

A stylized topographic map with green contour lines is positioned on the left side of the page, extending from the top to the bottom. The lines represent elevation, with several distinct peaks and valleys.

Sydney Swans Headquarters, Moore Park Microbat Management Plan

APP Corporation Pty Limited

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Template 2.8.1

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Abbreviations

Abbreviation	Description
ABLV	Australian Bat Lyssavirus
APP	APP Corporation Pty Limited
BC Act	<i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
CEMP	Construction Environmental Management Plan
ELA	Eco Logical Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP&A Act	<i>Environment Planning and Assessment Act 1979</i>
GPS	Global Positioning System
MMP	Microbat Management Plan
NPWS	National Parks & Wildlife Service
OEH	Office of Environment & Heritage
PPE	Personal Protective Equipment
RHI	Royal Hall of Industries
SEMP	Site Environmental Management Plan
SSD	State Significant Development
SWMS	Safe Work Method Statement

1. Introduction

1.1 Background

Eco Logical Australia (ELA) have been engaged by APP Corporation Pty Limited (APP), on behalf of the Sydney Swans, to prepare a Microbat Management Plan (MMP) for the proposed adaptive reuse of the Royal Hall of Industries (RHI) building for a high-performance sport and community facility for the Sydney Swans at 1 Driver Street in Moore Park, Sydney (the Subject site).

The proposed adaptive reuse of the RHI is identified State Significant Development (SSD-9726) in accordance with the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Eco Logical Australia (ELA) has prepared a Biodiversity Development Assessment Report (BDAR) and a Microbat Survey Report, which identifies the potential for the RHI to provide non-breeding roosting habitat for threatened microbats. The proposed works include replacement of the existing roof, gutters and fascia which contain cavities used as microbat habitat. Impacts to the RHI are considered a prescribed biodiversity impact.

Based on the above, and on recommendations by the Environment, Energy and Science Group (EES) of Department of Planning, Industry and Environment, this MMP is required to manage risks to microbats prior to, during and post construction works.

1.2 Scope of Works

The Subject site is located at 1 Driver Avenue, Moore Park and consists of the RHI, and the associated courtyard area to the immediate south of the building (Figure 1). The site is owned by the Centennial Park and Moore Park Trust and is leased to the Sydney Swans for the purposes of the development. The RHI is situated within the Entertainment Quarter, and immediately adjacent to the Hordern Pavillion live music venue. The RHI has been used intermittently for large music and cultural / arts events up to May 2019. Noise, light, vibration and general disturbance from these events would disturb any microbats roosting within cavities of the RHI during any events, especially events that commence during daylight hours when microbats are at rest.

Despite the intermittent occurrence of live music, cultural and arts events at the RHI up until May 2019, microbats are known to use cavities within the RHI as non-breeding roosting habitat. Microbats change roosts regularly and rely on a series of roosts within their foraging range and are therefore able to select appropriate roosts based on the prevailing circumstances each evening. Without an itemised list of events held at the RHI it is difficult to determine the level of disturbance that may occur from events held there. However, it has been assumed that in the recent past (last 5 years), the RHI has been unused by humans the majority of the time (>70%) each year, providing ample disturbance free time for microbats to select cavities within the RHI as roosting habitat.

The development will largely maintain the structural integrity and façade of the RHI, whilst re-purposing the interior of the building to support several compatible uses and utilise the space effectively. In addition to the repurposing of the RHI, an extension of the building will be constructed to the south of the building in the current service and courtyard area and will include a pool and other infrastructure such as a netball centre. Actions proposed to be conducted to the roof structure of the RHI to complete these works include:

- Replace existing roof sheeting, gutters, fascia
- Demolition and removal of all redundant mechanical equipment

- Install scaffolding around the perimeter of RHI
- Investigate / measure skylights
- Modify roof structure for skylights/installation of aluminium sections
- Install skylights
- Reglaze external windows and restore RHI façade.

Vegetated areas of the development site consist of a small area of planted native (0.009 ha) and exotic vegetation (0.002 ha) along the road edge. Impact to vegetated areas include:

- Removal of four immature, native Spotted Gums (*Corymbia maculata*)
- Trimming of the following exotic vegetation: 20% foliage canopy of one Jacaranda (*Jacaranda mimosifolia*) and 13% of one Liquidambar (*Liquidambar styraciflua*)

The impacted vegetation does not contain hollows suitable for use by microbats.



Figure 1: The subject site

1.3 Objective and Aims

The overarching objective of this MMP is to minimise impacts to threatened microbats as a result of the proposed adaptive reuse of the RHI which could have the potential to affect microbats in the following ways:

- death / injury of individual bats during works – roosting bats can be easily overlooked during the day and will often remain in a roost when threatened during daylight hours rather than risk predation by flying and searching for other roosts during daylight
- loss of roosting habitat – reduction in the amount of suitable roosting habitat locally available may lead to increased competition / overcrowding of remaining roosting resources

- disturbance during works – excessive noise (especially high pitched), dust and vibrations above the general background levels will cause bats to arouse more often during daylight when they would normally be resting, reducing energy reserves and possibly leading to starvation and death.

This MMP aims to:

- Identify microbats, including threatened species listed under the *Biodiversity Conservation* (BC) Act 2016 or the *Environmental Protection and Biodiversity Conservation* (EPBC) Act 1999, known or found likely to occur on site that may be potentially impacted by works.
- Reduce the potential for death or injury to microbats as a result of the proposed works by planning works for the least sensitive time of year for the affected species and excluding microbats from the RHI prior to works.
- Provide details of the exclusion procedures and other management measures required to safeguard microbats and minimise impacts to microbats for the duration of the works.
- Identify possible risks to construction personnel and outline procedures for mitigating those risks and dealing with unexpected microbat finds during proposed works.
- Identify monitoring and reporting requirements and responsibilities with respect to the actions outlined in this MMP.

