effect
16 September 1992, 3.00am-6.00am	Strobe lights	No marked effect
16 September 1992, 3.00am-6.00am	Synthesized sound	No marked effect
September 1992	Flying-fox distress calls played from tape player	No response from flying-foxes
September 1992, early morning and late afternoon	Beating a metal rubbish bin with a piece of wood	Disturbed flying-foxes; Specific detail not provided
September 1992, early morning and late afternoon	Street sweeper noise	Disturbed flying-foxes
September 1992, early morning and late afternoon	Chainsaw noise	Disturbed flying-foxes
16-18, 21-25 September 1992, morning (between 7.30 & 10.00am) & afternoon (between 3.45 & 4.30pm)	Deep percussion sounds (including metal can being hit with piece of wood – ~105 dB; ringing large school bell)	Flying-foxes immediately disturbed and left targeted area (Palm Grove) to roost in other trees in the RBG. After around one week of disturbance, flying-fox numbers halved and those remaining showed reluctance to return to Palm Grove. Numbers declined rapidly over the following few days and by 30 September all roosting flying-foxes had left the RBG.
5 March – 4 April 2001, early morning	Phoenix Wailer (sonic deterrent)	Initial response with reduced numbers of flying-foxes in target trees, and some hiding in 'sound shadows. After a while, flying-foxes seem to become habituated and drift back into targeted trees.
2001	Fermented prawn paste applied directly to male roosting branches	No effect – males returned to same branches
2001	Chili paste applied directly to male roosting branches	No effect – males returned to same branches
28 March 2001	Fermented prawn paste handsprayed onto flying-foxes	Flying-foxes immediately flew away to another tree, and began intensive grooming.

27 March – 5 April 2001	Python excrement in flyscreen mesh hung in trees	Flying-foxes moved slightly away from the python excrement, but did not leave the roost tree
1992 and June 2008	Sprinkler systems in trees	Noise of sprinkler head frightens flying-foxes out of target tree within seconds, but flying-foxes may return when system is turned off, or when Iit remains on for long periods. Trees may be damaged more as flying-foxes flee the sprinklers.
June 2008, pre-dawn as flying-foxes return	High-powered spotlight shone at tree canopy	No effect – flying-foxes still land in tree as normal – some even seemed to roost close to light for warmth. Rotating the light also had no effect.
July 2008 - present	Inflatable ‘event man’	Some apparent localised effect on target and adjacent trees – not yet confirmed. More effective the closer the man is to the canopy of the target tree. Some bats hide behind other trees

Appendix 3. Native wildlife that have been recorded or could potentially occur in the RBG (table adapted from Lesryk 2003).

Key

1 – indicates species listed under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.* Codes as follows: Vulnerable Species (V); Endangered Species (En); Migratory Species/Family (M).
2 – indicates species listed under the NSW *Threatened Species Conservation Act 1995.* Codes as follows: Vulnerable Species (V); Endangered Species (En).
$ - Indicates species of regional conservation significance (as at 2002)
* - exotic, naturalised or non-indigenous species.
(Es) – Cage escapee?

Source of records:

Species recorded in the RBG between 2002 and 2008
3. Pattison (unpublished) & V. Wilson pers. comm. 10/9/08.
Species considered to constitute resident populations in 2002/03.
4. Species recorded during four one-day vertebrate fauna surveys by Lesryk during May 2002 and January 2003.
5. Royal Botanic Gardens (1990) & A. Leishman pers. comm. 15/6/02.
Species recorded in the RBG between 1991 and 1998.
6. Royal Botanic Gardens (1998).
Species introduced to the Gardens between 1861 and 1867.
7. Leishman (1997).
Species that have been recorded in the region and could potentially occur.
8. NPWS (2002).

1	2	**Taxa**	**Common Name**	**Scientific Name**	3	4	5	6	7	8
		MAMMALS								
		Pseudocheiridae								
			$ Common Ringtail Possum	*Pseudochierus peregrinus*	x		x			
		Acrobatidae								
			$ Feathertail Glider	*Acrobates pygmaeus*						x
		Phalangeridae								
			Common Brushtail Possum	*Trichosurus vulpecula*	x	x				x
		Pteropodidae								

V	V		Grey-headed Flying-fox	*Pteropus poliocephalus*	x	x				x
			Black Flying-fox	*Pteropus alecto*	x					
		Vespertilioidae								
			Gould's Wattled Bat	*Chalinobus gouldii*		x	x			
	V		Large-footed Myotis	*Myotis adversus*		x				
		Muridae								
			Water-rat	*Hydromys chrysogaster*	x					x
			* Black Rat	*Rattus rattus*	x	x				x
		BIRDS								
		Phasianidae								
			* Common Pheasant	*Phasianus colchicus*					x	
			* California Quail	*Callipelpa californica*					x	
			King Quail	*Coturnix chinensis*					x	
			Stubble Quail	*Coturnix pectoralis*				x		
		Turnicidae								
			Painted Button-quail	*Turnix varia*			x			
		Pelicanidae								
			Australian Pelican	*Pelecanus conspicillatus*	x		x	x		
		Sulidae								
			Australasian Gannet	*Morus serrator*						x
		Anhingidae								
			Darter	*Anhinga melanogaster*	x			x		

		Phalacrocoracidae								
			Pied Cormorant	*Phalacrocorax varius*						x
			Little Pied Cormorant	*Phalacrocorax melanoleucos*	x		x	x		x
			Great Cormorant	*Phalacrocorax carbo*	x	x		x		x
			Little Black Cormorant	*Phalacrocorax sulcirostris*	x		x	x		x
		Podicipedidae								
			Hoary-headed Grebe	*Poliocephalus poliocephalus*						x
			Australasian Grebe	*Tachybaptus novaehollandiae*	x			x		
		Spheniscidae								
			Little Penguin	*Eudyptula minor*				x		x
M		Anatidae								
			Black Swan	*Cygnus atratus*				x		
			Pacific Black Duck	*Anas superciliosa*	x	x	x	x		
			Grey Teal	*Anas gracilis*		x		x		
			Chestnut Teal	*Anas castanea*	x			x		
			Australasian Shovelor	*Anas rhynchotis*				x		
			Hardhead	*Aythya australis*	x			x		
			Australian Wood Duck	*Chenonetta jubata*	x	x		x		
			Wandering Whistling Duck	*Dendrocygna arcuata*			x	x		
			* Mallard	*Anas platyrhynchos*	x		x	x		
		Rallidae								

			Buff-banded Rail	*Gallirallus phillippensis*	x	x	x	x		
			Dusky Moorhen	*Gallinula tenebrosa*	x	x	x	x	x	
			Purple Swamphen	*Porphyrio porphyrio*			x			
			Eurasian Coot	*Fulica atra*	x	x		x		
		Ardeidae								
			White-faced Heron	*Egretta novaehollandiae*	x		x	x		x
M			Great Egret	*Ardea alba*	x			x		x
M			Cattle Egret	*Ardea ibis*				x		
			Intermediate Egret	*Ardea intermedia*				x		
M			Eastern Reef Egret	*Egretta sacra*						x
			Nankeen Night Heron	*Nycticorax caledonicus*			x			
		Threskiornidae								
			Australian White Ibis	*Threskiornis molluca*	x	x	x	x		x
			Royal Spoonbill	*Platalea regia*	x			x		
M		Charadriidae								
			Masked Lapwing	*Vanellus miles*	x			x		x
		Laridae								
			Silver Gull	*Larus novaehollandiae*	x	x	x	x		x
			Kelp Gull	*Larus dominicanus*						x
M			Caspian Tern	*Sterna caspia*						x
M			Common Tern	*Sterna hirundo*				x		x
			Crested Tern	*Sterna bergii*			x	x		x
	V		Grey Ternlet	*Procelsterna albivitta*						x
		Accipitridae								

