Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Western Sydney International (Nancy-Bird Walton) Airport – Airspace and flight path design

Environmental Impact Statement

Technical paper 5: Wildlife strike risk

October 2024

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Terms and abbreviations

Term/abbreviation	Definition
AC	Advisory Circular
AE	Adverse Effect (strikes that results in damage, delay or other operational consequences)
AGL	Above Ground Level
AIP	Aeronautical Information Package
Airport Safeguarding	Land use planning processes to manage the impact of development around airports to improve safety outcomes and community amenity
ARP	Aerodrome Reference Point
ASRI	Airport Survey Risk Index
ATC	Air Traffic Control
ATSB	Australian Transport Safety Bureau
AUD	Australian Dollar
CAA	Civil Aviation Authority (United Kingdom)
CAANZ	Civil Aviation Authority of New Zealand
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations
Consequence	The outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event
Crepuscular	Active at dawn and dusk.
Critical Area	Areas within or in close proximity to the flight strip, approach and landing paths, and movement areas of an airport
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DCP	Development Control Plan
EIS	Environmental Impact Statement
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
ERSA	En Route Supplement Australia
Flying-fox camp	A permanent, or semi-permanent area, usually a group of trees, where flying-foxes congregate to roost and breed
Fly-over	When birds fly over the airspace without coming to or from an airside area
Hazard	A source of potential harm or a situation with potential to cause loss
IBSC	International Bird Strike Committee (succeeded by the World Birdstrike Association)

Term/abbreviation	Definition
ICAO	International Civil Aviation Organization
MOS	Manual of Standard
NA	Not applicable
NASF	National Airports Safeguarding Framework A national land use planning framework that aims to: a. improve community amenity by minimising aircraft noise-sensitive developments near airports; and b. improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions through guidelines being adopted by jurisdictions on various safety-related issues. Guideline C *Managing the Risk of Wildlife Strikes in the Vicinity of Airports*, provides guidelines to land users and planners regarding the management of wildlife hazards
NOTAM	Notice to Airmen
NSW	New South Wales
Occurrence	Collective term used for all accidents and incidents in aviation
PO	Performance Outcomes
Probability	The likelihood of a specific event or outcome, measured by the ratio of specific events or outcomes to the total number of possible events or outcomes
Risk	The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and probability
SEPP	State Environment Planning Policy
SRI	Species Risk Index
Soaring	When birds maintain height in the air without flapping wings
Thermaling	When birds find hot, rising pockets if air and use the currents to stay aloft and gain altitude
Transiting	When birds fly from one place to another but remain airside
USD	United States Dollar
WBA	World Birdstrike Association (previously the IBSC)
Wildlife breeding/roosting	A location where wildlife have established a breeding or roosting site. The site can be naturally occurring (e.g. forest) or in the built environment (e.g. building)

Term/abbreviation	Definition
Wildlife Strike	A **reported wildlife strike** is deemed to have occurred whenever: • a pilot reports a strike to the ATSB • aircraft maintenance personnel find evidence of a bird or animal strike on an aircraft • personnel on the ground report seeing an aircraft strike one or more birds or animals • bird or animal remains are found on the airside pavement area, or within the runway strip, unless another reason for the bird or animals death can be established. A **suspected wildlife strike** is deemed to have occurred whenever a bird or animal strike has been suspected by aircrew or ground personnel but upon inspection: • no wildlife carcass or remains are found, and • there is no physical evidence on the aircraft of the strike having occurred. A **confirmed wildlife strike** is deemed to have occurred whenever: • aircrew report that they *definitely* saw, heard or smelt a bird strike • bird or animal remains are found on the airside pavement area or within the runway strip, unless another reason for the bird or animal's death can be found • aircraft maintenance personnel find evidence of a bird or animal strike on an aircraft. A **wildlife near miss** is deemed to have occurred whenever a pilot takes evasive action to avoid birds or animals. An **on-aerodrome wildlife strike** is deemed to be any strike that occurs within the boundary fence of the aerodrome, or where this is uncertain, where it occurred below 500 ft on departure and 200 ft on arrival. A **wildlife strike in the vicinity of an aerodrome** is deemed to have occurred whenever a bird strike occurs outside the area defined as 'on aerodrome' but within an area of 15 kilometres radius from the aerodrome reference point or up to 1,000 feet above the elevation of the aerodrome. A **wildlife strike remote from the aerodrome** is deemed to have occurred whenever a bird strike occurs more than 15 kilometres from an aerodrome or more than 1,000 feet above the elevation of the aerodrome.
Wildlife Survey	Standardised[1] high-level surveys that capture data regarding wildlife species, their behaviours and their distribution. Usually completed by wildlife biologists
WSI	Western Sydney International Airport
YSBK	Bankstown Airport
YSSY	Sydney International Airport

[1] Standardised means the survey method is prescriptive and replicable.

Executive summary

Avisure was engaged to assess the wildlife strike risk to inform the EIS for the Airspace and Flight Path Design for Western Sydney International Airport (WSI) (the project). Consideration of the airport site relative to the land uses in the airport vicinity is important as wildlife are likely to use the whole landscape interchangeably, transiting to and from various habitats, potentially impacting aviation safety and negatively affecting fauna populations due to wildlife strikes.

Most wildlife strikes in aviation occur at or below 3,500 feet (ft), therefore of primary concern are the approach and departure paths at this altitude or below. While strikes above this altitude can occur with thermaling species such as Australian Pelican *Pelecanus conspicillatus* and Wedge-tailed Eagle *Aquila audax*, the frequency of high-altitude strikes is comparatively low. Therefore, the strike risk is highest below 3,500 ft and safeguarding principles applied to land use on these areas, and implementation of the Western Sydney International Airport wildlife management program, will be critical.

Managing wildlife hazards on airports is regulated by the Civil Aviation Safety Regulations (CASR) (1998) Part 139 (Aerodromes) Manual of Standards (MOS) as defined by the *Civil Aviation Act 1998* and is guided by a number of other industry recommendations and standards. There are also national and international requirements and guidance documents that indicate land use in the vicinity of an airport can contribute significantly to the wildlife hazard levels and safety of aircraft operations.

The assessment reviewed data and documents relating to the existing environment, the current wildlife attraction, WSI operations (current and proposed/in-construction), and all regulations, standards and industry guidelines relevant to wildlife hazard mitigation in aviation. The assessment also surveyed wildlife on- and off-airport in July, August, September and October 2022, with targeted flying-fox surveys also completed during each survey month. Data collected was used to assess species risk airside, and the risk associated with off-airport sites (up to 30 kilometres (km)).

The wildlife strike risk assessment identified one very-high risk species; Eastern Grey Kangaroo *Macropus giganteus* (although this risk should be minimal once the airport is fully contained by the secure perimeter fence and the existing airside population has been removed), and 8 high risk species; Straw-necked Ibis *Threskiornis spinicollis* Australian White Ibis *Threskiornis molucca,* European Brown Hare *Lepus capensis,* Red Fox *Vulpes vulpes,* Wood Duck *Chenonetta jubata,* Pacific Black Duck *Anas superciliosa,* Little Black Cormorant *Phalacrocorax sulcirostris,* and Chestnut Teal *Anas castanea.*

An off-airport risk assessment of 73 sites within 30 km of Western Sydney International Airport identified one very-high risk site; Duncan Creek, and 5 high risk sites; a pond on Elizabeth Drive, the Kemps Creek Resource Recovery Park, a pond on Wolstenholme Avenue, the Western Sydney Parklands, and the Lake Gillawarna Ibis Colony. Wildlife using an off-airport land use can affect wildlife strike risk. Aircraft overflying a site with birds in the air (e.g., thermaling or soaring) can conflict with aircraft. Birds traversing aircraft flight paths to and from land uses can conflict with aircraft. There can be significant population growth of species receiving abundant food resulting in spill over onto areas around or on the airport. Risk can increase during certain events, such as heavy rainfall or ploughing activity. For this reason, understanding how wildlife are using areas in the vicinity of the airport is just as important as wildlife using the airfield.

This report places a particular emphasis on flying-foxes and Australian White Ibis due to potentially significant issues with these species, however it is important that any species presenting an unacceptable risk to aviation is appropriately managed in a way that minimises their strike risk while conserving native wildlife populations.