2. Microbat survey and roost assessment

During September 2019 and February 2020, ELA undertook targeted surveys of potential microbat roosts within the Subject site consistent with the '*Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Methodology* (OEH 2018). Potential roosts within the subject site included five cavities in the façade of the building comprising areas where drainage pipes are attached and run into decorative external features, there is degraded timber / plasterboard fascia on / under the eaves and guttering and missing brickwork on the internal turret walls (Appendix A). The aim of targeted microbat surveys was to determine if bats were present, identify the species present, quantify the number of roosting bats, and the potential carrying capacity of the roosts within each potential roost.

The threatened microbat species targeted during the Subject site survey because they were known to occur within 10 km of the Subject site included;

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)
- *Miniopterus australis* (Little Bent-winged Bat)
- *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat)
- *Myotis macropus* (Southern Myotis)
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat).

Details about life history and ecology for each of the seven threatened species, number of records within a 10 km radius of the Subject site and an assessment of the likelihood of each species being impacted by proposed works at the RHI appears in Table 1. Of these seven threatened microbat species, four are considered to be potentially affected by proposed works at the RHI because they are known to roost in buildings or other artificial structures (Churchill 2008). The four potentially affected species are:

- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle,
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)
- *Miniopterus australis* (Little Bent-winged Bat)
- *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat).

Under the BC Act, the Large Bent-winged Bat and Little Bent-winged Bat are both dual credit species (ecosystem credit and species credit species), however species credits apply for breeding habitat only. In contrast both the Eastern Coastal Free-tailed Bat and Eastern False Pipistrelle are ecosystem credit species.

The Microbat Survey Report (ELA 2020) provides a detailed description of the survey methodology and the findings of targeted microbat surveys undertaken at the RHI in September 2019 and February 2020. Five potential microbat roost entry / exit points (Appendix A) were identified and surveyed by visual observation diurnally and nocturnally in conjunction with ultrasonic detection surveys and thermal imaging surveys over multiple nights during September 2019 and February 2020.

Table 1: Ecology and life history characteristics of seven threatened microbat species known to occur within a 10 km radius of the Subject site and likelihood of impacts

Scientific Name	Common Name	BC Act	EPBC Act	Distribution	Habitat requirements	Records within 10 km	Roost preference	Likelihood of impact
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes.	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	1	Subterranean	N/A. Not recorded ultrasonically during surveys for this report and not known to roost in buildings.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range.	Tall (greater than 20m) moist habitats.	1	Hollows / Buildings occasionally.	Potential. Not recorded ultrasonically during surveys for this report. Suitable but sub-optimal roosting and foraging habitat present.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V		East-coast of NSW from south of Sydney into south-east Qld and east of the Great Dividing Range	Commonly occurs in dry eucalypt forests and woodlands east of the Great Dividing Range. Common on Cumberland Plain. Prefers open spaces in forest and woodland, more active on upper slopes of forested areas.	10	Hollows / Buildings / Telegraph poles / Exfoliating bark. Known to use bat boxes	Potential. Not recorded ultrasonically during surveys for this report but suitable foraging habitat present on site and suitable roosting habitat present within cavities of the RHI.
<i>Miniopterus australis</i>	Little Bent-winged Bat	V		East coast and ranges south to Wollongong in NSW.	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	2	Subterranean / Buildings occasionally. Known to use bat boxes placed in subterranean	Potential Not recorded during surveys for this report but foraging habitat present within study area and may use cavities within the RHI for non-breeding roosting habitat.

Scientific Name	Common Name	BC Act	EPBC Act	Distribution	Habitat requirements	Records within 10 km	Roost preference	Likelihood of impact
							structures in small numbers.	
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V		In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	60	Subterranean / artificial structures. Known to use bat boxes placed in subterranean structures in small numbers.	Potential. Definitely recorded ultrasonically during surveys for this report and likely to forage over the study area. May use cavities in the RHI for roosting.
<i>Myotis macropus</i>	Southern Myotis	V		In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m. Rarely roosts more than 200 m from water.	35	Subterranean / Hollows	N/A Not recorded during surveys. RHI is too far from known foraging habitat on Sydney Harbour.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	V		.	.	1	Hollows	N/A. Not recorded ultrasonically during surveys for this report and likely to forage over the study area. May roost in tree hollows nearby.

The calls of up to four species of microbats were recorded during ultrasonic surveys of the five potential microbat roost entry / exit points to the RHI (Table 2). This included calls of one threatened species listed as vulnerable under the BC Act 2016, the Large Bent-winged Bat. No calls of threatened species listed under the EPBC Act were recorded during ultrasonic surveys.

To assist in determining whether any bats utilise the cavities within the RHI as roosting habitat, a thermal camera survey was undertaken over two nights at each of the five potential microbat roost entry / exit points to the RHI during February 2020. One microbat was identified exiting potential microbat roost entry / exit point 1 (Door 7) during thermal imaging surveys, however no calls were recorded on the ultrasonic detection units at the time of the emergence and the species of microbat could not be determined.

Table 2: Microbat species recorded at RHI during ultrasonic detection surveys conducted in September 2019 and February 2020

Scientific Name	Common Name	Present	BC Act status	EPBC Act status
<i>Austronomus australis</i>	White-striped Free-tailed Bat	Definite	Not listed	Not listed
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	Definite	Not listed	Not listed
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Definite	Vulnerable	Not listed
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	Potential*	Not Listed	Not listed

*Calls overlap with Gould's Wattled Bat and no defining characteristics were present on recorded calls so species cannot be confirmed to be present

The Microbat Survey Report (ELA 2020) identified that four of the five cavities within the RHI are microbat roosting habitat (figure 2). The fifth cavity was found to contain rats and has been removed from the list of potential microbat roost sites. None of the surveyed cavities constitutes breeding habitat for Eastern Coastal Free-tailed Bats, Eastern False Pipistrelles, Large Bent-winged Bats, Little Bent-winged Bats or any other species of threatened or non-threatened microbat. This is because neither the Large Bent-winged Bat or the Little Bent-winged Bat is known to breed in buildings and no evidence of large aggregations (1000s) of Large or Little Bent-winged Bats (required to sustain a maternity roost) or any other microbat species was found during surveys at the RHI over the spring and summer microbat breeding season (ELA 2020).