			White-bellied Sea Eagle	*Haliaeetus leucogaster*	x			x		x
V	E		Red Goshawk	*Erythrotriorchis radiatus*						x
			Whistling Kite	*Haliastur sphenurus*				x		
			Little Eagle	*Hieraaetus morphnoides*				x		
		Falconidae								
			Brown Falcon	*Falco berigora*				x		
			Peregrine Falcon	*Falco peregrinus*	x			x		x
			Australian Hobby	*Falco longipennis*						x
			Nankeen Kestrel	*Falco cenchroides*				x		x
		Columbidae								
	V		Superb Fruit Dove	*Ptilinopus superbus*				x		x
			White-headed Pigeon	*Columba leucomela*				x		x
			* Rock Dove	*Columba livia*	x	x	x	x	x	x
			* Spotted Turtle-dove	*Streptopelia chinensis*	x		x	x	x	x
			$ Bar-shouldered Dove	*Geopelia humeralis*						x
			Common Bronzewing	*Phaps chalcoptera*				x		
			Crested Pigeon	*Ocyphaps lophotes*	x		x	x		x
			Topknot Pigeon	*Lopholaimus antarcticus*	x		x	x		
		Cacatuidae								

			Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	x			x		x
			Galah	*Eolophus roseicapilla*	x		x	x		x
			Long-billed Corella	*Cacatua tenuirostris*			x			
			Little Corella	*Cacatua sanguinea*						x
			Sulphur-crested Cockatoo	*Cacatua galerita*	x	x	x	x		x
		Psittacidae								
			Rainbow Lorikeet	*Trichoglossus haematodus*	x	x	x	x	x	x
			Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*						x
			Australian King Parrot	*Alisterus scapularis*			x			x
V	V		Superb Parrot (Es)	*Polytelis swainsonii*				x		
			Cockatiel (Es)	*Nymphicus hollandicus*				x		
			Budgerigar (Es)	*Melopsittacus undulatus*				x		
			Crimson Rosella	*Platycercus elegans*	x		x	x		x
			Eastern Rosella	*Platycercus adscitus*	x			x		x
			Australian Ringneck (Es)	*Barnardius zonarius*				x		
			Red-rumped Parrot	*Psephotus haematonotus*						x
		Cuculidae								

			Horsfield's Bronze-cuckoo	*Chalcites basalis*						x
			Shining Bronze-cuckoo	*Chalcites lucidus*				x		x
			Pacific Koel	*Eudynamys orientalis*	x		x	x		x
			Channel-billed Cuckoo	*Scythrops novaehollandiae*	x		x	x		x
		Strigidae								
	V		Powerful Owl	*Rhabdoglaux strenua*	x		x			x
			Southern Boobook	*Ninox boobook*	x		x	x		x
	V		Barking Owl	*Ninox connivens*						x
		Tytonidae								
			Barn Owl	*Tyto alba*				x		
		Podargidae								
			Tawny Frogmouth	*Podargus strigoides*	x	x	x	x		x
		Alcedinidae								
			Azure Kingfisher	*Alcedo azurea*						x
			Laughing Kookaburra	*Dacelo novaeguineae*	x		x	x		x
			Sacred Kingfisher	*Todiramphus sanctus*	x		x			
		Coraciidae								
			Dollarbird	*Eurystomus orientalis*				x		x
		Maluridae								
			Superb Fairy-Wren	*Malurus cyaneus*	x	x	x	x		x
		Pardalotidae								
			Spotted Pardalote	*Pardalotus punctatus*			x	x		x
		Acanthizidae								
			White-browed Scrubwren	*Sericornis frontalis*	x		x	x		x

			$ Chestnut-rumped Heathwren	*Calamanthus pyrrhopygius*						x
			Brown Gerygone	*Gerygone mouki*			x	x		x
			Brown Thornbill	*Acanthiza pusilla*						x
		Meliphagidae								
			Red Wattlebird	*Anthochaera carunculata*						x
			Little Wattlebird	*Anthochaera chrysoptera*				x		
E, M			Regent Honeyeater	*Xanthomyza phrygia*						x
			Noisy Miner	*Manorina melanocephala*	x	x	x	x		x
			Yellow-faced Honeyeater	*Lichenostomus chrysops*				x		
			White-plumed Honeyeater	*Lichenostomus penicillatus*	x	x	x	x		x
			White-naped Honeyeater	*Melithreptus lunatus*						x
			New Holland Honeyeater	*Phylidonyris novaehollandiae*			x	x		x
			Eastern Spinebill	*Acanthorhynchus tenuirostris*				x		x
			Scarlet Honeyeater	*Myzomela sanguinolenta*						x
		Eupetidae								
			Eastern Whipbird	*Psophodes olivaceus*						x
		Petroicidae								
			Rose Robin	*Petroica rosea*				x		
			Eastern Yellow Robin	*Eopsaltria australis*						x
		Pachycephalidae								
			Golden Whistler	*Pachycephala pectoralis*			x	x		
			Rufous Whistler	*Pachycephala rufiventris*	x			x		

M		Dicruridae								
			Grey Fantail	*Rhipidura albiscapa*	x		x	x		x
			Rufous Fantail	*Rhipidura rufifrons*			x	x		x
			Willie Wagtail	*Rhipidura leucophrys*	x		x	x		x
			Magpie Lark	*Grallina cyanoleuca*		x	x	x		x
			Spangled Drongo	*Dicrurus bracteatus*	x			x		x
		Oriolidae								
			Olive-backed Oriole	*Oriolus sagittatus*				x		x
			Australasian Figbird	*Sphecotheres vieilloti*	x		x	x		x
		Campephagidae								
			Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	x		x	x		x
		Artamidae								
			Dusky Woodswallow	*Artamus cyanopterus*						x
			Grey Butcherbird	*Cracticus torquatus*				x		x
			Australian Magpie	*Gymnorhina tibicen*	x	x	x	x		x
			Pied Currawong	*Strepera graculina*	x	x	x	x		x
		Corvidae								
			Australian Raven	*Corvus coronoides*	x	x	x	x		x
		Hirundinidae								
			Welcome Swallow	*Hirundo neoxena*	x	x	x	x		x
			Tree Martin	*Petrochelidon nigricans*	x		x	x		
		Motacillidae								
			Australian Pipit	*Anthus australis*						x
		Alaudidae								
			*Eurasian Skylark	*Alauda arvensis*					x	
M		Sylviidae								

			Australian Reed-warbler	*Acrocephalus australis*				x		
		Passeridae								
			* House Sparrow	*Passer domesticus*			x		x	x
		Fringillidae								
			* European Greenfinch	*Carduelis chloris*					x	
			* European Goldfinch	*Carduelis carduelis*					x	
		Estrildidae								
			Red-browed Finch	*Neochmia temporalis*						x
		Dicaeidae								
			Mistletoebird	*Dicaeum hirundinaceum*						x
		Zosteropidae								
			Silvereye	*Zosterops lateralis*		x	x	x		x
		Pycnonotidae								
			* Red-whiskered Bulbul	*Pycnonotus jocosus*		x	x	x	x	x
		Muscicapidae								
			Bassian Thrush	*Zoothera lunulata*			x	x		
			* Eurasian Blackbird	*Turdus merula*	x	x	x	x	x	
			* Song Thrush	*Turdus philomelos*					x	
		Sturnidae								
			* Common Starling	*Sturnus vulgaris*			x	x	x	x
			* Common Myna	*Acridotheres tristis*	x	x	x	x	x	x
		REPTILES								
		Gekkonidae								
			Wood Gecko	*Diplodactylus vittatus*						x
			$ Leseur's Velvet Gecko	*Oedura lesueurii*						x
			$ Thick-tailed Gecko	*Underwoodisaurus milii*						x
		Pygopodidae								
			$ Burton's Snake-lizard	*Lialis burtonis*						x