A review of wildlife survey data on and around the airport noted 4 threatened species; Grey-headed Flying-fox *Pteropus poliocephalus,* White-bellied Sea-Eagle *Haliaeetus leucogaster,* Cattle Egret *Bubulcus ibis*, and Glossy Ibis *Plegadis falcinellus.* The vision of the Western Sydney Aerotropolis will see increased tree canopy cover to 40 per cent, enhanced riparian zones and wetlands and generally improved biodiversity across the area. This is likely to attract wildlife, including protected species such as *P. poliocephalus*, and will require a balanced approach to deliver this vision and safeguard airport operations.

The impact on protected species due to strikes with aircraft is likely to be minimal, however populations must be monitored to allow for the early detection of emerging issues. Ongoing monitoring will be needed to determine wildlife population trends, identify which ones are increasing, and assess the effectiveness of safeguarding principles and mitigation applied by the airport and surrounding land users to maintain aviation safety and conserve threatened species.

Safeguarding the airport against wildlife hazards requires a multi-stakeholder approach. Western Sydney Airport (WSA) will prepare, in accordance with civil aviation regulations, a wildlife management program that focuses on the airfield, however land users and relevant authorities within the vicinity of the airport must adhere to the safeguarding principles set out in the Western Sydney Aerotropolis Development Control Plan 2022.

Mitigation should aim to reduce the attraction of wildlife in the vicinity of the airport (targeting attractants linked to food water and shelter), and to reduce the risk of overabundant populations of opportunistic urban wildlife, such as Australian White Ibis.

Monitoring underpins all wildlife hazard mitigation and airport safeguarding and is highly recommended. Robust standardised monitoring programs that regularly collect meaningful data will inform decisions relating to wildlife management programs, identify emerging risks, and determine wildlife activity trends over time.

The scope, scale and variability in the mitigations recommended means costs cannot be estimated at this time.

How wildlife use the landscape, and how they will respond to changes in that landscape during airport construction and operation, is complex. Targeted and effective wildlife management must be informed by understanding how wildlife use this changing landscape, which can only be achieved through ongoing and standardised monitoring, including the use of radar, regular risk assessments and regular revisions of management procedures and assessment protocols.

Based on the wildlife risk assessment and the off-airport risk assessment there are species that present significant strike risk at Western Sydney Airport. In addition, land uses in the vicinity of the airport attract wildlife that will intersect with aircraft operating into and out of the airport. Therefore, Western Sydney International Airport requires a rigorous and integrated wildlife management program to effectively manage wildlife strike risk. Species risks are dynamic, may not be accurate predictors of future risks, and will change in response to landscape changes during airport construction and operation, as well as changing land use activity in the vicinity of the airport. As such, the assessment results should be viewed as preliminary.

Chapter 1 Introduction

This chapter provides an overview of the proposed airspace and flight path design for the Western Sydney International (Nancy-Bird Walton) Airport (WSI). This includes the background to WSI and its accompanying airspace and flight path design (the project) which impacts on the existing Sydney Basin airspace. It describes the key features and objectives of the project and identifies the purpose and structure of this this technical paper.

1.1 Western Sydney International (Nancy-Bird Walton) Airport

1.1.1 Background

In 2016, the then Australian Minister for Urban Infrastructure approved development for a new airport for Western Sydney, now known as the Western Sydney International (Nancy-Bird Walton) Airport (WSI), under the *Airports Act 1996* (Commonwealth). The site of the new airport (the Airport Site) covers approximately 1,780 hectares (ha) at Badgerys Creek, as shown in Figure 1.1. The Airport Site is located within the Liverpool local government area (LGA).

Following the finalisation of the *Western Sydney Airport – Environmental Impact Statement* (2016 EIS), the Western Sydney Airport – Airport Plan (Airport Plan) was approved in December 2016. The Airport Plan authorised the construction and operation of the Stage 1 Development. It also set the requirements for the further development and assessment of the preliminary airspace design for WSI. The Australian Government has committed to developing and delivering WSI by the end of 2026.

The 2016 approval provided for the on-ground development of Stage 1 Development of WSI (a single runway and terminal facility capable of initially handling up to 10 million passengers per year) utilising indicative 'proof of concept' flight paths. These flight paths, presented in the 2016 EIS demonstrated that WSI could operate safely and efficiently in the Sydney Basin. WSI will be a 24-hour international airport and will:

- cater for ongoing growth in demand for air travel, particularly in the rapidly expanding Western Sydney region, as well as providing additional aviation capacity in the Sydney region more broadly
- provide a more accessible and convenient international and domestic airport facility for the large and growing population of Western Sydney
- provide long term economic and employment opportunities in the surrounding area
- accelerate the development of critical infrastructure and urban development.

The Australian Government has committed to developing and delivering WSI by the end of 2026.

The design and assessment process for the next phase of the airspace design (referred to as the preliminary airspace design) was set by Condition 16 of the Airport Plan. This included the future airspace design principles and the establishment of an Expert Steering Group. Key to these design principles was the need to minimise the impact on the community and other airspace users while maximising safety, efficiency and capacity of WSI and the Sydney Basin airspace. The airspace design must also meet the requirements of Airservices Australia and civil aviation safety regulatory standards.

Led by the Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), the Expert Steering Group has developed the preliminary flight paths and airspace arrangements for WSI (the project). The preliminary airspace design is the subject of the EIS.