Though none of the four potentially affected threatened microbat species were positively identified roosting within the cavities of the RHI during the surveys, it is possible that the single unidentified microbat observed emerging from microbat roost entry / exit point 1 (Door 7) on 18 February 2020 was one of these four threatened microbat species.

The Microbat Survey Report (ELA 2020) identified that Large Bent-winged Bats forage in proximity to the RHI and it is therefore possible that individuals or small numbers of Large Bent-winged Bats use the RHI as non-breeding roosting habitat. Although no other threatened microbat species known to roost in buildings was recorded during surveys it is also possible that individuals or small numbers of Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, and Little Bent-winged Bat also utilise the cavities within the RHI as non-breeding roosts from time to time throughout the year. There is therefore a risk that the proposed works will affect microbats.

Table 3 below provides guidelines, (adapted from the Woolgoogla to Ballina Microbat Management Plan, prepared by GeoLINK on behalf of the Roads and Maritime Services, 2015) for assigning microbat

roosting habitat into high, medium and low conservation value to allow appropriate measures to be taken to avoid, minimise and mitigate any impacts to microbat roosting habitat from proposed actions which may impact identified microbat roosting habitat. Based on the results gathered during targeted surveys in September 2019 and February 2020 summarised above, and the criteria presented in Table 3 below, the conservation habitat value of the cavities within the RHI is determined to be **medium**.

For the above reasons it is necessary to safely exclude microbats from the cavities within the RHI prior to commencement of works, and, to ensure impacts to microbats are minimised throughout the construction period. Construction works can only be undertaken once an ecologist with experience in microbat management has confirmed that the exclusion process is complete and is satisfied that the risk of harm to roosting microbats has been minimised as far as is practically possible in line with this MMP.

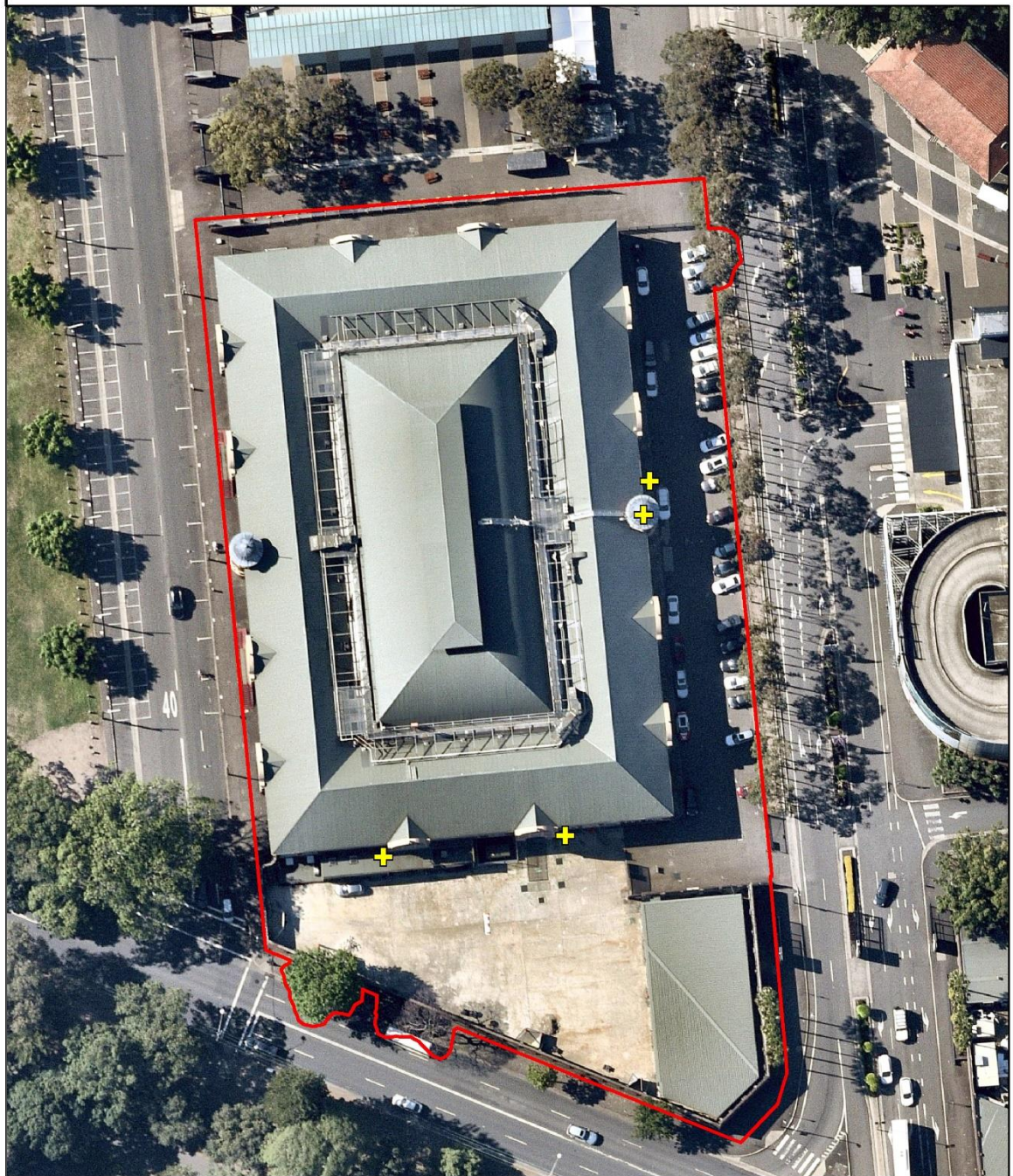
Table 3: Conservation habitat value category criteria for microbat roosting habitat within cavities of the RHI