			$ Common Scaly-foot	*Pygopus lepidopodus*						x
			Hooded Scaly-foot	*Pygopus nigriceps*						x
		Agamidae								
			Eastern Water Dragon	*Physignathus lesueurii*	x		x		x	
		Varanidae								
			$ Lace Monitor	*Varanus varius*						x
		Scincidae								
			Robust Ctenotus	*Ctenotus robustus*						x
			Copper-tailed Skink	*Ctenotus taeniolatus*						x
			Dark-flecked Garden Sunskink	*Lampropholis delicata*		x				x
			Pale-flecked Garden Sunskink	*Lampropholis guichenoti*						x
			Eastern Blue-tongue	*Tiliqua scincoides*	x					x
			Shingle-back	*Tiliqua rugosa*						x
			Three-toed Skink	*Saiphos equalis*						x
		Typhlopidae								
			$ Proximus Blind Snake	*Ramphotyphlops proximus*						x
		Elapidae								
			$ Red-naped Snake	*Furina diadema*						x
			$ Black-naped Snake	*Neelaps bimaculatus*						x
			Bandy-bandy	*Vermicella annulata*						x
			Saw-shelled Turtle	*Elseya latisternum*	x					
		AMPHIBIANS								
		Myobatrachidae								
			Brown-striped Frog	*Limnodynastes peronii*	x					x
			Peron’s Tree Frog	*Litoria peronii*	x					
			Eastern Dwarf Tree Frog	*Litoria fallax*	x					

		ARACHNIDS								
			Golden Orb-weaving Spider	*Nephila plumipes*	x					
			Dewdrop Spider	*Aygyrodes sp.*	x					
			Leaf-curling Spider	*Phonognatha sp.*	x					
			Saint Andrew's Cross	*Argiope keyserlingi*	x					
		FISH								
			Longfin Eel	*Anguilla reinhardtii*	x					
			Crimsonspotted Rainbowfish	*Melanotaenia duboulayi*	x					
		Family: Mulglidae	Mullet		x					
			European Carp	*Cyprinus carpio*	x					
V			Silver Perch	*Bidyanus bidyanus*	x					
			Goldfish	*Carassius auratus*	x					
		CRUSTACEANS								
			Yabby	*Cherax destructor*	x					
		INSECTS								
			Common Pearl White	*Elodina angulipennis*	x					
			Caper White	*Belenois java*	x					
			Cabbage White	*Pieris rapae*	x					
			Blue Triangle	*Graphium sarpedon*	x					
			Large Citrus Butterfly	*Papilio aegeus*	x					
M			Monarch	*Danaus plexippus*	x					
			Meadow Argus	*Junonia villida*	x					
			Common Brown	*Heteronympha merope*	x					
			Australian Painted Lady	*Vanessa kershawi*	x					
			Common Crow	*Euploea core*	x					
			Orange Palm-dart	*Cephrenes augiades*	x					
			Small Green-banded Blue	*Psychonotis caelius*	x					
		Family: Calliphoridae	Blowflies		x					

		Family: Syrphidae	Hover Fly		x					
			Green Lacewing	*Mallada signata*	x					
			Honey Bee	*Apis mellifera*	x					
			Bluebanded Bees	*Amegilla sp.*	x					
			Trigona carbonaria	*Trigona carbonaria*	x					
		Family: *Agaonidae*	Fig Wasps		x					
			Moreton Bay Fig Psyllid	*Mycopsylla fici*	x					
			parasitic wasp of Moreton Bay Fig Psyllid	*Psyllaephagus sp.*	x					
		Suborder: *Anisoptera*	Dragonflies		x					
		Suborder: Zygoptera	Damselflies		x					
			Cotton Harlequin Bug	*Tectocoris diophthalmus*	x					

Appendix 4. Flying-fox feedback forms used by RBG staff and volunteers to record relevant community feedback.

Flying-Fox Feedback Form

Please record a summary of any verbal feedback (suggestions, comments, etc.) received regarding flying-foxes in general, the RBG camp, the relocation, or other related issues.

Please forward to Vanessa Wilson, Project Officer - Wildlife Management, RBG Sydney

Date: _____ Comment received by: _____

Comment made by (name): _____

Interest (e.g. regular visitor, tourist, volunteer, researcher, etc.):_____

_____

Comments: _____

_____

_____

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Appendix 5. Tally sheet to record RBG visitors' attitudes towards wildlife.

Date:_____

animals	**positive**	**neutral**	**negative**
flying foxes			
possums			
introduced rats			
other native mammals (e.g. microbats, water rats)			
other non-native mammals (e.g. feral cats, foxes)			
ibises			
other waterbirds (e.g. ducks, moorhens)			
cockatoos			
other native birds (e.g. magpie, noisy miner)			
other non-native birds (e.g. indian mynah, pigeon)			
lizards			
other reptiles (e.g. snakes, turtles)			
fish (e.g. eels)			
invertebrates (e.g. insects, spiders)			

NOTES:

Appendix 6. Flying-fox FAQ sheet provided on the BGT website at http://www.rbgsyd.nsw.gov.au/welcome_to_bgt/royal_botanic_gardens/garden_features/wildlife/flying-foxes

Flying-foxes

>> Questions and Answers about the Grey-headed Flying-foxes at the Royal Botanic Gardens, Sydney

What are flying-foxes? Flying-foxes are large bats, weighing up to 1 kg, with a wing span which may exceed one metre. They sleep during the day and feed on pollen, nectar and fruit at night. In the wild they are important pollinators and seed dispersers of native trees. Seeds are discarded in the faeces or fall where the fruit is being eaten. These seeds germinate when conditions are suitable and ensure that dispersal occurs in a wide area.

What species are the flying-foxes at the Royal Botanic Gardens, Sydney? Flying-foxes, otherwise known as fruit bats, are mammals, and are members of the Pteropodidae family. They have the largest body size of all bats. The Grey-headed Flying-fox is the largest member of the family. Most flying-foxes at the Royal Botanic Gardens are Grey-headed Flying-foxes (*Pteropus poliocephalus*), which are listed as vulnerable under both NSW and Commonwealth legislation There are also a small number of Black Flying-foxes (*Pteropus alecto*), which are currently listed as vulnerable under NSW legislation.

Are Grey-headed Flying-foxes found elsewhere in the world? No. The Grey-headed Flying-fox is a native species that is endemic to Australia.

Where in Australia can they be found? Eastern Australia: Queensland, New South Wales, Victoria.

What is the natural habitat of the Grey-headed Flying-fox? Forests, woodlands, intertidal mangroves.

How many Grey-headed Flying-foxes are there in Australia? There are currently estimated to be less than 450,000 Grey-headed Flying-foxes in Australia. The species suffered a population decline of around 30 per cent over the 10 years between 1989 and 1999, which contributed to its listing as a threatened species. It is believed that the species is still rapidly declining due to the continuation of the key threats to the species.

How can you identify whether a bat is a Grey-headed Flying-fox? The Grey-headed Flying-fox has a mostly dark grey body and grey head (occasionally with 'blonde' flecks), with a rusty brown coloured collar. It is also the only bat to have fur from the top of its head right down to its toes. The fur of the Black Flying-fox only goes part-way down the leg.

