Bankwest Stadium Modification – Biodiversity Development Assessment Report

Prepared by AMBS Ecology & Heritage
for Venues NSW

Final Report

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Executive Summary

Bankwest Stadium (formerly referred to as Western Sydney Stadium) is a 30,000 seat purpose built stadium which is managed by Venues New South Wales (VNSW). Construction of the Bankwest Stadium precinct was completed in 2019, with the first sporting event held on 22 April 2019. VNSW is seeking to modify the current development consent for Bankwest Stadium (the Modification). The Modification would involve an increase to the number of major events that can be hosted at the Stadium each year. The Modification will not change the approved operational hours for major sporting or concert events at the Stadium, increase seating capacity at the Stadium, alter public domain areas, or increase the number of car parking spaces.

The Department of Planning, Industry and Environment (DPIE) advised VNSW that, under Section 7.17 of the *NSW Biodiversity Conservation Act 2016* (BC Act), a Biodiversity Development Assessment Report (BDAR) was required to assess potential impacts of the Modification on biodiversity values. In accordance with the BAM (OEH 2017) the streamlined assessment module (small area development that requires consent) was applied, on the basis that:

- no native vegetation will be removed and will therefore be less than the clearing threshold for the minimum lot size; and
- no clearing will occur in areas designated to have high biodiversity values as shown on the Biodiversity Values Map.

As required by the BAM (OEH 2017), relevant landscape features were identified and mapped. Important and/or local wetland, karsts, caves, crevices, cliffs and areas of geological significance, or areas of outstanding biodiversity value that have been identified under the BC Act do not occur in the assessment circle.

No Plant Community Types (PCTs) occur within the Bankwest Stadium precinct and no native vegetation will be removed due to the Modification. As such, no vegetation zones can be applied, the vegetation integrity assessment is not required, no BAM plots are required, and the patch size for the development is zero.

Two threatened entities that are known to occur outside the Bankwest Stadium precinct include:

- the Grey-headed Flying-fox roost, which occurs within vegetation adjacent to the Parramatta River to the north of the Bankwest Stadium precinct; and
- the River Flat Eucalypt Forest Threatened Ecological Community, which occurs to the west of the Bankwest Stadium precinct.

Field surveys of the Grey-headed Flying-fox roost were undertaken in August 2019 to map/confirm the camp's extent, estimate population size using roost counts and fly-out surveys, and record notes on the condition and behaviour of bats. Noise monitoring was also undertaken separately during two sporting events in August 2019.

The Modification will not result in direct impacts to the Grey-headed Flying-fox or River Flat Eucalypt Forest given that no vegetation will be removed. The additional events to be held at Bankwest Stadium will operate in accordance with the Biodiversity Operational Management Plan (BOMP) (AMBS 2019), and therefore are unlikely to significantly impact the roost or the River Flat Eucalypt Forest. Noise monitoring at two events indicated levels reaching the camp are at this stage within the parameters set by the BOMP (AMBS 2019). Monitoring data indicates that the Bankwest Stadium is not negatively impacting the Grey-headed Flying-fox roost. The monitoring program outlined in the BOMP (AMBS 2019) should enable detection of any unlikely negative impacts, and allow the corrective actions procedure to be initiated.

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1 Introduction

1.1 Background

Bankwest Stadium (formerly referred to as Western Sydney Stadium) is a 30,000 seat purpose built stadium which is managed by Venues New South Wales (VNSW), located in the City of Parramatta (Figure 1.1). It was built on the site of the former Parramatta Oval which had previously operated as a sporting and entertainment venue since 1985. The Bankwest Stadium precinct includes up to 500 surface car parking spaces, access infrastructure, ancillary infrastructure and landscaping. Construction of the Bankwest Stadium precinct was completed in 2019, with the first sporting event held on 22 April 2019.

VNSW is seeking to modify the current development consent for Bankwest Stadium (the Modification). The Modification would involve an increase in the number of major events that can be hosted at the Stadium each year, from 49 sporting events and 3 concerts, to 80 sporting events and 5 concerts. For clarity, the Modification is limited to increasing the number of events that can be hosted by existing stadium infrastructure and will not:

- remove native vegetation;
- change the approved operation hours of the Stadium;
- increase seating capacity at the Stadium;
- alter public domain areas; or
- increase the number of car parking spaces.

The Department of Planning, Industry and Environment (DPIE) advised VNSW that, under Section 7.17 of the *NSW Biodiversity Conservation Act 2016* (BC Act), a Biodiversity Development Assessment Report (BDAR) was required to assess potential impacts of the proposed Modification on biodiversity values (this document). This BDAR has been prepared in accordance with the streamlined assessment module (small area development that requires consent) of the Biodiversity Assessment Method (BAM) (OEH 2017) on the basis that:

- no native vegetation will be removed and will therefore be less than the clearing threshold for the minimum lot size associated with the property; and
- no clearing will occur in areas designated to have high biodiversity values as shown on the Biodiversity Values Map.

Considering the information outlined above, in particular that no native vegetation will be impacted, the BDAR focuses potential impacts of the Modification on the nearby Grey-headed Flying-fox (*Pteropus poliocephalus*) camp. The population is well-known, having been fully considered in the original applications and are central to the implementation of the Biodiversity Operational Management Plan (BOMP) for the Stadium (AMBS Ecology & Heritage [AMBS] 2019).

1.2 Subject land

The subject land relevant to this report is the Bankwest Stadium precinct operational boundary (Figure 1.2). Landmarks nearby the subject land include the Parramatta River to the west and south, Parramatta Leagues Club to the North and O'Connell Street to the east.

1.3 Information sources

Information to inform the BDAR was gathered from a number of sources, including a database and literature review focused on flora and fauna in the study area and nearby surrounds. Sources of information were the assessments undertaken for the original SSD applications, the BOMP for the Stadium (AMBS 2019), Acoustical Compliance monitoring reports, and the Grey-headed Flying-fox monitoring reports.