Conservation Habitat Value	Criteria	RHI
High	<ul style="list-style-type: none"> Known to provide breeding habitat for threatened species; or Known to provide non-breeding roosting habitat for large numbers (ie.>50) of threatened species (e.g. known to support large numbers of Bent-wing-bats over winter); or Supports one or more of the federally listed threatened species 	<p>No.</p> <p>Surveys for this report did not record any threatened species breeding habitat in cavities of the RHI. There was no evidence to suggest that large numbers of bats (>50) use the cavities within the RHI. No federally listed microbat species were recorded during surveys and there is no suitable habitat present for the only federally listed species known to occur within a 10 km radius of the Subject site.</p>
Medium	<ul style="list-style-type: none"> Does not satisfy high conservation/ habitat value category; Provides non-breeding roosting habitat for small numbers (ie. <50) of threatened species; or Medium to large guano accumulations and/ or stains present indicative of the occurrence of moderate numbers of microbats or medium to long-term usage (threatened/ non-threatened status unknown); or Supports protected cavities providing good potential long term roosting habitat; however, no bats or evidence of roosting bats present; and/or In proximity to open surface water, however provides mainly exposed roosting opportunities (e.g. cavities <50 mm deep, or rough concrete), offering limited potential for breeding roosting; and/or Supports a breeding colony of non-threatened microbats. 	<p>Yes.</p> <p>Cavities within the RHI can provide non-breeding roosting habitat for small numbers (<50) of microbats including Large Bent-winged Bats. The RHI supports protected cavities providing good potential long-term microbat roosting habitat and evidence of a single unidentified microbat emerging from one of the cavities was obtained during surveys.</p>
Low	<ul style="list-style-type: none"> Does not satisfy high or medium conservation/ habitat value categories; and Individual microbats or very small numbers of non-breeding microbats (e.g. <5) present; or Small guano accumulations and/ or stains present indicative of the occurrence of small numbers of microbats or short-term usage; or Provides mainly exposed roosting opportunities (e.g. cavities <50 mm deep, or rough concrete) offering limited potential for use as breeding habitat; or Not in proximity to open water. Roosting habitat of similar value locally is common. 	<p>No.</p> <p>Satisfies medium conservation value category</p>

Potential Microbat Roost Entry/Exit

Sydney Swans Head Quarters, Moore Park

335741



335741

6247954



Figure 2: Potential microbat roost entry/exit locations

3. Microbat Management

3.1 Approach

The exclusion of microbats from the subject site is required because four of the five cavities within the RHI are microbat habitat and there is a risk of injury and death to microbats from works associated with the proposed adaptive reuse of the RHI. The exclusion methods proposed are leading practice by bat experts.

Given the nature of the roost spaces within the RHI and the difficulties associated with obtaining a clear view into all potential gaps, cracks and crevices it is unlikely that the ecologist will have absolute certainty that the RHI is bat free following a single afternoon / evening of inspections. For this reason, exclusion will be undertaken gradually and in a staged manner. The exclusion will be carried out over multiple nights using one-way valves (plastic cones) placed over each of the entry / exit points after microbats have emerged to forage for the evening. The emergence and return of microbats to each exit point fitted with a one-way valve will be monitored for a two to three-night period. On the final morning (after two to three days) a permanent exclusion device will be installed over all entry / exit points.

Key actions outlined in the MMP involve the following main tasks;

- A project ecologist should be appointed by AAP to ensure the MMP is delivered according to specifications. The project ecologist is an individual with a minimum of three years industry experience, extensive experience in microbat ecology and management as well as extensive experience undertaking microbat field surveys. The project ecologist must also hold an Biodiversity Licence and Animal Care and Ethics Committee approval as well as current Australian Bat Lyssavirus (ABLV) vaccination.
- The exclusion of bats from roosting habitat at the subject site must occur during non-breeding or maternity seasons or overwinter hibernation and extended torpor seasons for microbats. Suitable time periods are late March to end of May at the end of the breeding season when all young should be independent and before food resources drop off over winter and microbats have established winter roosts. An alternative but less ideal option would be to exclude at the end of the winter / hibernation period and prior to the commencement of the breeding season in September, bearing in mind that some microbats may be pregnant in late September.
- Microbat box installation in consultation with the City of Sydney Urban Ecology Coordinator, as well as post-installation monitoring/ reporting on the use of bat boxes.
- Staff environmental inductions which advise contractors of the biodiversity values present onsite, risks to human health and safeguards for dealing with unexpected finds.
- Adaptive management techniques involving close communication between the project ecologist, contractors and client, monitoring and corrective actions. Adaptive management requires flexibility specifically where monitoring determines that microbats are not responding to interventions in an expected manner and additional mitigation actions may be required.

3.2 Compensatory Habitat – Bat Boxes

Bat boxes are to be installed at least one week (but preferably several weeks) prior to commencing the exclusion process and as close as possible to the site to provide alternative habitat for any microbat that is displaced during the exclusion process and for the duration of the proposed works.

This mitigation measure is aimed at providing additional and alternative diurnal roosting capacity, in the immediate local area prior to the planned exclusion works. Provision of bat boxes near the existing roosts ensures that any bats returning to the roosts contained within the RHI later in the morning following the nocturnal exclusion are not caught short and have a safe location in which to roost during the day light hours.

All bat boxes installed must have a unique identifier and the following data recorded for future monitoring and reporting:

- date installed
- unique ID number or code
- zone, easting and northing
- box type
- aspect
- tree species (if relevant)
- tree health (if relevant)
- DBH of tree (if relevant)
- box height above ground.

3.2.1 Bat box design and installation

The use of several box types and entrance sizes are recommended to cater to the needs of different microbat species that may be displaced by proposed works. Several reputable suppliers manufacture bat boxes constructed from wood or Cyplas (a recycled plastic material that has a longer life than wood) and either material would be suitable for this application. It is recommended that a total of four bat boxes be installed on vegetation within the study area or in nearby locations as agreed in consultation with the City of Sydney Urban Ecology Coordinator.

The four bat boxes should comprise a mix of single, double and triple chambered boxes with some boxes having entrance slots of 12 – 15mm wide and others 16-20mm wide at the base of the box. The boxes should be mounted in healthy trees at heights of no less than 4m.

The nest boxes should be installed in a manner that ensures there is a clear flyway to and from the landing pad of the box. Each bat box is to be installed under the canopy of a suitable tree to avoid direct sunlight during the hottest part of the day and more importantly, so that they are hidden from view of the general public. Where practical it is preferable to install boxes so that they are warmed by late afternoon sun.