How big are Grey-headed Flying-foxes? This species is the largest bat in Australia and can weigh up to one kilogram. It has the longest wingspan of any bat with a maximum wingspan of about one metre (3 feet). Its body length is normally between 22 and 27 centimetres (8.5 to 10.5 inches).

Can Grey-headed Flying-foxes see? All bats can see, but unlike the small insect-eating bats (otherwise known as micro-bats) that use echolocation (emitting high frequency sounds that bounce off objects to allow the bats to find their way around in pitch darkness) to find their food, the pollen, nectar and fruit-eating flying-foxes (otherwise known as mega-bats) use sight and smell to find their food. Their vision is just as good as ours during the day and even better at night.

What is the breeding cycle of Grey-headed Flying-foxes? Both the Grey-headed Flying-fox and the Black Flying-fox give birth once a year, usually to only one young. Although both species will mate all year round, they usually all conceive around late April. Conception is followed by a gestation period of six months, after which most young are born in October/November. For the first three weeks after birth, the females carry their dependent young with them on their foraging flights. By the age of around five to six months, the young should be fully weaned and foraging with the adults. They are relatively long-lived mammals with the average age of reproductive animals between six and ten years. Sexual maturity is reached after two to three years.

What is a flying-fox camp? The term camp is generally used to refer to a site where flying-foxes regularly roost, rather than referring to a group of a particular number of flying-foxes e.g. the flying-foxes have made the Royal Botanic Gardens in Sydney a 'permanent' camp, which is occupied all year round. However, there are 'annual' camps that the flying-foxes use at the same time every year, and also 'irregular' camps that the flying-foxes may roost in occasionally if there is a nearby food source available at the time.

Flying-foxes do prefer roosting together in large numbers (hundreds or thousands). Occasionally a smaller group may roost in a location for a short period, but these small groups will usually either attract more flying-foxes to the site, or will move on to join other larger flying-fox camps. Flying-foxes are very sociable and because they are so focussed on finding food in many different locations at night, they use 'camps' for social contact (as well as for rest) when they are all together during the day.

What do Grey-headed Flying-foxes eat? The favourite food of the Grey-headed Flying-fox is the nectar and pollen of eucalypts and other native trees, such as paperbarks and banksias. Flying-foxes also like eating rainforest fruits, such as figs and lilly pilly berries, which they chew to extract the juice and then spit out the fibre and the large seeds. Small seeds are often swallowed and may not pass through the gut until up to one hour later, by which time flying-foxes could be 35-50 km away from the tree that the seed came from. By dispersing rainforest seeds over wide areas, flying-foxes give seeds a chance to grow away from the parent plant, and potentially expand remnant patches of valuable rainforest vegetation. It is estimated that a single flying-fox can dispense up to 60,000 seeds in one night.

When do flying-foxes eat and sleep?

Flying-foxes sleep during the day and feed on pollen, nectar and fruit at night. At dusk, flying-foxes depart from their camps to feed on various local food resources. As dawn approaches, some flying-foxes gradually start to return to camp from which they came, whereas others may fly to another nearby camp to rest for the day.

Why is the Grey-headed Flying-fox a protected species? Almost all native Australian animals are protected by law. However due to large and rapid reductions (e.g. 30 per cent decline over 10 years) in numbers of Grey-headed Flying-foxes (*Pteropus poliocephalus*), the species was listed as vulnerable in 2001 under both the *NSW Threatened Species Conservation Act 1995* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. This reduction in numbers was mainly due to loss of habitat of in Queensland and New South Wales due to large scale land clearing, as well as culling.

What makes the Grey-headed Flying-fox important to protect? Flying-foxes are important pollinators of the eucalypt forests and woodlands of eastern and northern Australia. Their main food source is the protein-rich pollen produced by *Eucalyptus* flowers. *Eucalyptus* trees need pollen from other trees of their species (out-crossing) to produce fertile seed, and the largely nomadic flying-foxes are very good at providing this transport service. While feeding on nectar and pollen in flowers, pollen grains stick to the fur of the flying-foxes. Some pollen is eaten during grooming, but some is carried on the fur to other flowers to fertilise the ovules which

then develop into seeds. This pollen may be carried for very long distances (up to 100 km in one night) and across cleared land, which provides an essential genetic link between fragmented patches of native vegetation. Other pollinators, such as birds, bees (including native stingless bees), moths, butterflies, wasps, flies, beetles, other small mammals such as gliders and the wind, operate over much smaller areas.

Through pollination and seed dispersal, flying-foxes help to provide habitat for other flora and fauna species and also help to sustain Australia's hardwood timber, honey and native plant industries. But to be effective in this role, flying-foxes need to be in large numbers.

What can be done to help the Grey-headed Flying-fox species survive? To protect flying-foxes from further decline and to help reduce their apparent need for taking refuge in urban and suburban areas (where food is reliable), it is vital that large areas of forests, woodlands and heathlands are protected throughout the landscape to provide food throughout the year. It is also important to regenerate the mosaic of diet species across the landscape. Over the last decade, there has been a significant increase in the protection of habitat on the east coast and ranges of NSW, with approximately 40 per cent of this area now protected in National Parks and Reserves.

Appendix 7. RBG flying-fox relocation FAQ sheet provided on the BGT website at http://www.rbgsyd.nsw.gov.au/welcome_to_bgt/feature_stories/questions_and_answers

Questions & Answers

about the Grey-headed Flying-foxes at the Royal Botanic Gardens

>> Find out more about flying-foxes

Why does the Botanic Gardens Trust want to move the flying-fox colony?

Roosting flying-foxes are killing trees at the Royal Botanic Gardens. Thirteen trees have died since 1995 and 60 more are so damaged they are expected to die within the next three years.

For decades flying-foxes have visited the Gardens to feed, while trees were flowering or fruiting, then moving on. Damage to the trees began when large numbers of flying-foxes began to roost permanently in the Gardens. The Botanic Gardens Trust wants to discourage flying-foxes from roosting in the Gardens but not from feeding here. The Gardens and a permanent flying-fox camp cannot coexist. The trees will die and flying-foxes will leave the Gardens landscape degraded and then move on.

What type of damage do flying-foxes usually cause to trees/foliage etc.?

The weight and movement of large numbers of flying-foxes can break branches and strip trees of leaves and new shoots. This damage weakens the tree, and with continued pressure, may eventually result in its death. The damage caused by large numbers of flying-foxes living in the trees at the Royal Botanic Gardens is unsustainable.

Why are the Botanic Gardens so appealing to the Grey-headed Flying-foxes?

Flying-foxes have lost a lot of their natural roosting and feeding habitat through changes in land use. The Gardens provides habitat, conveniently located in relation to a reliable food source of mostly nectar and pollen of flowers, as well as fruits. Flying-foxes feed in the Gardens at night as well as roost during the day.

When did the flying-foxes first start coming to the Gardens?

The flying-foxes have set up camp in the Royal Botanic Gardens at various times since Governor Macquarie had the foresight to set aside this land for a world class botanic garden (they may have visited the area before European settlement, but the landscape and habitat were quite different). Large numbers are recorded for 1858, 1900, 1916 and 1920 - in those times, flying-foxes were culled, something we wouldn't contemplate today.

There are then no records of significant numbers for nearly 70 years. In 1989, 200 took up residence, growing to a peak of 3200 in 1992. Other urban camps in Sydney have similarly fluctuated in size and location over the years, and the biggest concentration at the moment is at Gordon where camp size can reach more than 50,000 animals.

How many flying-foxes currently reside at the Gardens approx?