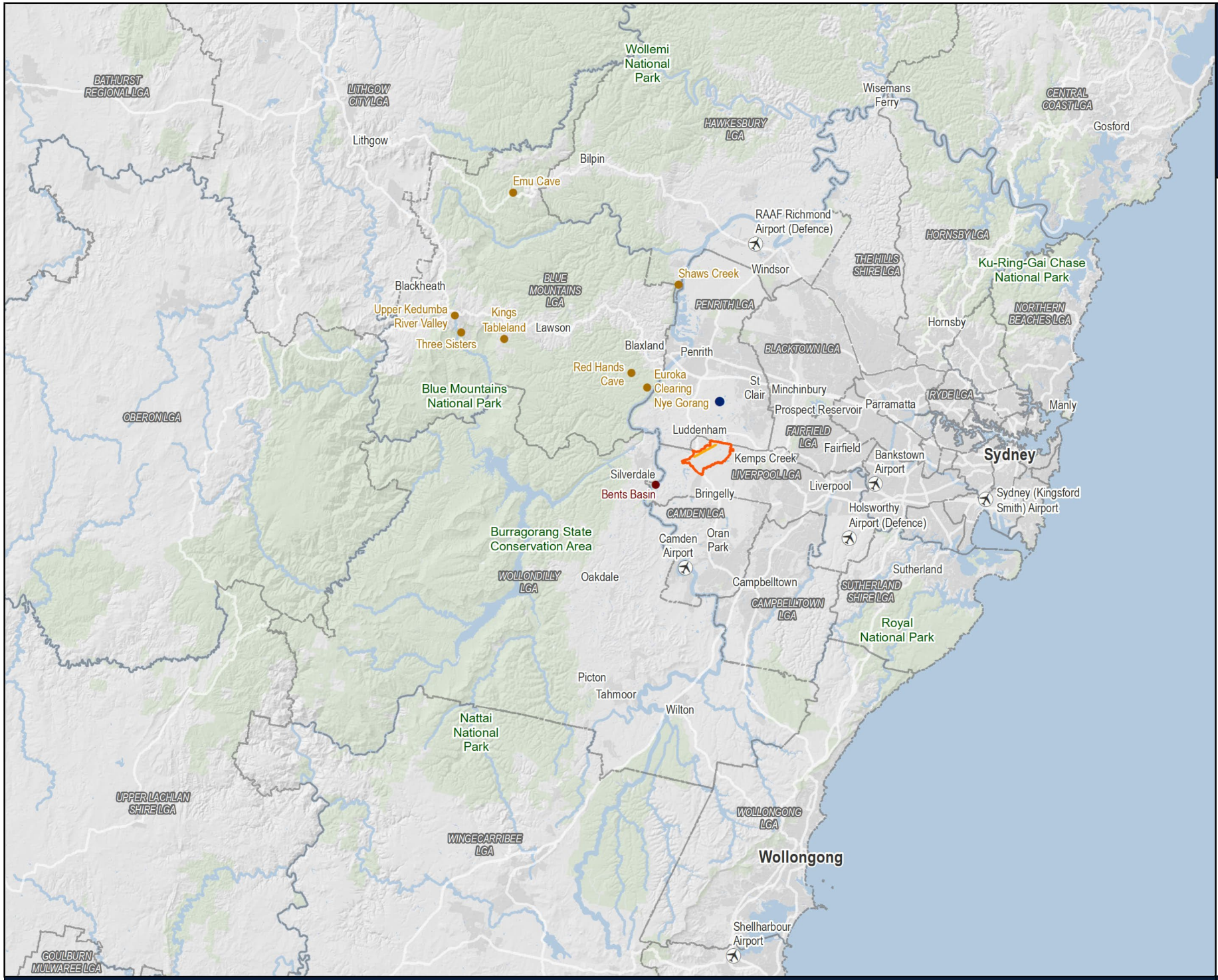

Figure 1.1

Regional Context of the Western Sydney International (Nancy-Bird Walton) Airport

Legend

- WSI Runway
- Western Sydney International (Nancy-Bird Walton) Airport land boundary
- State local government area (LGA)
- Orchard Hills Defence Establishment
- Aboriginal Places raised during consultation (NPW Act)
- Site of Aboriginal significance

0 10 20 km

Coordinate system: GDA 1994 NSW Lambert

Scale ratio correct when printed at A4

1:750,000 Date: 27/06/2023

Data sources: - DITRDC, DCS, Geoscience Australia
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Airbus,USGS,NGA,NASA,CGIAR,NCEAS,NLS,OS,NMA,Geodatastyrelsen,GSA,GSI and the GIS User Community

1.1.2 The Airport

1.1.2.1 Stage 1 Development

The Stage 1 Development of WSI has been approved and is limited to single runway operations. It will handle up to 10 million annual passengers and around 81,000 air traffic movements per year by 2033 including freight operations (a movement being a single aircraft arrival or departure). Single runway operations are expected to reach capacity at around 37 million annual passengers and around 226,000 air traffic movements per year in 2055.

The approval provides for the construction of the aerodrome (including the single runway), terminal and landside layout and facilities, and ground infrastructure such as the instrument landing systems and high intensity approach lighting arrays. Construction of the Stage 1 Development commenced in 2018. Figure 1.2 shows location of the single runway within the Airport Site.

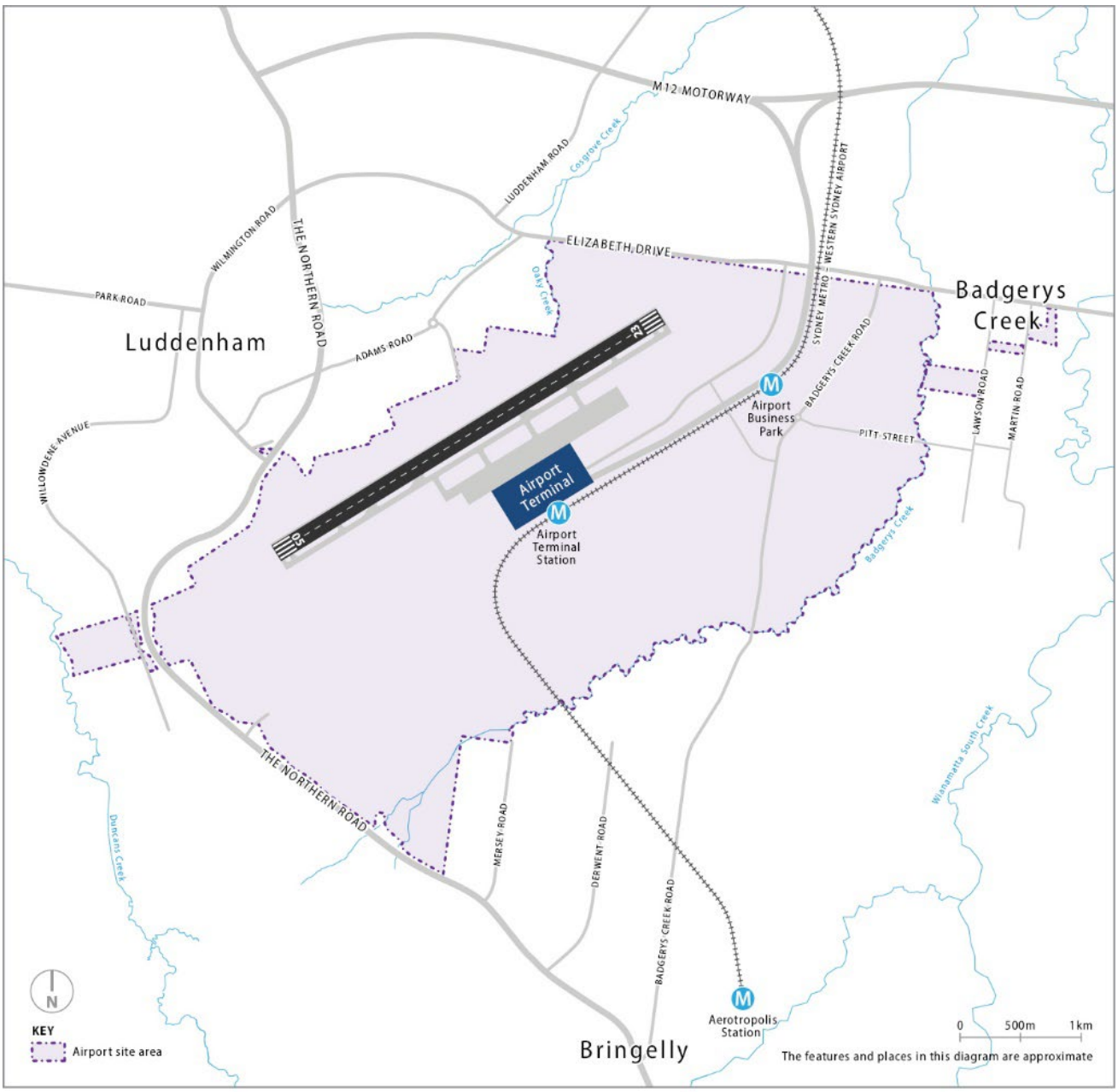

Figure 1.2 Western Sydney International Stage 1 Development

1.2 The project

The project consists of the development and implementation of proposed flight paths and a new controlled airspace volume for single runway operations at WSI. The project also includes the associated air traffic control and noise abatement procedures for eventual use by civil, commercial passenger and freight aircraft. The airspace and flight paths would be managed by the Air Navigation Services Provider (ANSP), Airservices Australia.

The project involves flight paths for all-weather operations on Runway 05 and Runway 23 during the day (5:30 am to 11 pm) and night (11 pm to 5:30 am), as well as head-to-head Reciprocal Runway Operations (RRO) during night-time periods (when meteorological conditions and low flight demand permit) to minimise the number of residences subjected to potential noise disturbance.

The flight paths differ during the day and night. Flight paths at night differ to take advantage of the additional airspace capacity offered when the curfew for Sydney (Kingsford Smith) Airport is in force. The proposed flight paths (as exhibited) are depicted in Figure 1.3 to Figure 1.7.

The project does not include any physical infrastructure or construction work.

Since the exhibition of the Draft EIS, refinements to the project have been incorporated into the preliminary flight path design. The final preliminary flight path design is presented in Chapter 7 (The Project) of the EIS.

1.2.1 Objectives of the project

The overall objectives for WSI are to:

- improve access to aviation services for Western Sydney
- resolve the long-term aviation capacity constraints in the Sydney Basin
- maximise the economic benefit for Australia by maximising the value of the Airport as a national asset
- optimise the benefit of WSI for employment and investment in Western Sydney
- deliver sound financial, environmental and social outcomes for the Australian community.

The project will assist in achieving these overall objectives as it would enable single runway operations to commence at WSI through the introduction of new flight paths and a new controlled airspace volume.

The Western Sydney Airport Plan sets out 12 airspace design principles that the design process is required to follow. The principles were informed by and reflect community and industry feedback on the 2016 EIS. The principles seek to maximise safety, efficiency and capacity, while minimising impacts on the community and the environment. For further information on the airspace design principles refer to Chapter 6 (Project development and alternatives) of the EIS.