Figure 1.1 Regional location of the study area

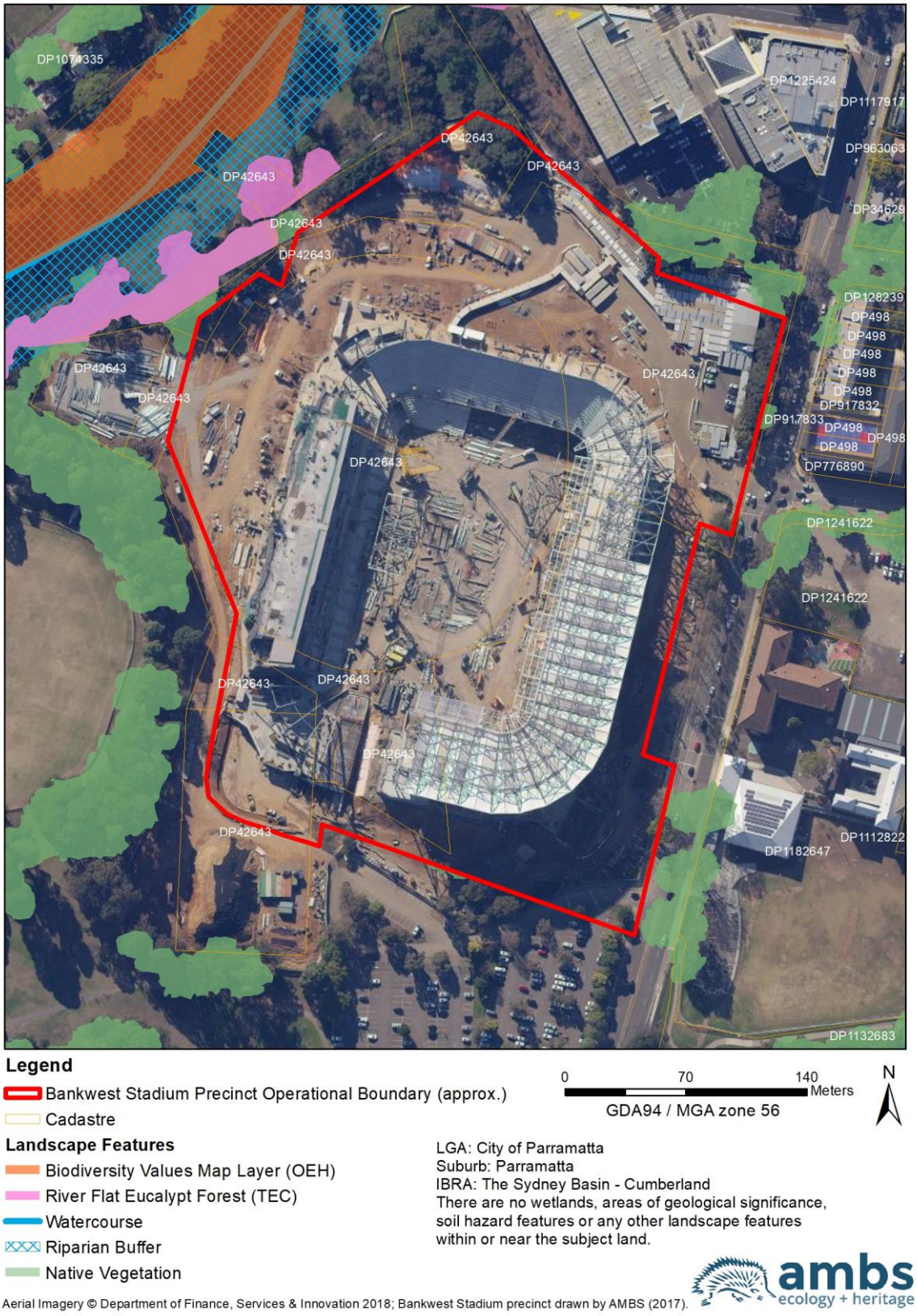

Figure 1.2 Site map

2 Landscape context

In accordance with the BAM (OEH 2017), a range of landscape features must be identified, where they occur on the subject land or within the study area surrounding the subject land. These features may contain biodiversity values that are important for the site context of the subject land, or for informing the likely habitat suitability of the subject land.

Details on relevant features within the subject land and surrounds are provided in the following sections.

2.1 IBRA bioregions/subregions & NSW landscape regions

The subject land is located within the:

- Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) Region;
- Cumberland IBRA subregion; and
- Ashfield Plains landscape (Mitchell Landscapes).

These layers are shown on Figure 2.1.

2.2 Vegetation extent in site and assessment area

The percentage of native vegetation cover within a 1,500 metre (m) assessment circle surrounding the subject land is required to be calculated for site context. The extent of native vegetation was investigated using OEH Regional Vegetation Mapping (OEH 2016), which showed some locations mapped as native vegetation. Areas classified by OEH (2016) as Exotic/Native were conservatively included in the calculations as native vegetation. The 1,500 m assessment circle occupied an area of approximately 879.7 hectares (ha). Of this, approximately 103.2 ha was estimated to comprise native vegetation. This equates to a native vegetation cover of 11.7%, which falls in the >10-30% vegetation extent class.

2.3 Connectivity

Connectivity features nearby the subject land and assessment circle are mostly limited to riparian vegetation along Parramatta River. Riparian vegetation has the potential to facilitate the movement of native fauna species across their range or during dispersal. While not extensive, roadside vegetation may also provide some connectivity across the city landscape, particularly in locations where the vegetation links other more vegetated areas such as parks.

2.4 Other features

Parramatta River occurs adjacent to the Bankwest Stadium precinct. The river forms at the confluence of Toongabbi Creek and Darling Mills Creek to the north of the precinct, and flows south around the western side of the precinct, before continuing east. Parramatta River riparian vegetation has been identified on the Biodiversity Values Map (Figure 2.1.). Domain Creek occurs to the west of the Parramatta River and the Bankwest Stadium precinct.