A short letter style report is to be sent to APP and the City of Sydney urban Ecology Co-ordinator once the bat boxes have been installed outlining the location of each nest box and including photographs of each installed box.

Post-installation monitoring of the four bat boxes is required to be undertaken once during autumn and once during spring, every year for a minimum of two years after installation, and the results to be reported on and delivered to the Sydney Swans and the City of Sydney Urban Ecology Co-ordinator following each monitoring session.

3.3 Exclusion Timing

The proposed exclusion works can only commence once bat boxes have been installed and must be undertaken and completed outside the breeding season (early – mid September to March) or over wintering period (June to August). Exclusion works may therefore only occur from late-March – end of May. Once the exclusion is in place and the cavities in the RHI have been certified to be bat free, works can be undertaken at any time of year.

The exclusion will be planned for a period of mild temperatures (warmer evenings, little or no wind, no rain) with a view to providing ideal foraging conditions for microbats. Microbats can remain in a roost and in torpor for more than two weeks during winter and up to five days during summer (Geiser and Kortner 2010) but are likely to emerge to forage every night or every few nights when the weather conditions are favourable. The staged exclusion will be undertaken over a three-night period when bats are likely to be foraging to allow any bats in torpor to wake naturally and exit the roost before it is excluded to them.

Roost exclusion would not occur during forecast periods of heavy rain (>20 mm in 24 hours according to the Bureau of Meteorology).

Exclusion devices should be installed at least 2 weeks prior to commencement of works to ensure microbats are not continuing to try to return to the cavities within the RHI.

3.4 Roost Exclusion Methodology

The following exclusion process would be applied to the four identified microbat roost entry / exit points of the RHI within the Subject site. Exclusion would aim to remove microbat access to these four cavities identified in the Bat Survey Report (ELA 2020). The objective of controlled roost habitat exclusion is to prevent microbat injury or mortality and avoid impacts to breeding or overwintering colonies of microbats.

3.4.1 Exclusion Process

Roost exclusion would involve the microbat ecologist inspecting the four microbat roost entry / exit points at least one hour prior to sunset to attempt to identify if microbats are present (record species and numbers) and if so, where they are roosting (record locations). Multiple roost entry / exit points can be inspected on a single night provided each roost entry / exit point has a dedicated ecologist conducting an emergence survey on the same evening that one-way valves are being fitted over a roost entry / exit point.

Following the initial inspection an emergence survey including ultrasonic recording must be undertaken outside each of the four entry / exit points. This emergence survey will commence 30 minutes prior to sunset and continue until the ecologist is satisfied that all bats have emerged from the roost, or until there has been a period of sustained inactivity (60-90 minutes). The number of microbats recorded exiting the RHI will be documented along with the general direction of travel and behaviour upon exiting. These observations will be undertaken with the aid of an ultrasonic recording device.

A follow-up inspection of each roost entry / exit point would then be undertaken at the conclusion of the emergence survey to determine whether any microbats remain in the roost.

Exclusion will be undertaken by installing one-way valves (plastic cones) over the roost entry / exit points after the conclusion of the emergence survey. This one-way valve is designed to let microbats out of the roost but not back into the roost. This technique will encourage bats to find roosts elsewhere, limiting the number of bats left without a roost once the permanent exclusion devices are installed over the roost entry / exit. One-way valves will be left in place for 2-3 nights, with emergence surveys undertaken for 1.5 hours at dusk each night to check and record any bats flying out.

Pre-dawn observations by the ecologist should be made at each of the roost entry / exits that have one-way valves installed beginning on the following morning. Pre-dawn observations are to be undertaken over a 1.5 hour period prior to sunrise to note and rescue any microbats roosting in unsafe places, determine whether any microbats have returned and assess the integrity of the exclusion devices. Any microbats roosting in unsafe places will be captured by hand, held in a calico bag (containing no more than five microbats of the same species) in a cool, dark, quiet place for the day until they can be released at the site after dark. Any breaches of the exclusion devices will be noted and marked for repair later that evening.

This dusk and pre-dawn observation process will be repeated on the second and third evening and morning noting any bats that fly out of the roost and rescuing any bats that return to roost in unsafe places.

A permanent exclusion device will be installed over the entrance of each structure on the final morning and secured in such a manner that will allow it to remain in place until and throughout construction works. The ecologist will need to conduct periodic inspections of the exclusion devices (one week after installation then each month prior to works and once on the day prior to roof removal or construction activity at a roost entry / exit point to ensure the exclusion devices continue to function as intended.

If the final early morning inspection (on day 3) records microbats within the a roost entry / exit, the process described above will be repeated using a thermal camera or night vision scope to observe microbats upon emergence to determine where the breach is occurring, and actions taken to rectify the breach after emergence of the microbats. Any evening changes made to the exclusion devices will always be followed by a morning inspection as outlined above.

3.4.2 Exclusion devices

Exclusion devices will comprise heavy duty plastic sheeting fixed around the entry / exit point and shaped into a cone with a small opening at the base. Once the ecologist is certain a roost entry / exit point does not contain microbats, a permanent exclusion device will be installed over all entry / exit points on the final morning of the staged exclusion process.

Hold Point 1- completion of exclusion process

The project ecologist will confirm completion of Hold Point 1 to verify the exclusion process is complete, permanent exclusion devices are in place, the four microbat roost entry / exits are free of microbats and works may commence.

3.4.3 Inspection and maintenance of exclusion devices

Exclusion devices would need to be monitored one week after installation, and then monthly until the commencement of construction works at each potential roost entry / exit point by the project ecologist prior to works to ensure they remain effective in excluding bats, especially following any high rainfall or high wind events. It will be critical that contractors ensure the exclusion devices remain secure and in place until permanent exclusion devices are installed.

Notification is to be sent to the project engineer / site supervisor following completion of the exclusion process confirming that the exclusion is complete and providing photos and descriptions of the exclusion devices that have been installed.

An action log (Table 4) will be kept during the exclusion process and for any monitoring inspections conducted between the exclusion and commencement of works. This log will be submitted to the project engineer / site supervisor upon completion of the project as part of the reporting requirements. The exclusion log will contain the following information:

- action undertaken
- date
- personnel involved
- results / outcomes against performance measures
- effort / time on site
- adaptive / alternative procedures required / recommended.