The numbers fluctuate in the thousands, but there are generally fewer flying-foxes here over winter. Current estimates are in the vicinity of 10,000-20,000. Fluctuations in numbers are believed to be related to local flowering and fruiting of known food trees in the area surrounding the camp - flying-foxes will follow their food sources for hundreds of kilometres, stopping off at various camps along the way.

What is the process the Botanic Gardens Trust must go through before it gets approval to relocate the flying-foxes?

Approval to relocate the flying-foxes is required under the NSW Threatened Species Conservation Act 1995 and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Before undertaking the noise disturbance relocation program a Section 91 Licence application must be approved by the Director General, Department of Environment & and Climate Change, and the proposal must also be approved by the Commonwealth Department of Environment, Water, Heritage & the Arts (NSW).

What parts of Sydney do you expect the flying-foxes will fly to and start roosting?

The Botanic Gardens Trust is in the process of identifying all existing flying-fox camps within a 50 kilometre distance of the Gardens, as well as any other potentially suitable new sites within 20 kilometres of the Gardens. The fly-out directions of the flying-foxes seem to mainly be to the south and east, with some flying north over Port Jackson.

The movements of the flying-foxes will be monitored after they leave the Royal Botanic Gardens to ensure they roost at appropriate sites. The Botanic Gardens Trust will actively seek feedback from local councils, rangers and the community about where the flying-foxes go following disturbance.

The Botanic Gardens Trust will work closely with those responsible for managing any potential sites.

Are the new areas the flying-foxes will move to in danger of being destroyed as well?

Wherever the flying-foxes go, we will be entering into negotiations with the land managers to determine whether or not the site is an appropriate roosting site for the flying-foxes, and whether the site is physically able to sustain the flying-foxes. If it is determined that the new site is likely to sustain unacceptable levels of damage, then we will commit to moving the flying-foxes on to a more suitable location.

Many of the existing nearby camps are known to host fewer flying-foxes in winter (when the relocation will take place) than in summer, so there should be plenty of room for them to move into without overcrowding these sites. Once they have established a new winter roost, it is likely that the maximum number of flying-foxes at each site will not substantially change, even with the usual spring/summer immigration, as researchers believe that the number of flying-foxes in a camp is more closely related to the amount of food available near the site, rather than the amount of available roosting space in the site.

What do you plan to do to remove the flying-foxes from the Gardens?

The Botanic Gardens Trust's flying-fox relocation proposal has largely been based on the successful 2003 Royal Botanic Gardens Melbourne's flying-fox relocation, when around 30,000 Grey-headed Flying-foxes were systematically disturbed out of the heritage listed Gardens using a variety of noises over a two week period. When the flying-foxes left the Gardens, they were followed-up to ensure that they did not stay roosting at any inappropriate sites, but were encouraged to stay in sites that were pre-determined as preferred sites. Most of the flying-foxes settled at Yarra Bend, where the Gardens supported the establishment of interpretive signage,

pathways, and a viewing platform overlooking the new flying-fox camp site. A small colony also established at a new site in Geelong which has since been accepted by both the community and land managers. Throughout the relocation, there were no reports of any death or injury to a flying-fox as a result of the disturbance activities

Aren't the situations different because the RBG Melbourne camp was a reasonably new camp (1985) at the edge of the flying-fox known distribution, whilst the Royal Botanic Gardens in Sydney is well known to be a long established camp with records of flying-foxes in the Gardens going back to the 1800s?

In Melbourne there were no major camps closer than East Gippsland while in Sydney there are camps within the normal nightly flying range of flying-foxes. The 1992-1997 experience in Sydney showed that the relocation can work here and at that time the flying-foxes seemed to join other nearby camps. Advice varies on whether the task will be easier or harder in Sydney but the previous experience confirms it can be achieved.

A successful relocation of flying-foxes has never been recorded in NSW. Does the Botanic Gardens Trust believe its relocation plan will work?

The relocation from Maclean Reserve in Northern NSW in 1999 was successful for a number of years but not long-lasting - it points to the importance for follow-up work to be committed to indefinitely.

The Botanic Gardens Trust's disturbance program in the 1990s succeeded in keeping flying-fox numbers very low for around six years between 1992 and 1998. After this, the noise disturbance was stopped and the flying-fox numbers increased again.

Five years ago, the Melbourne relocation succeeded at moving the flying-foxes to suitable alternative locations, where they have been ever since, and have not attempted to return to the Gardens in any substantial numbers.

The 2009 Sydney relocation strategy is expected to succeed by using a variety of mobile, moderate, and mainly percussive noises to disturb the sleeping patterns of the flying-foxes throughout the day and then using a slightly higher level of similar disturbance to disperse them from the Gardens a little earlier than they would normally exit the Gardens at dusk. This will make the Royal Botanic Gardens less attractive as a roost site, and will encourage the flying-foxes to find an alternative site.

The Botanic Gardens Trust will commit to following up the flying-foxes after they have left the Gardens to ensure that they are moved on from any other inappropriate sites, until they reach a site that is both sustainable for the flying-foxes and acceptable to the community.

The Botanic Gardens Trust cannot guarantee that flying-foxes will never try to return to roost in Sydney's Royal Botanic Gardens. However, the Botanic Gardens Trust has learnt from its previous noise disturbance program in the 1990s that the disturbance program may have to be reintroduced on an intermittent basis to prevent flying-foxes from re-establishing in large numbers.

Due to the significant value of the Royal Botanic Garden's botanical collections, every effort will be made to ensure their long-term protection.

What is the estimated cost of the Botanic Gardens Trust flying-fox noise disturbance relocation program?

After a few false starts, the operational part of the Melbourne relocation cost about $250,000 and our advice is that it will cost us about half that - a small price for even one of our heritage trees.

Even if higher than estimated, the cost of the project will be manageable within the Botanic Gardens Trust budget. It is expected volunteers will assist under staff supervision.

An assessment of the damage the flying-foxes cause to the trees will be made in financial terms, including the long-term repair of the Gardens, but we also need to consider the incredible heritage, scientific and aesthetic values of these trees.

In addition a critical cost consideration will be the monitoring, research and management support of existing and/or new camps where the flying-foxes may move to.

Will the noise disturbance program affect nearby residents and businesses?

Nearby residents and businesses are not expected to be affected by the noise disturbance program.

The noise disturbance program will be carried out according to EPA noise regulations. The City of Sydney will be consulted. Timely information will be provided to nearby residents and businesses via a letterbox drop, including a summary of the types of noises to be used.

What impact will the noise disturbance have on the welfare of the flying-foxes?

A noise disturbance program, if approved, will meet all requirements of the licence issued under the legislation that protects threatened species.

The noise disturbance program used by the Botanic Gardens Trust in the 1990s proved to be very successful with no injuries or deaths to flying-foxes being attributed to the disturbance program.

Timely information will be provided on the types of noises to be used to visitors, nearby residents of the Gardens and the Police.

Will the public access to flying-foxes roosting areas at Sydney's Royal Botanic Gardens be affected?

Signage will be appropriately placed on the paths entering the roost areas advising of any restrictions. In addition, adequate access controls will be in place to keep members of the public away from roost areas during the disturbance activity.

What should I do if they move to my backyard?

A media communication campaign will alert local media about the disturbance activity, including providing information on 'what to do if you find flying-foxes in your backyard', such as not to interfere with flying-foxes and where to go for further information.

CALL CENTRE/WEB: A 'Frequently Asked Question' fact sheet will be made available at call centres which will reinforce key messages.