Important and/or local wetland, karsts, caves, crevices, cliffs and areas of geological significance, or areas of outstanding biodiversity value that have been identified under the BC Act, do not occur in the assessment circle.

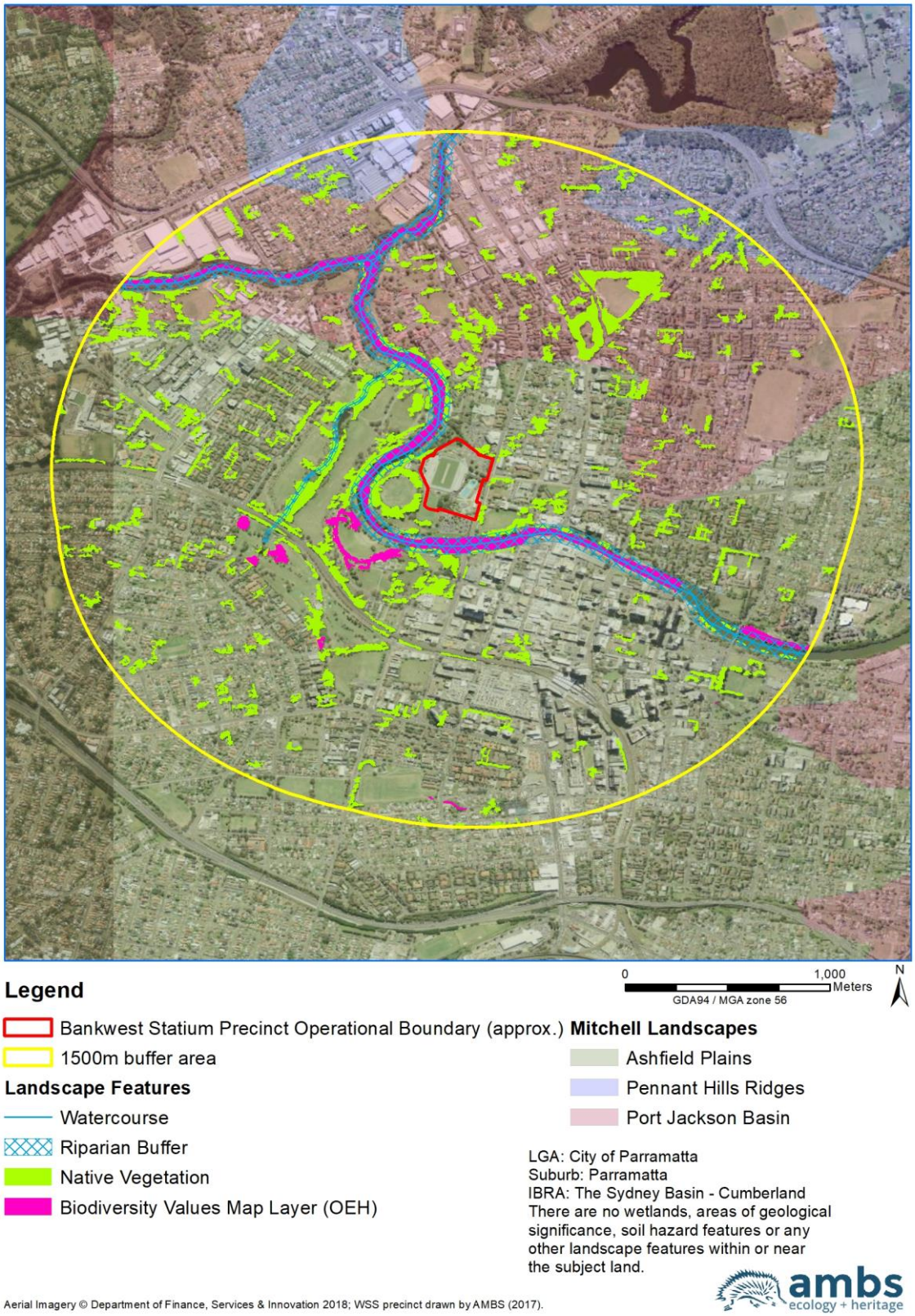

Figure 2.1 Location map

3 Native vegetation

The Bankwest Stadium precinct has been well-surveyed during previous studies associated with the demolition of the old stadium (Eco Logical 2016) and construction of the new stadium (AMBS 2017a). No Plant Community Types (PCTs) occur within the Bankwest Stadium precinct and no native vegetation will be removed due to the Modification. As such:

- no vegetation class, vegetation type or vegetation zone can be applied;
- the vegetation integrity assessment is not required;
- no BAM plots are required; and
- the patch size for the development is zero.

One endangered ecological community (EEC) listed under the BC Act, River-flat Eucalypt Forest, occurs adjacent to the north-western boundary of the Bankwest Stadium precinct (AMBS 2019; Figure 3.1). The area of the EEC is located outside of the Bankwest Stadium precinct boundary. The vegetation is in moderate condition with scattered remnant canopy species (AMBS 2017a). Section 6.2 of this report considers the potential for indirect impacts to the area of EEC.