3.5 Actions during construction

3.5.1 Site induction

All staff and contractors undertaking works at the subject site should be made aware of the environmental sensitivity of the site and the potential presence of threatened microbat species prior to commencing work through undertaking an environmental induction led by the site supervisor. A picture of the four potentially affected threatened microbat species should be placed in the crib room and the location of potential microbat roosts marked on site maps / design drawings displayed on site. Staff should be briefed on what to do in the event of unexpected finds of microbats. Some microbats carry diseases that can be lethal to humans if untreated, and inexperienced / unvaccinated people should never handle bats.



Figure 3: *Miniopterus orianae oceanensis* Large Bent-winged Bats



Figure 4: *Miniopterus australis* Little Bent-winged Bats

3.5.2 Daily Inspection

A daily check of the exclusion devices at the RHI is to be undertaken by the site supervisor prior to commencement of works and records kept of these checks. If the exclusion devices are unsecure the site supervisor must contact onsite environmental staff, the project engineer and the project ecologist immediately so that the breach can be inspected and repaired as soon as possible. No works are to commence at a roost entry / exit point if the exclusion device at the location is not secure. Works at the roost entry / exit point can only recommence once the ecologist provides advice that the site is secure.

If a breach of the exclusion devices has occurred, the exclusion methodology outlined in Section 3.4.1 will be followed by the project ecologist over a single night. The breach will be repaired following conclusion of evening emergence and a dawn inspection of the repaired exclusion device(s) will be undertaken.

A pre-works inspection of each roost entry / exit would be undertaken by the site ecologist prior to works commencing at that location.

Microbats or evidence of their presence can manifest in a range of ways and works staff should be made aware of these signs as part of the site induction process. A set of visual aids for use in the induction process is included as part of this MMP. Evidence of microbat occupancy includes the following:

- Visual (diurnal) observations of singles or clusters of roosting microbats hanging from the obvert (ceiling or roof) or walls or lying within horizontal crevices within the RHI structure.
- Visual (nocturnal) observations of bats flying from or returning to a structure at dusk and dawn, respectively.
- Audible sounds made by roosting bats include a chattering clicking type noise often heard around dusk and dawn or if bats are disturbed in a roost. Any suspicion of unusual noises within the culvert will be investigated further with a handheld ultrasonic call recorder.
- Guano (bat dung / scats) will be present if bats are utilising a roost, even just for a couple of days. Often guano collects immediately under the roost site or sticks to the structure walls under the roost or around the entrances to a roost.

- Staining (urine) may be present where bats frequently access a roost.
- Bat bugs (ectoparasites) or their casings are frequently observed throughout microbat roosts and take the form of tiny tick like or spider like invertebrates.
- Any Welcome Swallow or Fairy Martin nests – mud and earth constructed bird nests - should be investigated as some bat species will utilise disused nests as roost sites.

Works should not commence / all works should stop if roosting bats are found or heard within a work area or bats are observed flying from a roost or around the works site during daylight. Unexpected finds of microbats should be reported immediately to onsite environmental staff, project engineer / site supervisor and the supervising ecologist who will advise the best course of action. In the first instance, photographs should be taken and then sent to the project ecologist to identify the microbats and to determine what actions are required.

4. Contingency Measures

Wild animals can display unpredicted and unexpected behaviours, and this MMP should be considered flexible in its application so that a range of potential outcomes can be provided consistent with NSW Biodiversity Licences and Animal Care and Ethics Committee approvals.

4.1 Adaptive Procedures

The procedures of this plan may be adapted in response to factors such as microbats remaining in cavities within the RHI and not emerging to forage which would have implications for the length of time it takes to exclude microbats from those roost entry / exit points.

The aim is to facilitate the identification of the best course of action for the situation, including time and logistical constraints, as well as the biological constraints posed by the microbats. This would require open communication between the work supervisor, project engineer / site supervisor, onsite environmental staff and the project ecologist.

Microbats are wild animals and do not always behave in the ways we expect or predict. Management plans need to be adaptable enough to respond to situations as they arise and deal with a range of possible outcomes. Modifications to the procedures outlined in this plan may be undertaken provided there has been consultation with the supervising ecologist. The aim of this clause is to allow for the identification of the best course of action to facilitate construction given time and logistical constraints as well as ecological constraints imposed by the affected microbat species.

4.2 Capturing and releasing healthy microbats

If healthy microbats are discovered during works or observed flying from a roost site or around the works site during daylight, stop works immediately and inform the site supervisor, onsite environmental staff, project engineer / site supervisor and supervising ecologist. This is the responsibility of all site personnel. Works that are disruptive to microbats include those which create excessive noise (particularly high-pitched), vibration or light and heat sources, or give off smoke or other potentially noxious gases.

The supervising ecologist may elect to retrieve isolated bats (if possible) that are alive and healthy from the work area, hold them in a calico bag (no more than 5 microbats of the same species to be held in a single bag) during the day in a cool, quiet, dark, well ventilated place and release them at the point of capture once the work area is secured. This should only be undertaken if microbats can be safely released on the night after they were captured. Bats should not be held for more than 12 hours.

If it is not possible to capture and remove the bats, a suitable exclusion zone will be set up by the supervising ecologist and no works will be undertaken within that zone until specifically directed by the supervising ecologist. The exclusion zone will remain in force until the cavity can be confirmed to be bat free.

Some microbats carry diseases that can be lethal to humans if untreated. Bats should not be handled by unvaccinated ((Australian Bat Lyssavirus (ABLV)) and inexperienced persons. This is to minimise any potential for possibility of serious disease transmission. If a non-vaccinated person does come into contact with a microbat, they must seek immediate medical attention. A post- ABLV exposure vaccine is available and should be commenced the same day.

Any evidence of a roosting microbat should be documented, photographed and actions recorded with onsite works staff and directed to the project ecologist for further action. Photos are the first and best course of action to help identify microbats and should be supplied to environmental staff and the project ecologist.