If flying-foxes are found in backyards and don't move on after a short period of time people are advised to contact WIRES or Sydney Metropolitan Wildlife Services.

WIRES 13 000 WIRES or 1300 094 737
Sydney Wildlife: (02) 9413 4300

Are people at risk from diseases spread by flying-foxes such as the Lyssavirus?

The risk of a person catching any disease from a flying-fox is minimal; however the Australian Bat Lyssavirus is deadly to humans as well as bats, so it is important to take precautions. This disease is believed to be carried in a very small proportion of the flying-fox population, and can be transmitted to humans through a bite or a scratch. Flying-foxes are generally quite docile animals that do not scratch or bite people unless they are being handled. So the best precaution is to make no attempt at handling a flying-fox unless you are appropriately trained and vaccinated. If you find one in distress, call WIRES or Sydney Wildlife (contact numbers above).

Although, there is no known risk of disease transmission through flying-fox urine or faeces, basic hygiene/cleaning practices (washing any food preparation surfaces with an appropriate cleaning solution, and cleaning with water any walking surfaces that may present a slip hazard) are recommended in cases where flying-foxes leave behind a mess on your property.

The Botanic Gardens Trust can reassure people that although large numbers of flying-foxes have roosted at the Royal Botanic Gardens for almost 20 years there has never been any reported serious injuries caused by or diseases caught from these flying-foxes. However, it is important for the public to understand what should be done if they come into contact with flying-foxes, and we will continue to provide that information.

Why should the Botanic Gardens, and not others, be allowed to move the flying-foxes?

The Royal Botanic Gardens is applying for a Licence to relocate the camp in the same way that any other organisation would need to. The Gardens are one of our cultural and scientific icons. The Gardens were established in 1816 to study and grow Australian and overseas plants and, the landscape has been a public recreation precinct for almost 200 years. There is significant heritage value in the plants and landscape. Many trees were collected by pioneering botanists and explorers, some of the exotic trees were collected from wild habitats which no longer exist. Most of the trees and palms being damaged by the roosting flying-foxes are the oldest in the Gardens. If these trees are allowed to die an irreplaceable part of our heritage and culture will be lost.

What is the scientific value of the tree collection?

The tree collection at Royal Botanic Gardens Sydney is of exceptional heritage significance (it is one of the great tree collections of the world) and also has scientific significance because of the rarity of some species or their association with scientific work in the Gardens.

Professor David Mabberley, in his contribution to the Conservation Management Plan for the Royal Botanic Gardens, identifies the collection of kauris and the only known mature specimen, apparently anywhere in the world, of the palm, Pritchardia maideniana, as ‘trees’ of international scientific and conservational significance. The Kauris, in particular, have been greatly effected by the flying-foxes and some significant specimens (including a specimen from the critical ‘type collection’ of Agathis moorei) have been killed already.

Several fungal species have been discovered and described from palms in the Palm Grove so these specimens become what we call ‘type localities’ - important scientific reference points.

There are also many other trees which are difficult to collect or may be rare in the wild today and provide representative specimens for scientific study by scientists at the Botanic Gardens Trust and elsewhere.

For the study of plant taxonomy and classification (systematics), in particular, the living collections are a rich resource. Plants grow in similar conditions, their life cycle can be observed, their DNA extracted, their variability in form documented, and so on. Much of the recent research on plant evolution and new DNA bar-coding

techniques has relied on samples from botanic garden collections. Several of the kauri pines, as well as trees in the Proteaceae family, were sampled - these trees are carefully documented on our database and from known wild origins. Our Tree Waratah, for example, was used for DNA extraction, dissection of flowers and studies of wood anatomy, all part of a worldwide study of the family Proteaceae.

As additional examples, a bamboo-like plant, Joinvillea, growing in the Palm Grove has been used to study floral development in a study with the Jodrell Laboratory at Royal Botanic Gardens Kew. The Brown Silky Oak on the edge of the Palm Grove was used for chromosome counts in some research done by one of the Trust scientists.

There are 48 species of wild-collected palms that are available for scientific study or conservation. A number of these are rare in cultivation - e.g. *Ceroxylon alpinum*, *Howea belmoreana* X *forsteriana*, *Jubaeopsis caffra*, *Polyandrococos pectinatus* - and our New Caledonian palms are particularly valued by the Palm and Cycad Societies of Australia.

Aren't there other ways of minimising damage rather than moving the flying-foxes out of the Gardens?

Over a number of years the Botanic Gardens Trust has trialled a number of other techniques to minimise damage from roosting flying-foxes. Plastic bags have been tied to branches; mirrors were used to reflect light into trees; sirens and fire alarms were rung; mesh bags of toilet deodorant blocks were hung among leaves; recorded flying-fox distress calls were played; containers of rock carbide were placed high in the tree canopies; a high intensity strobe light was focused on affected trees; containers of raw bullock liver were placed on branches; a synthesised sound on the same wavelength as a street sweeper was introduced; plastic pythons were placed on branches; dog whistles were blown; 'shu-roo', an ultrasonic device, was trialled and a product named D-Ter applied to leaves. None of these techniques deterred the flying-foxes from roosting and the size of the camp continued to increase.

If the flying-foxes are protected, how can you move them from the Gardens without causing them harm?

The Grey-headed Flying-fox is listed as a vulnerable species in NSW and nationally. In 1992 the Botanic Gardens Trust successfully used noise to discourage flying-foxes from roosting. Numbers in the Gardens were reduced from around 3000 to less than 100 and the population remained low for six years without any detected impact on the population as a whole. The Royal Botanic Gardens in Melbourne were also successful using noise to move flying-foxes to a more suitable location without any harm to the animals and with the support of animal welfare and conservation groups. The Royal Botanic Gardens in Sydney will use a similar model, overseen by a steering committee including a range of experts and key stakeholder groups.

The flying-foxes have been in the Gardens for years, why move them now?

There are records of flying-foxes in the Gardens as early as the 1850s. In 1990 there were only 200 but numbers had increased to more than 3000 by 1992. The Botanic Gardens Trust used noise to discourage roosting and the permanent population reduced to fewer than 100 flying-foxes for much of the time up until 1998, when the numbers rose once again to more than 3000. Since then, the colony has continued to grow in size, and now approximately 20,000 flying-foxes are permanently roosting in the Gardens. Damage is severe and widespread in the Palm Grove and among the rainforest trees, with more than 300 trees (10 per cent of the collection) being affected. Thirteen trees have died since 1995 and up to 60 more are so damaged they are

expected to die within the next three years. Sydney tree expert, Judy Fakes, has advised us that heritage trees in the Palm Grove will continue to die unless we do something now.

Can't the Gardens plant more trees and provide a habitat for the flying-foxes?

The landscape of the Royal Botanic Gardens itself is considered to be of heritage importance and the composition and design of the Royal Botanic Gardens is carefully planned to maintain its heritage value. The landscape design, plant content and variety has the primary purpose of providing key plant related messages through landscape displays and the use of interpretative information. For educational and aesthetic purposes, many plantings are grouped according to their scientific, geographical, evolutionary, aesthetic and horticulture history and values. Any new plantings take a long time to mature, and with many of our most significant tree specimens now dying, we do not have time to wait. Our thematic plantings may not even suit the requirements of a flying-fox colony, even when they have matured, as they are designed with the purpose of maintaining the heritage, plant science, and aesthetic values of the Gardens in line with our Conservation Management Plan, rather than recreating habitat for wildlife.

Why don't you just net the heritage trees to keep them out, like farmers do?