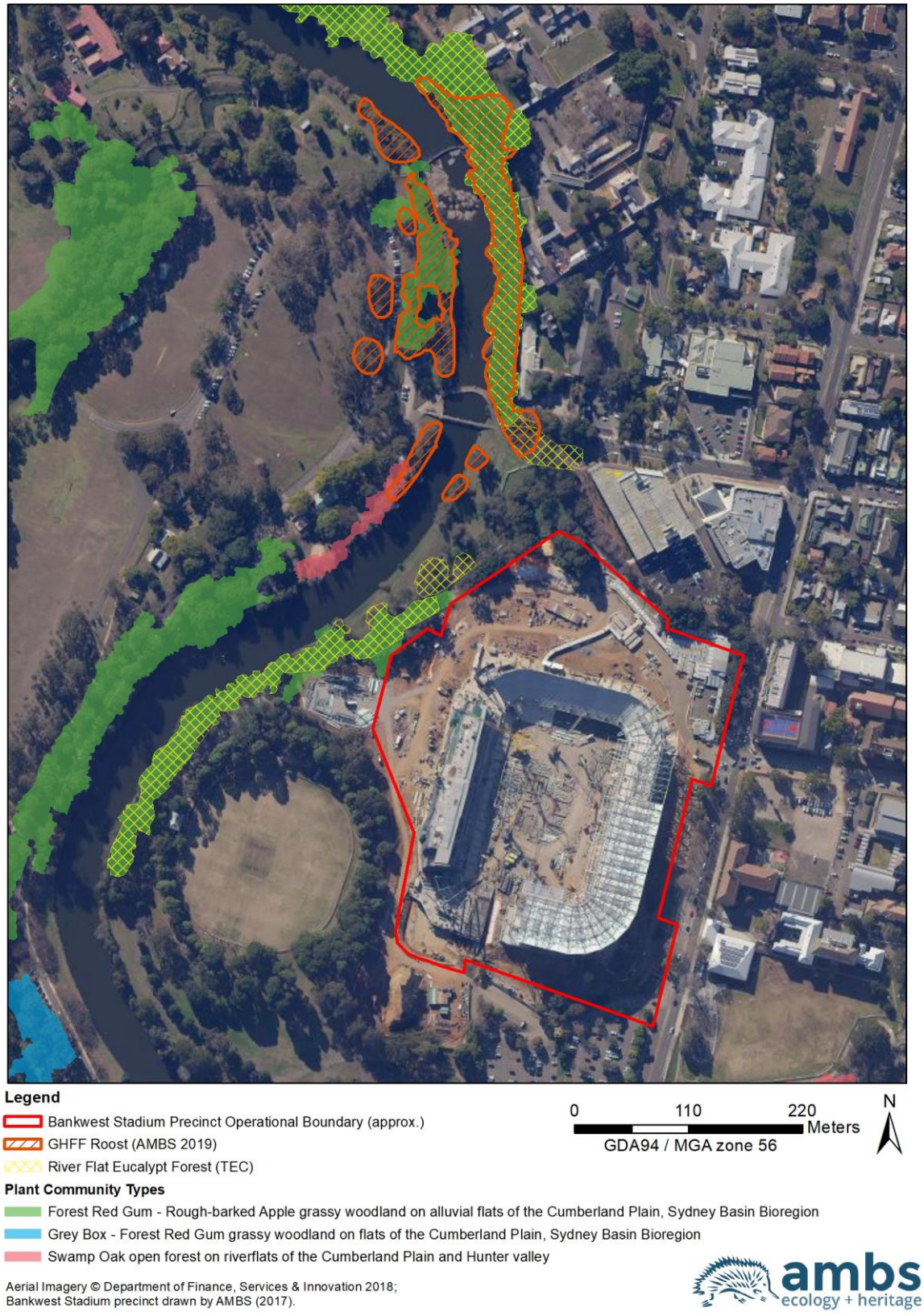

Figure 3.1 Threatened entities nearby the Bankwest Stadium precinct

4 Threatened species

4.1 Determine presence or absence of a candidate threatened species

In the BAM, the suitability of the habitat within the study area for threatened species is determined by a number of criteria:

- is the threatened species known or predicted to occur within the IBRA subregion;
- is the subject land within any geographic constraints of the distribution of the species within the IBRA subregion;
- is the species associated with any of the PCTs identified as occurring within the subject land;
- is the native vegetation cover within an assessment area 1,500 m wide surrounding the boundary of the subject equal to or greater than the minimum class that is required for the species;
- is the patch size which the vegetation zone is part of equal to or greater than the minimum specified for that species; and
- is the species identified as an ecosystem or species credit species in the Threatened Biodiversity Data Collection.

Consideration of these factors is usually undertaken within the BAM Calculator, and ultimately determines which threatened species require assessment for the Modification. If any one of the criteria relevant to the species outlined above are not met, the subject land is considered not suitable habitat for the threatened species and no further assessment is required for that species. No PCTs occur within the Bankwest Stadium precinct (i.e. the subject land) and no native vegetation or fauna habitat will be removed due to the Modification. As such, no ecosystem credit species or species credit species meet all of the criteria outlined above.

There have been a number of biodiversity reports prepared during the various construction phases of the Bankwest Stadium precinct, including:

- Stage 1 demolition of the previous Parramatta Stadium (Eco Logical 2016, AMBS 2017b);
- Stage 2 construction of the current Bankwest Stadium precinct (AMBS 2017a); and
- the Biodiversity Operational Management Plan (AMBS 2019).

Each of these reports was required to consider the potential impacts (and mitigation measures) of activities related to the demolition, construction, or operation of the Stadium, on threatened flora and fauna and ecological communities known from the locality.

All previous reports have included a targeted assessment of potential impacts to:

- the Parramatta River Grey-headed Flying-fox roost, which occurs within vegetation adjacent to the Parramatta River to the north of the Bankwest Stadium precinct (Figure 3.1); and
- the River Flat Eucalypt Forest TEC, which occurs to the west and outside of the Bankwest Stadium precinct (Figure 3.1).

Therefore, we have conservatively included an assessment of potential impacts of the Modification, to the Grey-headed Flying-fox camp and River Flat Eucalypt Forest.

4.2 Grey-headed Flying-fox surveys

4.2.1 Background

Previous biodiversity reports prepared for the Bankwest Stadium precinct identified that the Parramatta River Grey-headed Flying Fox roost could potentially be impacted by factors associated with the development and operation of the Bankwest Stadium facility. All reports concluded that if impacts occurred, they were likely to manifest themselves by one or some of the following:

- long-term decline in the number of Grey-headed Flying-foxes using the roost;
- decline or significant change in area occupied by the roost;
- observation of stress behaviours included licking and day-time flyouts; and
- total abandonment of the roost.