4.3 Injured or dead microbats

If microbats are found injured or dead in a works area, all works in the immediate area should cease and the site supervisor, onsite environmental staff, project engineer / site supervisor and supervising ecologist must be informed. Any evidence of injured or dead microbats should be documented, photographed and actions recorded with onsite works staff and directed to the project ecologist for further action. A suitable exclusion zone will be set up by the supervising ecologist and no works will be undertaken within that zone until specifically directed by the supervising ecologist. The supervising ecologist will inspect the work area and once it has been determined to be bat free, will provide approval for works to recommence.

Injured bats will be removed and taken to a local veterinarian or wildlife carer experienced in the care and handling of microbats by the project ecologist. Options for treatment and future release would be decided and then documented by the supervising ecologist. Costs for treatment would be the responsibility of the contractor. Dead microbats will be collected by the project ecologist (using gloves and a plastic bag) and retained for lodgement with the Australian Museum.

5. Risks

Some of the procedures detailed within the plan pose various risks to human safety. The key risks include:

- contact with microbats
- working at night
- working at heights.

These risks are to be addressed by the project ecologist through preparation of a Safe Work Method Statement (SWMS) that outlines control measures required to eliminate or reduce the risks to acceptable levels.

5.1 Exposure to diseases such as Australian Bat Lyssavirus

Some microbats carry diseases that can be lethal to humans if untreated. Bats should only be handled by vaccinated (ABLV) and suitably experienced persons. This is to minimise any potential for possibility of serious disease transmission. Photos are the first and best course of action to help identify microbats and should be supplied to onsite environmental staff and the project ecologist.

Even if previously vaccinated against ABLV, if anyone is bitten or scratched by a bat, the following actions should be undertaken:

- immediately wash the wound thoroughly with soap and water for at least five minutes - proper cleansing of the wound reduces the risk of infection
- apply an antiseptic with anti-virus action such as povidone-iodine, iodine tincture, aqueous iodine solution or alcohol (ethanol) after washing
- seek medical attention as soon as possible to care for the wound and to assess whether you are at risk of infection.

If at risk of infection, treatment consisting of a combination of rabies immunoglobulin and rabies vaccine may be required. If not vaccinated previously, an injection of rabies immunoglobulin is required as soon as possible and a series of either four or five rabies vaccine injections over one month. If vaccinated previously with a full course of vaccination, two further doses of vaccine will be required. In NSW, Public Health Units will work with general practitioners to assess your risk and where indicated, will arrange for rabies vaccines and immunoglobulin to be delivered to your general practitioner or hospital.

The project ecologist and any other ecologists working on site must be vaccinated against Australian Bat Lyssavirus and wear gloves when handling microbats. The equipment and procedures for dealing with potentially infected persons outlined above must be detailed within the SWMS. Appropriate bat rescue equipment / Personal Protective Equipment (PPE) must be available on site before works commence (cotton bags, gloves, soap and water to wash hands).

Controls to eliminate or reduce the remaining key risks identified above are commonly encountered on construction projects and should be adequately addressed in the Safe Work Method Statement (SWMS) prepared by the project ecologist.

6. Roles and Responsibilities

The construction personnel, project ecologist, project manager and environmental officer form a team that work together to achieve short-term management of microbats at the Subject site through delivery of the MMP.

The project engineer / site supervisor is responsible for:

- notifying the project ecologist if there are any changes to the scope of works or works schedule
- including the actions outlined in the MMP in the Construction Environmental Management Plan (CEMP) or Site Environmental Management Plan (SEMP)
- notifying the project ecologist of the proposed date for commencement of works
- notifying the project ecologist of the proposed date for conclusion of works
- immediately notifying the project ecologist (within the same day) in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- covering the costs associated with rehabilitation and release of any microbat injured during the course of works
- ensuring monitoring of any new microbat habitat is undertaken (if required) and reported on with any recommendations for future improvement provided to the Sydney Swans.

The project ecologist is responsible for:

- providing basic information and pictures of microbats to be included in the environmental induction and to be kept in the crib room and available to all site personnel
- preparing a SWMS and undertaking daily Toolbox Talks for the implementation of the MMP
- procuring bat boxes and exclusion material
- maintaining an action log in relation to activities related to the implementation of the MMP
- monitoring and installing bat boxes and exclusion devices (may require assistance from construction personnel or subcontractors to conduct the exclusion)
- conducting a pre-works inspection of each roost entry / exit point
- providing regular updates to the project manager and site supervisor on the progress of works
- dealing with any unexpected finds of microbats on site, including provision of advice, attendance at site at short notice, rescue, handling, and release of healthy bats, transfer of injured bats to an appropriate wildlife carer and lodgement of dead microbats with the Australian Museum
- reporting on the outcomes of the MMP within one month of completion of works
- undertaking and reporting on monitoring of the bat boxes.

The project ecologist is to provide guidance to the project manager such that the aims of the MMP are achieved and impact to microbats are minimised. Any decision relating to statutory obligations would be discussed or referred to the project manager and environmental officer.

The contractor site supervisor is responsible for:

- conducting environmental inductions for all personnel working on site

- providing the relevant materials on site to deal with the immediate care of bites and scratches from microbats
- conducting daily checks of the exclusion device during the works period
- notifying the project ecologist if the exclusion device is not secure
- notifying the project manager of the proposed date for commencement of works
- notifying the project manager of the dates for conclusion of works
- stopping works on site in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- notifying the project manager of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- maintaining a suitable exclusion zone around any unexpected finds on the advice of the project ecologist.

Construction staff and contractors are responsible for:

- undertaking site inductions including the environmental induction
- assisting the project ecologist with installation of a permanent exclusion device (if required)
- stopping works immediately and notifying the site supervisor, project manager and environmental officer in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead).

7. Reporting and Communication

The project engineer and contractor site supervisor will be kept informed via regular email and phone updates of progress at key milestones throughout the implementation of the MMP by the project ecologist, as listed in table 4. An action log summarising all site works undertaken will be maintained by the project ecologist. The action log will be a record of the actions taken, personnel responsible, timing, results as measured against performance measures and decisions made regarding adaptive measures if required during the installation and monitoring of exclusion devices. The action log will be included in final project report.