In orchards trees are a uniform height (usually no more than 5 m) and planted in straight rows. In the Royal Botanic Gardens netting would need to accommodate the tallest affected trees which are 30 m tall and would have to cover the entire Palm Grove as the trees and palms form a single canopy. Netting would be very expensive and some people may consider it inappropriate to the look of the Gardens. In addition, unless the netting were to cover the entire Palm Grove as well as adjoining garden beds where the flying-foxes are roosting, it is likely that the flying-foxes would simply move from the netted areas into the un-netted areas of the Gardens. The Botanic Gardens Trust wants to save the heritage trees and safely relocate the flying-foxes to an appropriate habitat. Unlike mobile disturbance, netting would not be able to direct the flying-foxes to any particular locations once they had left the Gardens.

There may be some interim measures taken to protect the most significant trees including trial netting where possible before the relocation begins in May 2009. The public will be kept informed about these measures.

Will you just be moving the problem somewhere else?

The Trust intends to relocate the flying-foxes to one or more locations where the habitat is suitable and sustainable, the land use is appropriate, and they are accepted by the local community and relevant land managers. The Trust has committed to moving the flying-foxes on from any inappropriate locations for as long as is permitted under the relevant licences. The best outcome would be for the camp to disperse into existing campsites within the Sydney basin and beyond, without overcrowding any one campsite.

What will you do if you there is no suitable place for the camp to relocate to?

There are a number of other camps currently established in the Sydney region and previous experience has shown that they can be relocated in this area without resulting in the establishment of inappropriate campsites. We will ensure that their movements are closely monitored to see that they either join other established camps or establish a new camp in an appropriate sustainable location.

What will you do if the flying-foxes go to new areas where they are unsafe or unwanted?

We will be ready to work with land managers and support disturbance to move them on from unsuitable locations to suitable ones - this was done successfully when flying-foxes were relocated from the Royal Botanic Gardens Melbourne.

How can you be sure the flying-foxes won't just come back next season? Is this a permanent solution?

If the initial disturbance is successful at relocating the flying-foxes from the Gardens, we plan to continually monitor the trees and recommence noise disturbance at the first sign of any further roosting by the flying-foxes in the Gardens in order to prevent the numbers from building up to unsustainable levels again.

Will the damaged trees regenerate or is it too late?

Approximately 60 trees have been severely damaged, 40 of which are unlikely to survive. Nine of these trees are damaged to the point where survival is uncertain, while the remainder should start to recover once the stress from the roosting flying-foxes has been removed, although these trees may never regain the same condition that they had prior to roosting.

How loud will the noise be? Will it disturb people too?

Numerous different sounds will be used with varying noise levels depending on the reactions of the flying-foxes. We intend to begin the program using noise levels similar to those produced during every-day work in the Gardens, by equipment such as chainsaws, hedge trimmers, tractors and bobcats. This noise, although common in the Gardens, will be produced more frequently than usual throughout the program, and the noise will be aimed at the roosting flying-foxes. If different noise types are not eliciting the desired reaction of the flying-foxes, the noise level may be raised slightly in order to increase the effectiveness of the disturbance. However, in the Melbourne experience, the noise levels were actually able to be lowered after a while, as the flying-foxes became sensitised to the disturbance, so that much lower noise levels were able to disturb them. Throughout the relocation program, we will be closely consulting with nearby residents and local councils at each site of disturbance to ensure that any disturbance to people is minimal. Initially, the disturbance will take place throughout the day and just prior to dusk. If the flying-foxes need to be prevented from roosting in a particular inappropriate site, some low level disturbance may be required during the pre-dawn hours, but this will only be done if the land owner/manager/resident is agreeable, and if it is permitted by the Department of Environment & Climate Change (DECC) licence conditions.

Will the noise affect other wildlife in the gardens? Will it drive away the birds as well?

Wildlife such as ibises and possums share the Palm Grove with the flying-foxes. Wildlife that is active in the Gardens during the day move to other parts of the Gardens to avoid the noise of chainsaws, hedge trimmers, tractors, bobcats and a range of noise created by staff and visitors, later returning when the area is quiet. Brushtail possums, which are extremely common in the Gardens, will be asleep in their hollows during the day, and are more likely to hide from the noise than try to run away. The flying-foxes are active at night so the noise disturbance is designed to interrupt their sleep cycle during the day, thus making the Gardens an unattractive place to roost.

How long will the relocation take?

The noise disturbance program is planned to start in May 2009. It is estimated that a concerted disturbance effort will take between two and four weeks to remove all the flying-foxes from the Gardens. We'll then

maintain a look out for any inappropriate camps establishing in the Sydney Metropolitan region, so that we can move them on towards the preferred sites. For the welfare of the flying-foxes, we do not intend to continue the relocation disturbance beyond the end of July 2009, when the females will be getting heavily pregnant and thus more vulnerable to stress. However, we do plan to maintain an ongoing vigil to prevent new camps settling in the Gardens for as long as is necessary. We'll encourage them to feed on our fruit and flowers (nectar and pollen) but not to roost here.

How will the Gardens encourage flying-foxes to feed but not roost?

Noise disturbance will not be conducted at all during the night-time foraging period. This will allow the flying-foxes freedom to feed wherever they choose.

When will the relocation take place?

Flying-fox experts, veterinary scientists and conservationists on our steering committee have agreed that between May and July is the optimum time to avoid interrupting the flying-foxes' mating season, separating mothers from their dependent young, or stressing heavily pregnant females.

Who are the experts?

Our steering committee consists of representatives of the RSPCA, NSW Wildlife Council, NSW Department of Environment and Climate Change, NSW Wildlife Council, Ku-ring-gai Bat Conservation Society, Ku-ring-gai Council, The Cabramatta Creek Flying-fox Committee, Fairfield City Council, Sydney University (including biologists specialising in flying-foxes) the Botanic Gardens Trust, Friends of The Gardens, and the Royal Botanic Gardens Melbourne.

Appendix 8. Trees lost or at high risk of being lost as a result of damage by roosting flying-foxes (Bidwell, March 2008)

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
9	*Toona ciliata*	Red Cedar	Exceptional	At risk	Branch dieback	permanent	Yes	Yes	Planted 1820's?	5 to 20
10b	*Melaleuca quinquenervia*	Paperbark	Exceptional	At risk	Foliage thinning & shredding	Temp	Yes	No	Planted 1820's?	20 to 50
22b	*Backhousea myrtifolia*	Grey Myrtle		At risk	Foliage thinning & shredding	Temp	Yes	No		5 to 20
23a	*Keteleeria fortunei*		High	At risk	Branch dieback	permanent	Yes	No	Planted 1860's	5 to 20
23a	*Tripterodendron filicifolia*			At risk	Virtually dead	permanent	yes	no		<5
23b	*Schizolobium parahybum*	Bacurubu		At Risk	Foliage thinning & shredding + some branch dieback	Borderline	Yes	Yes	Planted 1974	5 to 20
25	*Serianthes sachetae*		Not listed	Lost						
25	*Tristaniopsis laurina*	Water Gum		lost			Yes			
25	*Flindersia xanthoxyla*	Yellow Wood	Exceptional	At risk	Major dieback	Perm	Yes	No	Planted 1828	5 to 20
25	*Pseudobombax grandiflora*			At risk	Foliage thinning & shredding	Perm	Yes	No		5 to 20
25	*Brachychiton acerifolius*	Flame Tree		At risk	Major branch dieback. Probably lost	Perm	Yes	Yes		<5
25	*Stenocarpus sinuatus*	Firewheel Tree	High	At risk	Foliage thinning & shredding	Temp	Yes	No		20 to 50