As a result, monitoring plans were developed to facilitate adaptive management responses in the event that the Grey-headed Flying-fox roost showed signs of negative impact from the operation of the Bankwest Stadium precinct. Sections 4.2.2 and 4.2.3 summarise the results and conclusions of the monitoring undertaken since October 2017.

4.2.2 Field Survey Methods

Cumberland Ecology
Cumberland Ecology undertook monitoring of the roost during the construction phase between October 2017 and October 2018 (Cumberland Ecology 2018a-g). The roost count results of these surveys are summarised in Table 4.1

In accordance with the BOMP (AMBS 2019) they have also undertaken monitoring in May 2019 and 27 August 2019. Each monitoring session included mapping/confirmation of the camp's extent, population estimates using fly-out surveys, and recording notes on the condition and behaviour or bats (Cumberland Ecology 2019).

Roost count surveys were undertaken by two ecologists within two areas; one along the south-eastern portion of the camp, and one along the south-western end of the camp. In primary roosting habitat two separate counts were undertaken (one by each person) with an average used for a density estimate which was extrapolated throughout the area of primary roosting habitat. Within secondary roosting habitat all individuals were counted by two people and the average of the two counts was used (Cumberland Ecology 2019). Fly-out counts were also undertaken by two ecologists stationed to the south of the roost adjacent to the river. Finally, the boundaries of the roost were estimated by marking locations on a hand-held GPS unit.

Notes on the general condition and behaviour of individuals were taken concurrently during the mapping, roosting and fly-out surveys. In particular, animals were observed to determine whether any showed signs of stress such as occurring within two metres of the ground or on the ground and whether any showed signs of excessive saliva production and licking (Cumberland Ecology 2019).

AMBS Ecology & Heritage
A roost count of the Grey-headed Flying-fox camp was undertaken by AMBS ecologist Narawan Williams on 28 August 2019. All individuals observed within six survey areas were counted. Four survey areas were located on the western side of the camp, and two were located on the eastern side. The number of individuals counted within each survey area was used to calculate a density estimate per hectare (ha). An estimation was also made of the density of individuals (low, medium, high) throughout other locations within the camp area. Total number of individuals within the camp was calculated by applying the density estimate per ha throughout the camp. Mapping of

the extent of the Grey Grey-headed Flying-fox camp was undertaken by marking boundaries of the roost with a GPS where possible, and through visual observation for inaccessible areas.

4.2.3 Results

In comparison to the mapping produced by Cumberland Ecology (2018a-g), the latest surveys undertaken by AMBS and Cumberland Ecology have both mapped the extent of the Grey-headed Flying-fox roost in additional locations. The roost now also occurs in two small locations to the south of the pedestrian footbridge, slightly closer to the Bankwest Stadium precinct.

Estimates of population size based on roost counts undertaken in August 2019 vary between 16,379 (Cumberland Ecology) and 28,828 (AMBS). Differences between the two estimates are likely due to a combination of factors, including the location and size of sample survey areas within the extent of the roost, and variation between observers.

The estimates of population size since October-November 2017 are provided in Table 4.1. For the purposes of this report it is important to note that based on the available data, the Parramatta Grey-headed Flying-fox population does not appear to have decreased since the operation of the Bankwest Stadium commenced. Notably, the current population estimates are the highest over the previous 2 years (Table 4.1). The numbers recorded by Cumberland Ecology (2018a-g) and AMBS are comparable to numbers counted as part of the National Flying Fox Monitoring Project (NFMP), and indicate that the number of individuals in the roost and the area covered by the roost have not declined beyond recent trend levels.

Table 4.1 Parramatta Grey-headed Flying-fox population roost counts, October 2017 – August 2019

Survey month	Count source	Population estimate
August 2019	Cumberland Ecology (2019)	16,379
August 2019	AMBS Ecology & Heritage (this report)	28,828
May 2019	Cumberland Ecology (2019)	15,050
October 2018	Cumberland Ecology (2018g)	5,684
August 2018	Cumberland Ecology (2018f)	5,024
June2018	Cumberland Ecology (2018e)	10,975
April 2018	Cumberland Ecology (2018d)	14,454
February 2018	Cumberland Ecology (2018c)	8,539
January 2018	Cumberland Ecology (2018b)	5,679
December 2017	Cumberland Ecology (2018a)	6,550
October-November 2017	Cumberland Ecology (2017)	12,260

Surveys undertaken by Cumberland Ecology and AMBS did not observe animals showing signs of illness or distressed behaviour. AMBS did not observe or any deceased individuals.

Cumberland Ecology (2019) noted that during the August 2019 survey, the behaviour of the bats present was consistent with what Cumberland Ecology had observed within the roost previously. Individuals were observed leaving their roost approximately 30 minutes after sunset, at 6:00 pm. No individuals appeared to be distressed from the project and no light spillage into the camp was observed (Cumberland Ecology 2019). Some individuals were observed leaving their roost well prior to dusk as a result of disturbances from unrelated project activities (e.g. motorcycles, cars, birds) (Cumberland Ecology 2019). Although such disturbances cause bats to leave their roost periodically throughout the day, the disturbed individuals were never observed leaving the camp entirely, but would fly to the other side of the camp to an area further from the disturbance (Cumberland Ecology 2019).

Figure 4.1 Grey-headed Flying-fox roost location

5 Avoiding or minimising impacts on biodiversity values

Potential impacts of the Modification have been reduced given that no native vegetation or fauna habitat will be removed. As discussed in Section 2.4 there are no karsts, caves, crevices, cliffs, or significant rock outcrops on the subject land. The Modification does not involve the use of wind turbines. Due to the small-scaled nature of the Modification and that it relates to a change in frequency of use of existing infrastructure, it is not expected to impact the hydrology of Parramatta River or increase the likelihood of vehicle strikes.