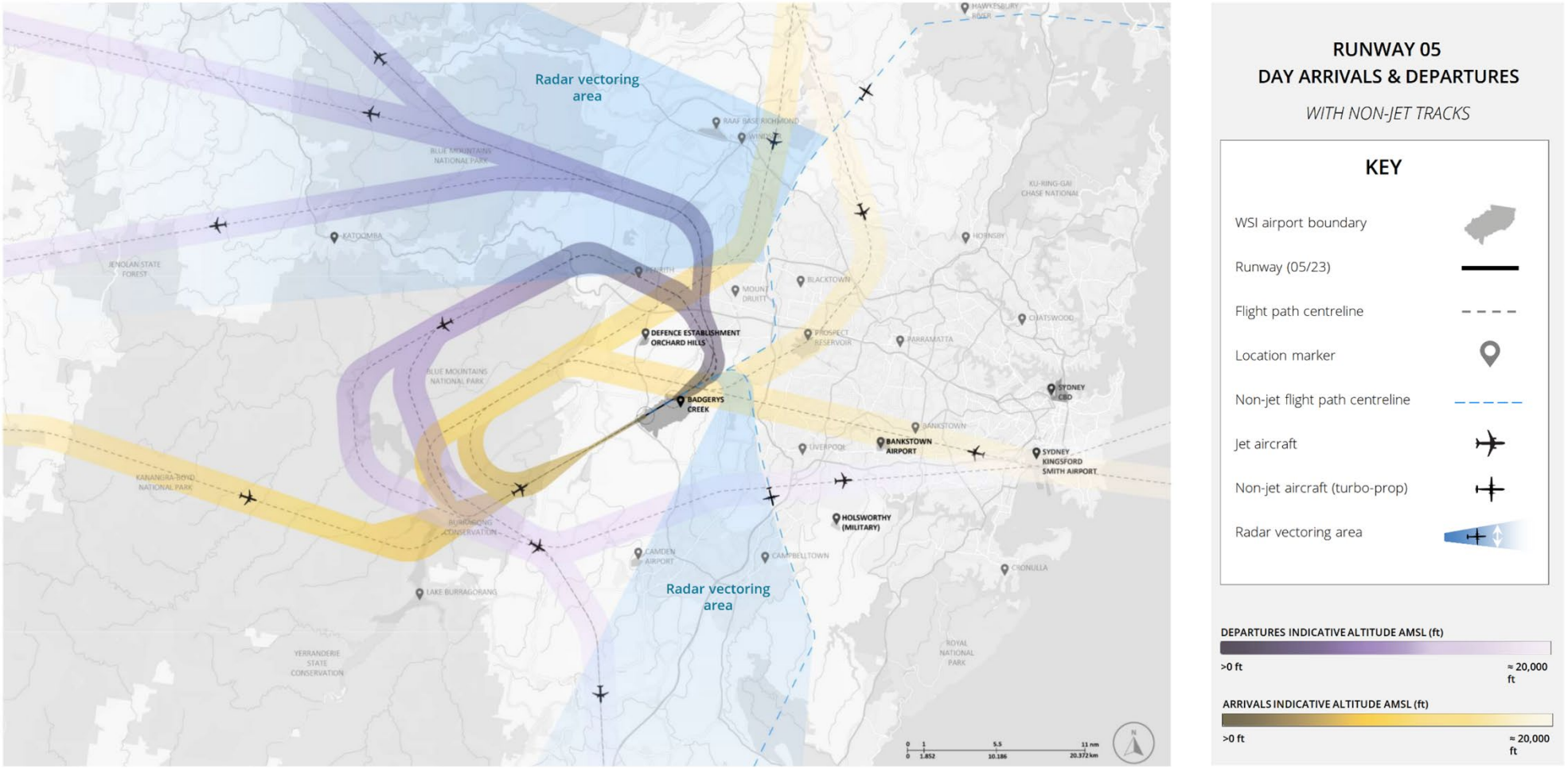

Figure 1.3 Proposed flight paths for Runway 05 (day)

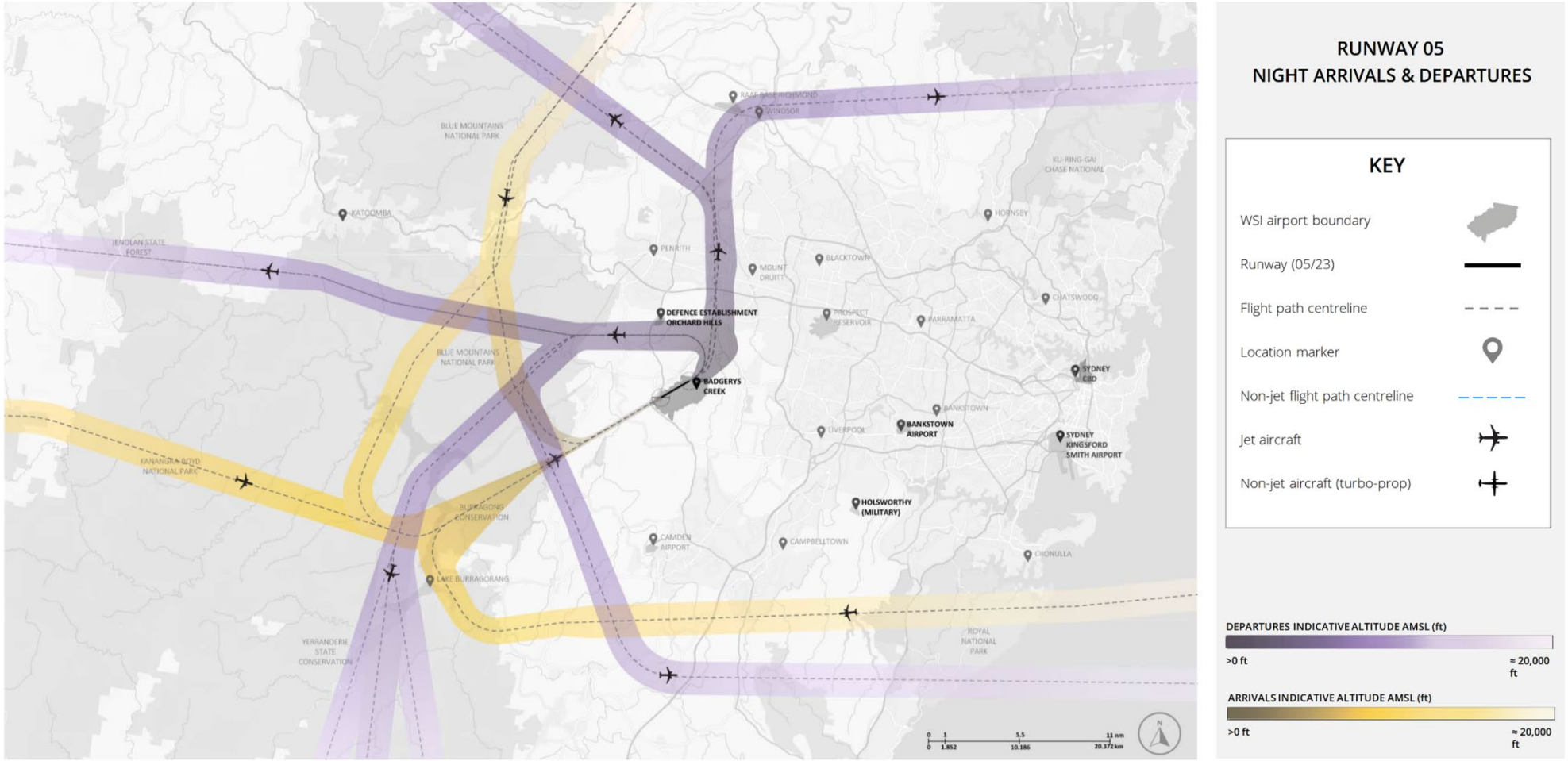

Figure 1.4 Proposed flight paths for Runway 05 (night)