A final project report outlining the actions taken in implementing the MMP and the success or otherwise of the MMP in mitigating impacts to microbats including recommendations for improvements to the process that could be employed on future projects will be submitted one month following project completion.

Table 4 below outlines the main actions required in implementing the MMP and this will form the basis of the action log.

Table 4: Action log summary table to be included in the final report

Management Measures	Details	Timing	Performance Indicators	Responsibility
Site inspection	Project inception	Commencement of project	Undertaken at correct timing; inspection report	Project ecologist, site supervisor, project engineer
Environmental induction	Discussion of risks involved and safety procedures	Commencement of project	Staff induction records	Project ecologist, site supervisor, project engineer, contractors and all site personnel
Action log	Commence logging actions	Commencement of project	Action log completed from project commencement	Project ecologist
Procure bat boxes and exclusion materials	Purchase suitable materials	At least two weeks prior to exclusion	Materials obtained at correct timing	Project ecologist
Install bat boxes	Installation of bat boxes	At least one week prior to exclusion	Installed at correct timing	Project ecologist or contractors
Exclusion – Day 1	First diurnal inspection	Late March – May	Correct time of year	Project ecologist
	Emergence survey	After diurnal inspection	Undertaken at correct timing	Project ecologist
	Inspection following emergence survey	After emergence survey	Undertaken at correct timing, record	Project ecologist
	Installation of one-way exclusion devices	After nocturnal inspection	Undertaken at correct timing, record.	Project ecologist
	Dawn inspection	Morning of Day 2	Undertaken at correct timing	Project ecologist
Exclusion – Day 2	Second diurnal inspection	Late March – May	Correct time of year	Project ecologist

Management Measures	Details	Timing	Performance Indicators	Responsibility
	Emergence survey	After diurnal inspection	Undertaken at correct timing	Project ecologist
	Inspection following emergence survey	After emergence survey	Undertaken at correct timing	Project ecologist
	Dawn inspection	Morning of Day 3	Undertaken at correct timing	Project ecologist
Exclusion – Day 3	Third diurnal inspection	Late March – May	Correct time of year	Project ecologist
	Emergence survey	After diurnal inspection	Undertaken at correct timing	Project ecologist
	Inspection following emergence survey	After emergence survey	Undertaken at correct timing	Project ecologist
	Dawn inspection	Morning of Day 4	Undertaken at correct timing	Project ecologist
Permanent exclusion	Install permanent exclusion device	Moring of Day 4	Undertaken at correct timing	Project ecologist
Notification	Email to PM to confirm exclusion complete	Day that exclusion is completed	Undertaken at correct timing, record kept	Project ecologist
Exclusion monitoring	Inspect exclusion device and email results to project manager	One week following install of permanent exclusion device	Exclusion device secure	Project ecologist
Exclusion monitoring	Inspect exclusion device and email results to project manager	Monthly following install of permanent exclusion device and up to commencement of works	Exclusion device secure	Project ecologist
Daily works inspection	Inspect exclusion device and inform project ecologist if action required	Daily during works on Subject site	Exclusion device secure	Site supervisor
Pre-works inspection	Inspect exclusion devices and email results to project manager	Day prior to works at each entry / exit point	Exclusion device secure	Project ecologist
Advice and on-site unexpected finds	Provide advice when requested and remain on-call to attend site during construction	Throughout project as required	Timely responses, attend site as requested	Project ecologist
Reporting	Prepare a report outlining actions undertaken	Within one month following completion of works	Report, at the correct timing	Project ecologist
Bat box monitoring reporting	Conduct checks of bat boxes during autumn and spring	Autumn and spring. Reporting completed	Boxes functional and showing evidence of use. Report delivered	Project ecologist

Management Measures	Details	Timing	Performance Indicators	Responsibility
	each year for two years. Prepare a report outlining monitoring actions and results	following each monitoring event	within a month following box checks	

8. Monitoring

The objectives of monitoring are to:

- ensure no microbats are harmed by the construction works
- identify the need to adjust the exclusion methodology to minimise impacts to microbats
- identify whether the microbat management actions have been implemented and gauge their success
- provide further recommendations for consideration on future projects with similar impacts on threatened microbats.

Monitoring of the exclusion devices would be undertaken by the project ecologist:

- daily during the exclusion process
- one week following the completion of the exclusion process
- once per month until construction occurs
- one day prior to construction at each roost entry / exit point.

8.1 Monitoring methodology

Monitoring during exclusion involves diurnal and nocturnal visual inspections of the roost entry / exit points using binoculars, torches, burrow scopes and cameras, as well as emergence surveys and ultrasonic recording during emergence. Evidence of microbats, the number and species of microbat present, indications of breeding activity, occurrence of any pest species, date and time of inspection and record of the rainfall and weather during inspections will be recorded during each monitoring event. The methodology is outlined in detail in Section 3.4.1.

Details of all monitoring inspections would be recorded in the log of actions and provided to the project manager following each monitoring inspection. The action log (Table 4) would be appended to the final report compiled by the project ecologist and provided to the project manager within one month upon completion of the project.

8.2 Performance measures

The project would be considered successful if there are no microbats injured or harmed as a result of the exclusion process and construction works.

8.3 Monitoring report

The monitoring report would include a brief description of the background to the project, details of the microbat habitat lost and aims and objectives of the monitoring, monitoring methodology, results of monitoring events and recommendations for future improvements to MMPs.

9. Reference List

Churchill, S. (2008). *Australian Bats. Second Edition*. Allen and Unwin Sydney

Eco Logical Australia. (2020). *Sydney Swans Head Quarter Microbat Survey Report*. Prepared for APP on behalf of the Sydney Swans

Geiser, F. and Kortner, G. (2010). Hibernation and daily torpor in Australian mammals. *Australian Zoologist* 35 (2) 204 - 215

Appendix A Potential microbat roost entry/exit location photos

Potential microbat roost entry/exit	Photo
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1: Near Door 7



2: Near Door 8



Potential microbat roost Photo
entry/exit

3: Eastern turret and facade



4: Inside eastern turret