There may be potential for indirect impacts to the Grey-headed Flying-fox associated with noise. This is discussed further in Section 6.

6 Assessing and offsetting impacts

6.1 Grey-headed Flying-fox

The BOMP (AMBS 2019) identified a number of potential impacts to the Grey-headed Flying-fox due to operation of the Stadium, including noise and vibration, crowds/human interaction, light spill and cumulative impacts. The most likely impacts would result from noise, which is discussed in detail in Section 6.1.3, with other potential impacts discussed in Section 6.1.4. Section 6.1.1 provides an overview of the ecology of the Grey-headed Flying-fox, while Section 6.1.2 contains information specific to the Parramatta Grey-headed Flying-fox camp.

6.1.1 Ecology

The Grey-headed Flying-fox is a large bat found along the East-coast and ranges of Australia. It's core distribution ranges from Rockhampton in Queensland to the southern Victorian coasts close to Warrnambool (DoE 2018). The species has recently established a permanent colony in Adelaide, South Australia. While its distribution is primarily coastal, records have been reported over 400km from the coast. Its core range may be expanding in response to factors such as climate change, habitat destruction and resource availability. The new roost in Adelaide was established as recently as 2010.

Population estimates for the species vary significantly and it has been difficult to determine the overall population trend. Counts between 1998 and 2005 estimated the population between 320,000 and 435,000. Recent surveys as part of the NFMP have resulted in estimates varying between 335,000 – 963,000 (CSIRO 2013, 2016). The CSIRO note that the methodology employed during the NFMP counts means that if bats are not at the regularly monitored roost sites, they will not be counted. As such, the smaller number of the range represents a seasonal trough in the number of bats utilising the roosts.

Grey-headed Flying-foxes roost in large aggregations known as roosts or camps in the exposed branches of trees. Camps are either permanent or temporary. Permanent camps often have histories of occupation dating back over 100 years. Temporary camps are often occupied in response to a pulse of food in the region or as short-term resting sites by animals that are migrating (Eby 1991, Tidemann & Nelson 2004). The number of animals in a permanent camp can vary seasonally, annually or even over the course of several years. Animals will leave or join the camp in response to factors such as food availability, climate and disease. The largest camps recorded in Australia can have over 50,000 bats. Camps are usually located close to a permeant water source (Wescott *et al.* 2011). The foraging behaviour of the Grey-headed Flying-fox is dependent on the availability and location of food (Eby 1998, Parry-jones & Augee 1992). Large scale migrations and the establishment of temporary roosts is closely linked to seasons when food becomes scarce (CoA 2017, Eby 1998).

The species utilises subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps, gardens and cultivated fruit crops. The fruits and flowers of a wide variety of species are the food source of the Grey-headed Flying-fox. The species is regularly recorded feeding on the fruit, blossom and leaves of tree species such as *Ficus* sp., *Eucalyptus* sp., *Corymbia* sp., *Angophora* sp. as well as shrubs including *Melaleuca* sp., *Banksia* sp. and *Syzygium* sp. (CoA 2017, Eby and Law 2008, Hall and Richards 2000, Tidemann 1999, Eby 1998, Eby 1991, Parry-Jones & Augee 1991).

Breeding behaviours usually begin in January, leading to conception around August and birth between October and November. Young will travel with mothers during nightly foraging flights for four to five weeks, holding onto the mother's ventral surface during flight. After they are fully furred, young are left in maternity camps with other juvenile flying-foxes while the mother forages.

6.1.2 Parramatta River Grey-headed Flying-fox Roost

The Parramatta River Grey-headed Flying-fox roost is situated along thin strips of riparian vegetation either side of the Parramatta River (Figure 4.1). Based on information contained within BOMP (AMBS 2019), the southern boundary of the roost on the western bank of the river was located approximately 140-150m north of the Bankwest Stadium precinct, within the boundaries of Parramatta Park. It extended approximately 150m north along the river. On the eastern bank, the roost extended approximately 400m north (AMBS 2019). The Black Flying-fox (*Pteropus alecto*) is also known to utilise the roost in smaller numbers. The roost has co-existed with a variety of developments and land uses over the past decade including construction activity, sporting events, concerts and pyrotechnic displays (AMBS 2019).

The roost is monitored regularly as part of the NFMP. In 2008, it was reported that the roost supported between 5,000 and 6,000 individuals (Eco Logical 2008). Recent monitoring work for the NFMP indicates that the number of individuals utilising the camp fluctuates. Data from 2018 indicate that there were between 10,000 and 15,999 individuals in the camp (CSIRO 2018).

Prior to the opening of the Stadium, private monitoring of the roost was undertaken by Cumberland Ecology on behalf of Lend Lease. Monitoring has been undertaken since October 2017 (Cumberland Ecology 2017, 2018a-g). The number of individuals detected within the roost during the surveys has fluctuated between approximately 5,000 and 14,000 (Cumberland Ecology 2017, 2018a-g). Cumberland Ecology concluded that the roost experiences natural seasonal fluctuations. They have observed behavioural disturbance in response to noises originating from developments in the area but concluded that the roost was co-existing with the developments (Cumberland Ecology 2018f). Naturally cycling occupation of permanent roosts has been observed at numerous locations during the NFMP.

6.1.3 Potential Impacts - Noise

The BOMP (AMBS 2019) discussed that operation of Bankwest Stadium will result in periodic episodes of loud noises. Regular loud noise or periodic episodes of sudden loud noise has potential to:

- cause temporary or permanent abandonment of roosts;
- cause increased abandonment and mortality of juvenile bats; and,
- cause declining health and increased risk of disease.