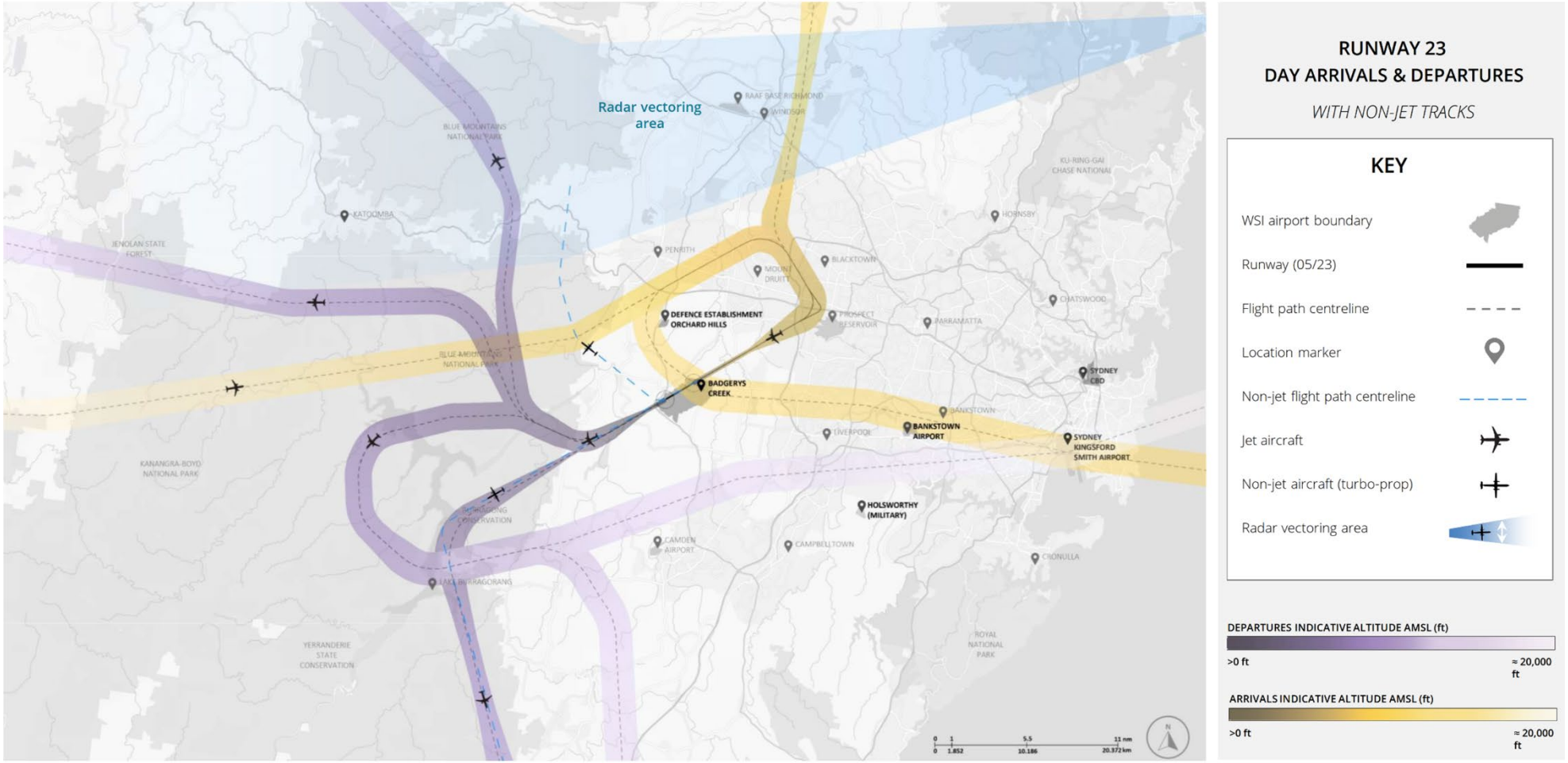

Figure 1.5 Proposed flight paths for Runway 23 (day)

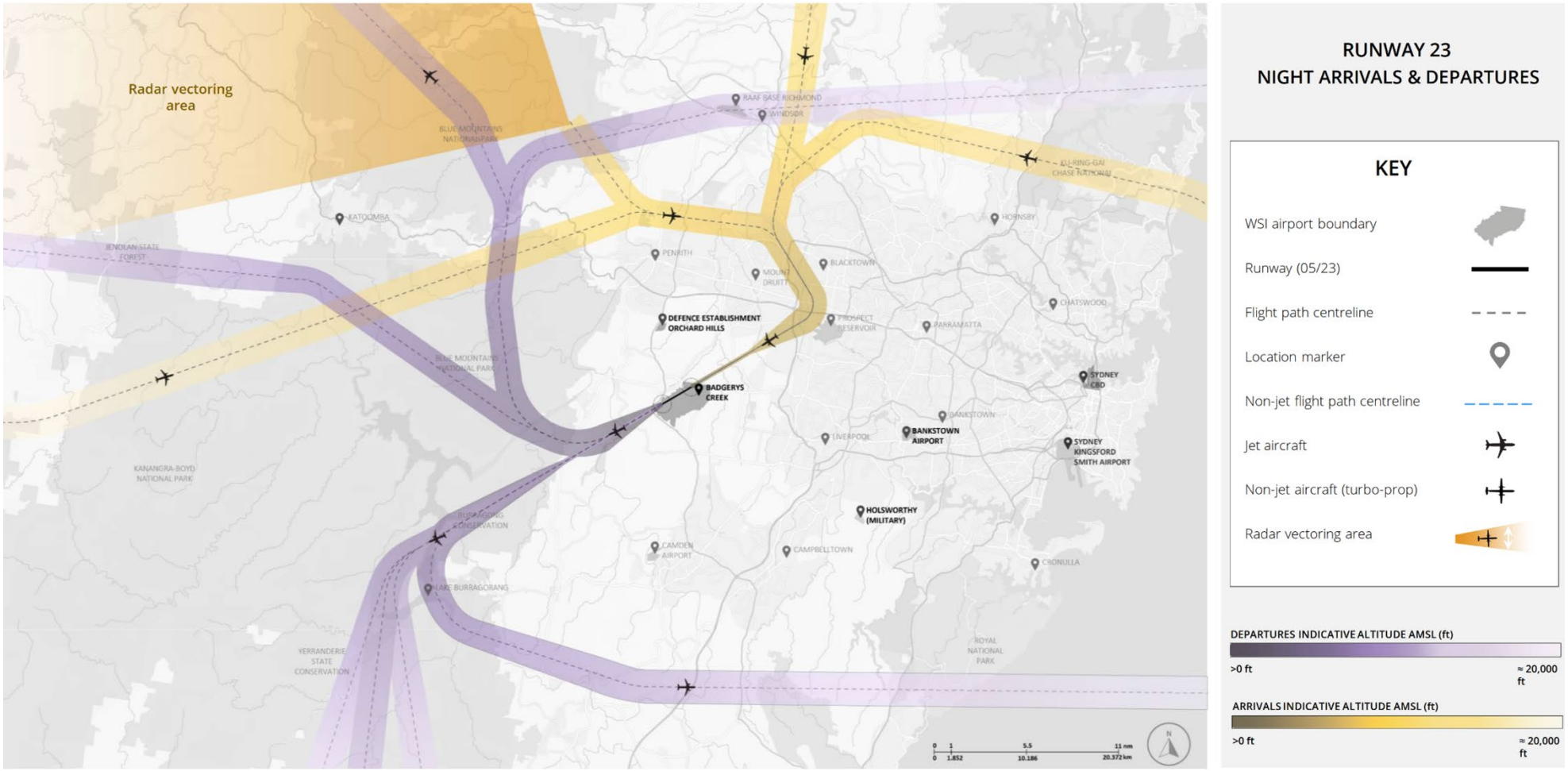

Figure 1.6 Proposed flight paths for Runway 23 (night)