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
25	*Harpulia pendula*	Tulipwood		At risk	Major branch dieback	Perm	Yes	No		20 to 50
26	*Aphananthe phillipinensis*	Native Elm	Not listed	Lost						
26	*Waterhousea floribunda*	Weeping Lilly Pilly	Exceptional	At risk	Major dieback of branches. Probably lost	Perm	Yes	No	Planted 1828	<5
28a	*Agathis moorei*		Exceptional	Lost	Tree removed 2007					Lost
28a	*Agathis lanceolata*	Kaori de Montagne	Exceptional	Lost	Tree removed 2007					Lost
28a	*Agathis macrophylla*	Large Leaved Kauri Pine	Exceptional	Lost	Virtually dead	Remove	Yes	No	Planted 1857?	0
28a	*Agathis laurifolia*		Exceptional	Lost	Virtually dead	Remove	Yes	No	Planted 1857?	0
28a	*Agathis robusta*	Queensland Kauri	Exceptional	At risk	Foliage thinning & shredding. At far greater risk with loss of surrounding trees	Borderline	Yes	No	Planted 1857?	20 to 50
28a	*Podocarpus totara*			At risk	Major dieback	Perm	yes	no		<5
29	*Planchonella myrsinoides*	Yellow Plumwood	Moderate	Lost						Lost
29	*Pyrus calleryana*	Callery Pear	Not listed	Lost						lost
29	*Alloxylon flammeum*	Tree Waratah	High	At risk	Some branch dieback, becoming worse	Perm	Yes	No	Planted 1950	5 to 20
29	*Brachychiton discolour*	Lace Tree	High	Lost	Virtually dead. Will not recover	Perm	Yes	Yes		0
29	*Mellicope octandra*			At risk	Branch dieback	Perm	yes	no		5 to 20

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
30	*Alphitonia excelsa*			At risk	Branch dieback	Borderline	Yes	No		5 to 20
30	*Tilea X europaea*			At risk	Branch dieback	Borderline	yes	yes		20 to 50
31	*Fraxinus ornus*	Manna Ash	Not listed	At risk	Damaged pruned off in 2006, recovered but in decline again	Perm	Yes	Yes		5 to 20
31	*Jubea chiliensis*			At risk	Shredding of fronds	Temp	yes	no		5 to 20
31	*Davidsonia pruriens*			At risk	Top dieback	Perm	yes	no		5 to 20
32	*Metasequoia glyptostoboides*	Dawn Redwood		At risk	Major dieback. Will probably not recover	Perm	Yes	Yes	Planted 1948?	<5
32	*Beilschmedia elliptica*			At risk	Branch dieback	Perm	Yes	No		5 to 20
33b	*Hernandia cordigera*		Exceptional	At Risk	Branch dieback	Perm	Yes	No		5 to 20
34	*Phoebe nanmu*			At risk	Branch dieback	Perm	yes	no		5 to 20
35	*Quercus macrocarpa*	Bur Oak	Moderate	Lost						
41	*Cinnamomum camphora*	Camphor Laurel	Not listed	Lost						
41a	*Flindersia schottiana*			At risk	Major dieback	Perm.	Yes	No		<5
41*	*Ailantus triphysa*			At risk	Branch dieback	Perm	Yes	Yes		5 to 20
41a	*Ginkgo biloba*	Maidenhair Tree		At risk	Major dieback	Perm.	Yes	No		<5
41a	*Chorisia speciosa*	Floss Silk Tree		At risk	Foliage thinning & shredding	Temp.	Yes	No		20 to 50
41b	*Waterhousea*	Weeping Lilly		At risk	Major dieback	perm	Yes	No		5 to 20

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
	floribunda	Pilly								
43	*Ficus laurifolia*	Fig		At risk	Foliage thinning & shredding	temp	yes	no		20 to 50
43	*Funtimia Africana*			At risk	Foliage thinning & shredding	temp	yes	no		20 to 50
43	*Davidsonia pruriens*			At risk	Branch dieback	perm	yes	no		5 to 20
49	*Ficus virens*	White Fig	Exceptional	At risk	Foliage thinning & shredding	Temp	Yes	Yes		20 to 50
50	*Tristaniopsis laurina*	Water Gum	Moderate	At risk	Branch dieback	Borderline	Yes	No		5 to 20
50	*Syzygium francissii*	Water Gum	Exceptional	At risk	Branch dieback	perm	Yes	No		5 to 20
53	*Elaeocarpus kirtonii*	Quandong		At risk	Nearly dead. Will not recover	Perm	Yes	No		0
56	*Cedrella mexicana*		Not listed	Lost						Lost
57	*Davidsonia pruriens*	Davidson's Plum	Moderate	At risk	Branch dieback	Perm	Yes	No		<5
57	*Phoebe nanmu*			At risk	Major dieback	Perm	yes	no		<5
57	*Sloanea australis*			At risk	Top dieback	perm	yes	no		5 to 20
57	*Hovenea dulcis*		Not listed	Lost						Lost
57	*Schefflera elegantissimma*		Moderate	lost	Tree removed					Lost
58	*2 X Podocarpus elatus*	Plum Pine		At risk	Foliage thinning & shredding	borderline	Yes	No		20 to 50
58	*Aleurites moluccana*	Candlenut		At risk	Foliage thinning & shredding	Perm	yes	No		5 to 20
59	*Araucaria birmulata*	Birimule	High	lost	Tree removed					

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
		Araucaria								
59	*Araucaria rulei*			At risk	Branch dieback	Perm	yes	no		5 to 20
59	*Syzygium panniculatum*			At risk	Branch dieback	Perm	yes	no		<5
60	*Endiandra discolour*		Not listed	At risk	Top completely destroyed. Left to reshoot	Perm	Yes	No		5 to 20
60	*2 X Casuarina cunninghamiana*	River Oak		At risk	Foliage thinning & shredding	Borderline	Yes			5 to 20
60	*Bischofia javanica*			At risk	Branch dieback	Perm	Yes	No		5 to 20
60	*Cryptocarya obovate*		High	At risk	Foliage thinning & shredding	Perm	Yes	No		20 to 50
65i	*Bischofia javanica*			At risk	Branch dieback	Perm	Yes	No		20 to 50
65i	*Waterhousea floribunda*	Weeping Lilly Pilly	Moderate	At risk	Major dieback	Perm	Yes	No		5 to 20
65i	*Liriodendron tulipifera*	Tulip Tree		Dead	Dead, will remove	Perm	yes	yes		0
65i	*2 X Acacia elata*			Dead	Dead	perm	yes	no		0
102i	*Castanospermum australe*	Black Bean	High	At risk	Branch dieback	Temp	yes	no		20 to 50
L5	*Melaleuca styphelioides*			At risk	Branch dieback	Borderline	Yes + other	no		5 to 20
L17	*Platanus X hispanica*	Plane		At risk	Branch dieback	Perm	Yes	Yes		5 to 20
L19	*Lophostemon*	Brush Box		At risk	Foliage thinning &	Borderline	Yes	No		20 to 50

Bed no.	Species	Common Name	Significance	Lost/ at risk	Nature of Damage	Is damage permanent or temporary?	Damage done by GHFF? Yes/No	Deciduous? Yes/No	Age	Expected life span
	confertus				shredding					
L24	*Melaleuca quinquenervia*	Paperbark	Exceptional	At risk	Foliage thinning & shredding	Temp	Yes	No	Planted 1881	20 to 50
L24	*Harpephyllum caffrum*	Kaffir Plum		At risk	Foliage thinning & shredding	Perm	Yes + possums	No		5 to 20
L8b	*Cupressus sempervirens*			At risk	Foliage thinning & shredding	Temp	Yes	No		20 to 50