Noise levels pre-Bankwest Stadium opening

The BOMP (AMBS 2019) discussed that the Parramatta River Grey-headed Flying-fox roost has co-existed with the old Parramatta Stadium for over 20 years during which there were regular sporting events and concerts. An acoustic assessment determined that the background noise 180m from the old Parramatta Stadium (corresponding to the distance between the new stadium and the southern boundary of the Flying-fox colony) was between 45-54 dB(A) with periodic spikes during music concerts and sporting events between 52-73 dB(A) (Acoustic Log 2017a).

Noise levels associated with the demolition and construction of Bankwest Stadium were monitored for over a year by Acoustic Logic. Daily monitoring indicated that background noise during demolition and construction ranged between 60dB(A) to 65dB(A) with occasional bursts up to 82.5 dB(A) (Acoustic Logic 2017b, 2018). Monitoring data collated between the same time period indicated that the Parramatta River Grey-headed Flying-fox roost population size remained within its recent historical range (Cumberland Ecology 2018f, DoE 2018).

Noise levels – Bankwest Stadium monitoring

Noise monitoring has been undertaken during two sporting events since the opening of Bankwest Stadium. One monitoring event took place on 10 August 2019 between 3:30pm and 7:30pm (The Acoustic Group 2019a) and the second took place on 22 August 2019 between 5:30pm and 9:45pm (The Acoustic Group 2019b). Both events involved noise monitoring from a location at the southern extent of the Grey-headed Flying-fox roost. In accordance with the BOMP (AMBS 2019), noise at the southern boundary should not exceed 75-76 dB(A) with occasional spikes up to 84 dB(A) during operation.

During both sporting events, all noise levels were below the parameters specified in the BOMP (Table 6.1; The Acoustic Group 2019a, 2019b). However, The Acoustic Group (2019a) noted that during the first sporting event, the half-time and full-time siren approached the upper limit, producing occasional spikes which reached 82 dB(A) (Table 6.1). Considering this data, VNSW ensured the siren volume was reduced for the next sporting event, to a level that would not approach the upper limit of the parameters specified in the BOMP (2019) (Table 6.1).

Table 6.1 Noise monitoring results from two sporting events in August 2019

Source of noise	10 August 2019	22 August 2019
Crowd cheering	60-62 dB(A)	53-77 dB(A)
PA announcements	60-62 dB(A)	54-73 dB(A)
Siren	78-82 dB(A)	64 dB(A) average maximum
Amplified music	-	53-61 dB(A)

Noise levels – Bankwest Stadium predictions (AMBS 2019)

Potential noise levels during music concerts being held at the Bankwest Stadium have been estimated for the southern and northern extent of the Grey-headed Flying-fox roost, as well as the western satellite camp. The southern extent of the roost and the satellite roost may experience average noise of 75-76 dB(A) during a concert, with occasional spikes up to 84 dB(A) (Acoustic Logic 2017a). The northern extent of the roost may experience average noise of 73 dB(A), with occasional spikes up to 81 dB(A) (Acoustic Logic 2017a). These numbers represent a worst-case scenario but they are outside the noise parameters in which the colony currently co-exists with. There are limited published data to inform what frequency of noise spikes is likely to result in negative impacts to the Grey-headed Flying-fox roost. When noise has been used in an attempt to disperse roosts, the noise has generally been applied over a continuous 30-minute to 60-minute period, and repeated throughout the day over the course of several days.

BOMP Monitoring Program

The BOMP (AMBS 2019) outlines a monitoring program that aims to:

- document the short-term and long-term response of the roost to noise from the operation of the Bankwest Stadium;
- document changes in area occupied and population size of the Parramatta River Grey-headed Flying-fox roost during the operational phase of the Bankwest Stadium;
- document diurnal and nocturnal behavioural responses to noise, vibration, crowd interaction and lights originating from operation of the Bankwest Stadium;
- document breeding success and observations of juvenile mortality; and
- investigate options for habitat augmentation which can allow the colony to respond to unanticipated stress responses to operational noise and vibration.

Key components of the monitoring program include:

- quarterly roost occupancy estimates, area calculations and counts/estimates of number of juveniles present in the roost;
- observation of diurnal and nocturnal behavioural response to potential impacts originating from operation of Bankwest Stadium;
- noise monitoring utilising a noise sensor located at the southern extent of the Grey-headed Flying-fox roost;
- noise monitoring is undertaken for at least two major sporting events each year and every concert;
- where possible, quarterly roost counts will overlap with a concert or major event to facilitate observation of animal behaviour; and
- performance criteria and corrective actions procedure to facilitate ongoing adaptive management (e.g. if performance criteria are breached during the operation of Bankwest Stadium, the noise management contractor and/or the ecological consultant will notify the operator of the Stadium immediately).

The proposed monitoring program will be reviewed after 3 years or if data collected during monitoring facilitates a review (AMBS 2019). If the Parramatta River Grey-headed Flying-fox roost shows that it is continuing to co-exist with the operation of the Stadium, a reduction in the frequency of monitoring could be investigated in consultation with relevant stakeholders including DPIE. If signs of stress or population displacement are observed, a modification to the monitoring program may be initiated to investigate potential causes of stress and displacement.

Impact Assessment Conclusion

The Modification will not result in direct impacts to the Grey-headed Flying-fox given that no roosting habitat will be removed. The additional events held at the existing Bankwest Stadium will operate within existing noise parameters specified within the BOMP (2019), and therefore are unlikely to significantly impact the roost. Indirect impacts from noise are considered unlikely on the basis that:

- noise monitoring at two events indicated levels reaching the camp are at this stage within the parameters set by the BOMP (AMBS 2019);
- the Grey-headed Flying-fox camp has coexisted nearby the previous Parramatta Stadium for many years and may have adapted to some levels of noise related disturbance (AMBS 2019);
- monitoring data indicates that the Bankwest Stadium is not negatively impacting the Grey-headed Flying-fox camp (i.e. population estimates are at least the same or potentially higher than previous years);
- the monitoring program outlined in the BOMP (AMBS 2019) should ensure the Stadium operates within specified noise parameters; and

- the monitoring program outlined in the BOMP (AMBS 2019) should enable detection of any unlikely negative impacts and initiate the corrective actions procedure.