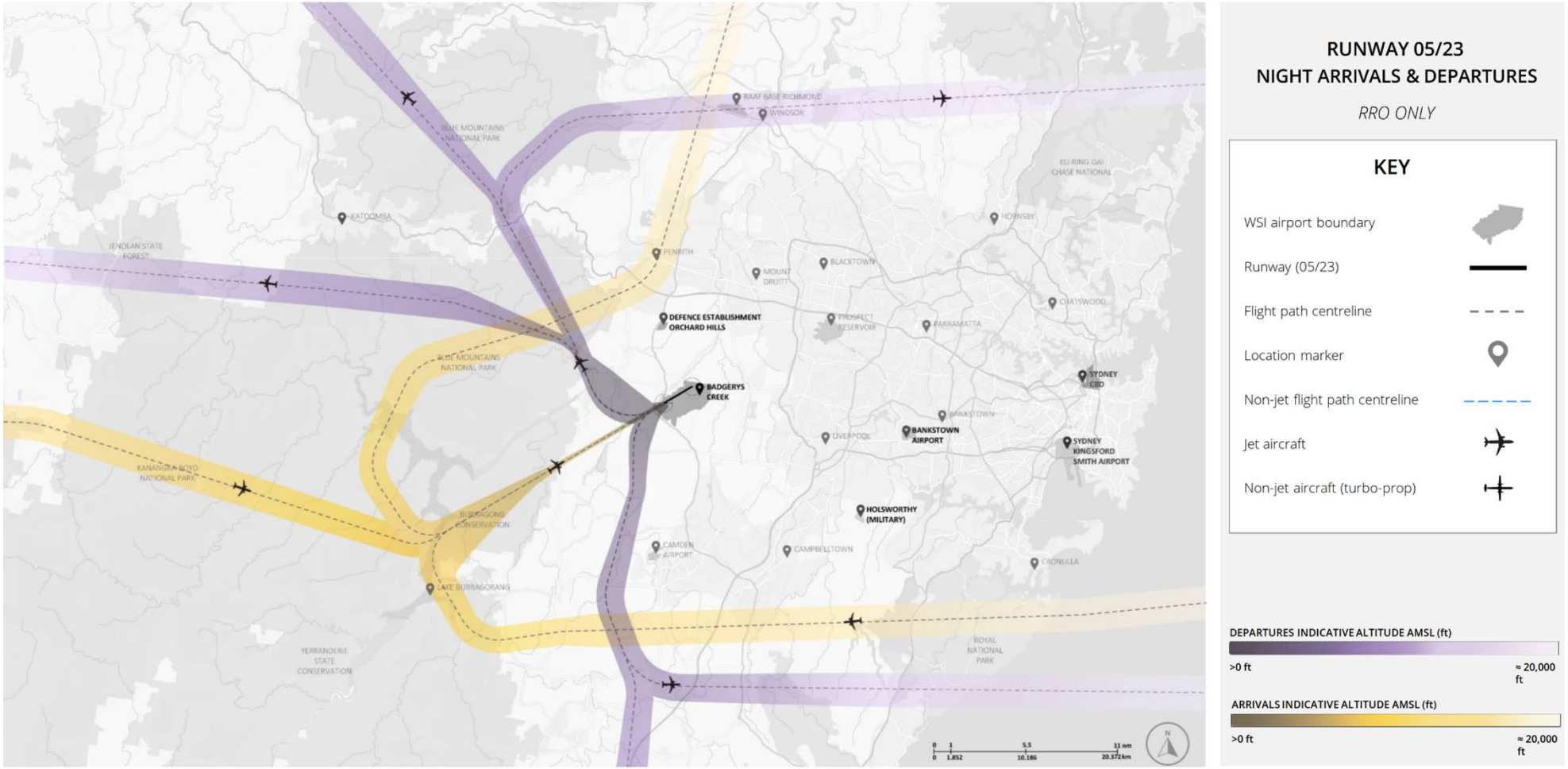

Figure 1.7 Proposed flight paths for Runway 05/23 (night)

1.3 Purpose of this technical paper

This technical paper has been prepared to inform the EIS for the project and to document the process and outcomes of the assessment of potential wildlife strike risk assessment impacts that may occur during operation of the project.

The report:

- describes and assesses the avifauna strike risk
- describes the wildlife strike risk relative to the vision of the Western Parkland City and Western Sydney Aerotropolis, and the government commitments to biodiversity
- identifies land use activities within 30 km of the airport that support wildlife species or populations that may contribute to the strike risk including the interchangeable use of off-airport land uses that can influence the strike risk (i.e., wildlife infringing critical airspace enroute to feeding, breeding, roosting grounds)
- describes the flying-fox hazard and the unique risk they can contribute to the WSI strike risk and to flying-fox populations
- describes the impact of wildlife strikes on threatened and migratory species listed under the *Environment Protection and Biodiversity Act 1999* (Commonwealth) and the *Biodiversity Conservation Act 2016* (NSW)
- comments on the impact of aircraft noise on avifauna
- outlines strategies to mitigate the wildlife strike risk and manage hazards and consider how these strategies could impact flora and fauna
- outlines approaches to monitoring wildlife hazards on and in vicinity of WSI.

As identified in Section 1.2, refinements to the project have been incorporated into the preliminary flight path design. The assessment of these changes has been presented in Appendix G (Assessment of the refinements to the project) of the EIS.

1.3.1 Assessment requirements

The project was referred to the Minister for the Environment and Water in 2021 (EPBC 2022/9143) in accordance with Section 161 of the EPBC Act and Condition 16 of the Airport Plan. In response, the delegate for the Minister for the Environment and Water determined that an EIS would be required and issued the EIS Guidelines on 26 April 2022.

This technical paper has been prepared to address the requirements related to the wildlife strike risk assessment outlined in Table 1.1.

Table 1.1 EIS Guidelines relevenat to the wildlife strike assessment

EIS Guidelines reference	Information required	Location in this report
7.2.1	Detailed assessment of any likely impact that the proposed action may facilitate (at the local, regional, state and national scale) including but not limited to impacts from noise, lights and risk of bird and bat strike	Entire technical report focuses on the bird and bat strike risk

1.4 Study area

For the purposes of this technical paper, the study area is defined by 3 categories: airside, off-airport, flying-fox camps:

- The airside comprises the airside area, contained by the perimeter fence, for the Stage 1 Development (see Appendix B; Figure B.1). Airside is in construction with major earthworks underway and the first runway complete. All other airside infrastructure is under development, scheduled for completion by 2026.
- Off-airport includes any natural or anthropogenic structure or land use within 13 km of the airport, including the airport's landside areas (see Appendix B; Figures B.2–B.4), identified as an actual or potential wildlife attractant. This radial distance from the airport aligns with the NASF's safeguarding limit associated with 3 km, 8 km, and 13 km wildlife buffers measure from the runway boundary. In some instances, sites beyond the 13 km buffer (up to 30 km) were included if wildlife activity at the site was deemed a particular hazard based on the wildlife present and their capacity to regularly travel more than 13 km to access foraging and roosting/breeding sites.
- Flying-fox camps are those sites where flying-foxes have established daytime roosts. This study included 8 camps within 30 km from WSI (see Appendix B; Figure B.5). Despite 7 of these camps laying outside the 13 km wildlife buffer zone, they were included in the study because flying-foxes can travel 100 kilometres in a single night with a foraging radius of up to 50 km from their camp (McConkey et al. 2012) and have been recorded travelling over 500 km in 2 days between camps (Roberts et al. 2012). It is also noted that flying-foxes[2] were the most reported species group struck at Australian airports between 2008 and 2017 (1240 strikes, of which listed species (i.e. Grey-headed Flying-fox) accounted for less than 2 per cent[3]), with over 10 per cent of these strikes resulting in aircraft damage (ATSB, 2019). Based on potential strike risk, the study included all flying-fox camps within 30 km of WSI.

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2 Includes data where species was reported as fruit bat, bat and flying-fox.

3 There are significant limitations in the ATSB strike data with species identification. More than 90 per cent of the flying-fox strikes reported during this period were reported as 'Unidentified Flying-fox' or 'Unidentified Bat' and it is likely that some of these strikes involved Grey-headed Flying-foxes.

Chapter 2 Legislation and strategic context

This chapter provides an overview of the broader wildlife strike policies, legislation and strategies relevant to the project and considered in this technical paper.

Table 2.1 summarises the instruments and Appendix A provides more detail.