6.1.4 Potential Impacts – Other

Other potential impacts identified in the BOMP (2019) due to operation of the Stadium, include crowds/human interaction, light spill and cumulative impacts.

Light Spill

Bankwest Stadium is an enclosed stadium with 268 direction LED spotlights installed under the croft of the stadium roof. In addition, permanent precinct lighting includes car park lighting and path lighting. Occasionally, depending on the event, mobile temporary light towers are utilised. Light spill is of primary concern during the breeding season, specifically, when juvenile flying-foxes remain in the roost during the night while their mothers forage away from the roost. Excessive light spill can cause stress in juvenile flying-foxes and can result in suitable creche habitat being abandoned (AMBS 2019).

During August 2019, Cumberland Ecology (2019) did not observe light spillage into the roost area. Further, no individuals appeared to be distressed. The behaviour of the bats present was consistent with what Cumberland Ecology had observed within the camp previously. Current population estimates are at least the same, or potentially higher, than previous years suggesting the new Bankwest Stadium is unlikely to be negatively impacting the Grey-headed Flying-fox roost. The BOMP monitoring program (AMBS 2019) should enable detection of any unlikely negative impacts and initiate the corrective actions procedure. On the basis of the above, light spill associated with the Modification is unlikely to significantly impact the Grey-headed Flying-fox roost.

Crowd Interaction

The Grey-headed Flying-fox roost currently occupies a thin strip of riparian vegetation on both the western and eastern banks of the Parramatta River. During construction of the Stadium, the southern extent of the roost was on the eastern bank directly adjacent to the pedestrian bridge over the Parramatta River that leads to the Bankwest Stadium precinct. Surveys undertaken in August 2019 show the southern extent of the camp is now slightly further south, on the southern side of the pedestrian bridge, slightly close to the Stadium (Figure 4.1).

The increased number of events proposed in the Modification may mean the chance of human and crowd interaction with the Flying-fox roost could increase; however we acknowledge this is difficult to quantify. There may be potential to impact the Flying-fox roost, especially during sensitive periods like the breeding season and during extreme climatic events. Continuation of the monitoring program outlined in the BOMP (AMBS 2019) is essential to again an improved understanding of any potential impacts relating to interaction with crowds.

Current population estimates are at least the same or potentially higher than previous years, suggesting the new Bankwest Stadium is unlikely to be negatively impacting the Grey-headed Flying-fox roost. The BOMP monitoring program (AMBS 2019) should enable detection of any unlikely negative impacts and initiate the corrective actions procedure. On the basis of the above, crowd interactions associated with the Modification are unlikely to significantly impact the Grey-headed Flying-fox roost.

Cumulative Impact

The Parramatta River Grey-headed Flying-Fox colony appears to have shown resilience to major construction projects being undertaken at the Bankwest Stadium precinct (AMBS 2019). Studies have shown that the chance of permanent roost abandonment increases if elevated noise episodes are frequent over an extended period of time. The area surrounding the roost on the eastern bank has been subject to an increasing rate of development. In addition to the development of the Bankwest Stadium precinct, a redevelopment of Parramatta Leagues Club has been undertaken, and the Parramatta North Growth Centre is in the initial stages of redevelopment.

While the Flying-fox roost has co-existed with the previous stadium, and appears to be co-existing with operation of the Bankwest Stadium, there is a small risk that it will be less adaptable to an increase in the number of major events held at the Stadium, in conjunction with additional developments that are occurring in the area. We acknowledge that potential impacts relating to an increase in the number of events, are likely to be less severe than potential impacts that could have occurred during stadium demolition and construction.

Current population estimates are at least the same or potentially higher than previous years, suggesting the operation of Bankwest Stadium is unlikely to be negatively impacting the Grey-headed Flying-fox roost. The BOMP monitoring program (AMBS 2019) should enable detection of any unlikely negative impacts and initiate the corrective actions procedure. On the basis of the above, cumulative impacts driven by the Modification are unlikely to significantly impact the Grey-headed Flying-fox roost.

6.2 River Flat Eucalypt Forest

River-flat Eucalypt Forest occurs adjacent to the north-western boundary of the Bankwest Stadium precinct (Figure 3.1). The area of the EEC is located outside of the Bankwest Stadium precinct boundary and is therefore unlikely to be directly impacted the Modification. The BOMP (AMBS 2019) concluded potential impacts to the EEC are strongly associated with construction related activities and that operation of Bankwest Stadium is unlikely to contribute to the degradation of the EEC. However, the BOMP (AMBS 2019) also acknowledged that unexpected impacts could occur as a result of the operation of Stadium. To account for the potential for unexpected impacts the following is monitored in accordance with the BOMP (AMBS 2019):

- monitor litter build up;
- assess the overall condition of the EEC and compare to previous investigations;
- document weed species and their coverage and compare to previous investigations; and
- identify potential impacts that could be driving a decrease in condition of the EEC (if condition is decreasing).

In accordance with the BOMP (2019), the monitoring should occur every 2 years over the course of 5 years. If key performance criteria are met over the 5-year period the monitoring requirement would be reduced to once every 5 years, however, the frequency would be increased again if performance criteria fail to be met.

Condition monitoring of the EEC would be undertaken by establishing a small set of permanent survey plots (AMBS 2019). Initial surveys would be biannual so that change over time can be detected.

It is unlikely that the operation of Bankwest Stadium will impact the EEC and given that the Modification is limited to an increase in use of existing infrastructure, it is considered unlikely for any additional impacts to occur. The monitoring program outlined in the BOMP (2019) should provide appropriate safeguards to determine if any unexpected impacts eventuate.

7 Thresholds for the assessment and offsetting of impacts of development

The Modification will not result in serious and irreversible impacts to a threatened entity. There are no potential impacts of the Modification which require an offset.

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