Table 2.1 Overview of legislation, regulation and guidance relevant to wildlife hazard management in aviation

Instrument	Overview	Appendix reference
CASR Part 139 MOS	Prescribes the aerodrome requirements, and Advisory Circular (AC) 139-29(0) guides interpretation of the MOS. Sections relevant to wildlife hazard management focus on: bird hazard information for the Aeronautical Information Package (AIP), drainage and drains in the runway strip, requirements for serviceability inspections, Notice to Airman (NOTAM) requirements for bird hazards, Reporting Officer responsibilities, animal hazard management requirements, and standing water on paved surfaces.	Appendix A Table A.1
Environment Protection and Biodiversity Conservation Act 1999	Provides the framework for the protection of the Australian natural environment and its biodiversity and establishes processes that help to protect threatened species and ecological communities, and as well as promoting their recovery. Within the context of wildlife hazard management on airports, of principal consideration is the effect management actions, such as dispersal and lethal control, may have on threatened species. The management of species listed as either Critically Endangered, Endangered, Vulnerable or Conservation Dependent under the Act, may require Departmental approval and Airports may need to consult the Department for clarification.	Appendix A
NSW Biodiversity Conservation Act 2016	Certified airports in NSW can lethally control hazardous native wildlife (by means of shooting by authorised shooters) for the purpose of aircraft hazard reduction. Specific permit conditions vary for each airport, and usually include the requirement to report activities on a regular basis relating to species and numbers culled. Breeding disruption and lethal control can only occur under a Licence to Harm Protected Animal under the *Biodiversity Conservation Act 2016*, issued by the Department of Planning, Industry and Environment (Environment, Energy and Science), unless the target species is categorised as introduced.	Nil
NSW Environmental Planning and Assessment Act 1979	Institutes the state's planning system and describes the Ministerial Directions under Section 9.1. Table 3.3 describes the Ministerial Directions that relate to safeguarding aviation and the Western Sydney Aerotropolis.	Appendix A Table A.2

Instrument	Overview	Appendix reference
Damage by Aircraft Act 1952	Describes 'unlimited liability' to aircraft operators in the event of property damage/destruction or personal injury/loss of life by an aircraft or part thereof. In worst case situations following a significant strike, aircraft operators may seek to clarify if aerodrome operators, and even land users in the vicinity of airports, showed adequate due diligence in their responsibility to safeguard operations against wildlife strikes.	Appendix A Table A.3
Workplace Health and Safety Act 2011	Requires appropriate duty of care to employees and contractors to maintain a safe working environment. Although not directly linked to aviation and wildlife strike management, the presence of wildlife in workplaces can create health issues for workers. Therefore, managing land use activities that are attracting wildlife, particularly where birds are nesting or roosting, not only contributes to airport safeguarding but maintains a safe work environment.	Appendix A Table A.4
State Environmental Planning Policy (SEPP) (Precincts – Western Parkland City) 2021	Establishes the planning provisions for the Western Parkland City precincts. Contains development controls relevant to airport safeguarding, including for wildlife hazards.	Appendix A Table A.5
National Airports Safeguarding Framework (NASF)	Guideline C of the NASF, *Managing the Risk of Wildlife Strikes in the Vicinity of Airports*, provides guidelines to land users and planners regarding the management of wildlife hazards. Adhering to the International Civil Aviation Organization (ICAO) guidelines relating to radial distances from airports (3 km, 8 km and 13 km), the NASF allocates risk categories to land uses from very low to high and recommends actions for both existing and proposed developments (i.e., incompatible, mitigate, monitor, no action).	Appendix A Table A.6 to Table A.8
ICAO Annex 14, Volume 1 (Aerodrome Design and Operation)	As a member state to the ICAO, Australia must adhere to the rules and regulations stipulated by ICAO, including those relating to wildlife hazard management on and around airports. There are a series of guidance documents and best practice standards airports can reference to assist with wildlife hazard management. ICAO Annex 14, Volume 1 (Aerodrome Design and Operation) establishes requirements for the management of wildlife strikes, including the requirement for authorities to take actions to reduce the number and types of wildlife-attracting sites in the vicinity of airports.	Appendix A Table A.9
ICAO Airport Services Manual Doc. 9184: Part 2 Land Use and Environmental Control	Provides airport personnel with guidance on land use planning within the vicinity of aerodromes, and the need for good planning and control measures. It focusses on how an airport's presence impacts its surroundings, and vice versa, with regard to people, flora, fauna, the atmosphere, water courses, air quality, soil pollution, rural areas, and the environment in general. It frequently discusses the significance of how some land use in the vicinity of airports, such as landfills, can influence an airport's strike risk profiles. Appendix 2, Land-use Guidelines for the Avoidance of Bird Hazards, notes that "Any land use that had the potential to attract birds in the airport vicinity should be subject of a study to determine the likelihood of bird strikes to aircraft using the airport".	Nil

Instrument	Overview	Appendix reference
ICAO Airport Services Manual Doc. 9137: Airport Services Manual Part 3, Wildlife Control and Reduction	Elaborates on the wildlife management responsibilities of airports, providing guidance on the development and implementation of effective airport wildlife management programs. It includes recommendations on hazard review and habitat management and identifies a recommended boundary for monitoring off-airport wildlife hazards and land uses.	Nil
World Birdstrike Association (WBA) Standards	The WBA (previously the International Bird Strike Committee (IBSC)) provides a series of standards relevant to all aspects of integrated wildlife hazard management programs.	Appendix A Table A.10

2.1 Western Sydney Aerotropolis and Western Parkland City

The vision of the Western Parkland City and Western Sydney Aerotropolis includes natural area revitalisation, water retention, enhancing biodiversity, establishing an extensive blue-green grid, and increasing tree canopy coverage to 40 per cent. This vision could create long-term wildlife hazard issues for aircraft operating out of WSI in the absence of effective safeguarding requirements.

Chapter 3 Methodology

This chapter provides an overview of the methodology for the wildlife strike risk assessment, including the approach to assessment, consultation carried out, dependencies with other studies and any limitations and assumptions.

3.1 Impact assessment approach

3.1.1 Desktop review

Avisure reviewed a number of data and documents relating to the existing environment, the current wildlife attraction, WSI operations (current and proposed/in-construction), and all regulations, standards and industry guidelines relevant to wildlife hazard mitigation in aviation. Appendix C lists the information reviewed.

3.1.2 Wildlife surveys

3.1.2.1 Airside

Avisure completed airside surveys in July, August, September and October 2022. Each round consisted of airside surveys across 4 periods (i.e. early morning, midday, afternoon, evening) (Stage 1 Development area only). Using Fulcrum[4], surveys recorded; species, numbers, locations, behaviours, habitat, and infringements into critical areas.[5] Appendix B details the survey method.

3.1.2.2 Off-airport

Avisure surveyed a total of 73 sites during off-airport surveys in July, August, September and October 2022 (58 sites within the 13 km wildlife buffer and 15 sites beyond). Each round consisted of a single survey. Using Fulcrum, surveys recorded; species, numbers, locations, behaviours, and habitat. Appendix B details the survey method and sites surveyed.

3.1.2.3 Flying-foxes

Flying-fox monitoring included:

- daytime presence/absence checks at 8 camps within 30 km of WSI
- evening fly-out estimates, at active camps only. Surveys recorded time of fly-out start and finish, numbers, directions
- evening transit surveys at WSI. Surveys recorded time of transit start and finish, numbers, direction, height, and infringements into critical areas.

Appendix B provides a camp location map.

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4 Fulcrum is a data collection platform designed to electronically collect data in the field.

5 Critical area includes runways and runway strips.

3.1.3 Data analysis and risk assessment

3.1.3.1 Species risk assessment

Avisure assessed the species risk to aviation operations using the airside survey data. This data was used to derive probability factors (population size, position on airport, time spent in air and the species' ability to avoid strikes) and consequence factors (bird mass and flock size) for all species recorded. The combination of these probability and consequence factors gave a numerical risk index, the Species Risk Index (SRI).

Appendix D details risk assessment methods.

3.1.3.2 Off-airport risk assessment

Off-airport sites were assessed to determine their potential contribution to the WSI aviation strike risk. It involved likelihood based on survey data and desktop assessments to derive values for the wildlife attracted (or potentially attracted) to a site and to derive values for the inherent wildlife attractiveness of a location. It also included strike consequence information based on the wildlife species and the location of the site relative to an airport. This method also accounted for the connectivity of wildlife attractive (or potentially attractive) sites to determine the potential for wildlife to transit through critical airspace.

Appendix D details risk assessment methods.

3.2 Consultation

N/A

3.3 Dependencies and interactions with other technical papers

The information presented in this paper has been informed by the following:

Table 3.1 Dependencies and interactions with other technical papers

Technical paper	Relevance
Aircraft Noise (Technical paper 1)	Informed this report in its assessment of aircraft noise on avifauna.
Hazard and Risk (Technical paper 4)	Bird and bat strike data informed the overall hazards and risk assessment associated with airborne aircraft.
Biodiversity (Technical paper 8)	Findings from this report were used to inform the overall biodiversity assessment for the project, in particular the impact of wildlife strikes on threatened and migratory species listed under the *Environment Protection and Biodiversity Act 1999* (Commonwealth), including the Glossy Ibis *(Plegadis falcinellus*) (migratory) and Cattle Egret *(Bubulcus ibis)* (marine) and the *Biodiversity Conservation Act 2016* (NSW).
Greater Blue Mountains World Heritage Area (GBMA) (Technical paper 14)	Findings from this report were used to inform the overall biodiversity assessment for the project, in particular the impact of wildlife strikes on threatened and migratory species listed under the *Environmental Protection and Biodiversity Act 1999* (Commonwealth) and the *Biodiversity Conservation Act 2016* (NSW).

3.4 Limitations and assumptions

The risks identified are dynamic and are not necessarily accurate predictors of future risks. Risks are likely to change in response to landscape changes during airport construction and operation, and the significant changes to land use around the airfield (i.e., as part of the Western Sydney Aerotropolis, changes to major infrastructure (i.e. road and rail networks, and some of the NSW Government's' commitments to delivering the Western City Parkland such as mitigating the heat island effect and providing cooler places by extending urban tree canopy and retaining water in the landscape (Greater Sydney Commission, 2018)). How wildlife use the landscape, and how they will respond to changes in that landscape is complex.

A high-level wildlife movement study has not been completed. Such a study would involve using remote sensing equipment such as radar to understand how birds and bats move around the landscape and if done over several years, what climatic and seasonal conditions affect behaviour. This assessment has therefore made assumptions based on habitats and species' requirements (e.g., likely areas of food preference and subsequent directional movements of flying-foxes to and from known camps).

Delays in approval to access private land use types meant not all identified sites were surveyed during each survey round.

Delays in overall project approval and commencement limited the time available to complete the 4 survey rounds, and therefore seasonal variations cannot be fully accounted for in detail. However, assumptions are made based on the data collected. The assessment could also draw on survey data collected by Avisure from January to December 2018 as part of a wildlife monitoring project commissioned by WSA.

Despite these limitations, the assessment achieves its purpose.

Chapter 4 Existing conditions

This chapter describes the existing conditions and features of the study area to provide a baseline against which the project's impacts can be assessed.

The airport site is located in Badgerys Creek, approximately 50 km west southwest of the Sydney Commercial Business District. Land use within 13 km of the airside area is a mosaic of urban infrastructure including residential areas, town centres, agriculture, parklands, conservation areas, large waterbodies, waste disposal facilities, commercial facilities, and industrial areas. The climate is temperate, and the area is contained within the Cumberland subregion of the Sydney Basin Bioregion. Natural elements of this subregion include grassy woodlands, ironbark and turpentine forests, and floodplain communities (Biosis, 2020), however it has been extensively modified for agriculture and urban development. The fauna diversity in the area is supported by the remnant and disturbed natural areas and the resources provided by agriculture and urban development (e.g., putrescible waste, parks, gardens, water retention facilities, grains, crops etc.).

4.1 Sensitive receptors

The primary sensitive receptors from the biodiversity perspective may be flying-foxes and Australian White Ibis due to potentially significant issues with these species.

Chapter 5 Facilitated changes

The potential wildlife strike risk will remain largely unaffected by any facilitated changes prior to airport operations commencing in 2026. The actual wildlife strike risk will be realised following the commencement of operations.

Chapter 6 Impact assessment

The preliminary assessment has identified Australian White Ibis as high risk and monitoring has identified the establishment of Australian White Ibis breeding colonies in the vicinity of WSI. Australian White Ibis populations close to other Australian airports have created significant strike risks and have resulted in some serious strike events. Therefore, proactive Australian White Ibis management applied now would be beneficial to WSI once operational. Long-term regional Australian White Ibis management programs (e.g., in south-east Queensland) are successfully, and sustainably, managing Australian White Ibis populations and their impacts on the urban environment.

Flying-foxes are the most struck wildlife group at Australian airports. The high number of flying-fox camps in the vicinity of WSI means flying-fox strikes are likely when the airport is operational. Establishing a comprehensive monitoring program to understand how flying-foxes are moving through the Western Sydney landscape will be critical to effective strike mitigation.

6.1 Wildlife strikes and Western Sydney International Airport

Major Australian airports between 2008 and 2017 averaged 4.8 strikes per 10,000 aircraft movements (ATSB, 2019). If WSI aligned with this rate, then based on their aircraft movement projections of 81,000 by 2033 and 226,000 by 2055, they would expect 39 strikes and 108 strikes per year, respectively. Furthermore, if WSI aligns with the international benchmark of 1 strike causing an adverse effect (AE) on flight (e.g., damage, delay) per 100,000 aircraft movements (Begier & Dolbeer, 2011), it would be expected that there will be one AE strike approximately every 2 years from the beginning of operations to approximately 3 per year by 2055. However, and critically, aligning with this industry standard assumes that the airport will implement a rigorous and integrated wildlife management program, aviation safeguarding principles are incorporated into land use planning decisions, and land users at least within 13 km of the airport effectively manage their contributions to WSI's strike risk. This point cannot be underestimated. In addition, it is difficult to accurately project strike rates for an airport that is not yet operational, particularly when attempting to extrapolate this on a national average or an industry standard, because:

- a comparative analysis of strike rates at other airports does not account for the site-specific variables and nuances at each airport that contribute to the strike risk.

There can be stark differences in the strike risk profiles for 2 seemingly similar airports. For example, Airport A and Airport B may be located in coastal habitats, operate the same number of runways and hours, and have a similar number of aircraft movements. But Airport A is in a tropical environment and Airport B in a temperate one, meaning climatic variables create 2 very distinct suites of wildlife using each airfield and surrounds. Even if both airports were situated in a similar climate, Airport B may have high-risk land uses adjacent to the airfield (e.g., putrescible waste landfill, retention ponds, wildlife breeding colonies), but land use surrounding Airport A is mostly industrial activity with enclosed warehouses and factories. This means the number and type of wildlife moving around Airport B's operational space is a contrast to those at Airport A.

- Wildlife management programs at airports vary considerably in their content and implementation. Despite the CASR Part 139 MOS outlining airport requirements for monitoring and managing wildlife hazards, it can be broadly interpreted. Some airports have robust integrated programs, others less so.
- Strike reporting protocols at airports vary considerably.

6.2 Airside wildlife

Species risks are dynamic, are not accurate predictors of future risks, and will change in response to landscape changes during airport construction and operation, as well as changing land use activity in the vicinity of the airports. Results should be viewed as preliminary.

6.2.1 Species risk assessment

Avisure has developed a model for determining risk categories using wildlife survey data. The survey data is used to derive likelihood factors (population size, position on airport, time spent in air and the species ability to avoid) and consequence factors (mass and flock size) for all species recorded, Table 6.1. These results are based on a limited data set and should be viewed as provisional. Appendix D describes the wildlife risk assessment method.

Table 6.1 Species risk based on airside surveys, WSI, July-October 2022

Rank	Overall risk	Species	Diurnal risk	Nocturnal risk
1	Very High	Eastern Grey Kangaroo *Macropus giganteus*	Very High	Not applicable (NA)
2	High	Straw-necked Ibis *Threskiornis spinicollis*	High	NA
3	High	Australian White Ibis *Threskiornis molucca*	High	NA
4	High	European Brown Hare *Lepus capensis*	High	NA
5	High	Red Fox *Vulpes vulpes*	High	NA
6	High	Wood Duck *Chenonetta jubata*	Moderate	High
7	High	Pacific Black Duck *Anas superciliosa*	Moderate	High
8	High	Little Black Cormorant *Phalacrocorax sulcirostris*	High	NA
9	High	Chestnut Teal *Anas castanea*	Very Low	High
10	Moderate	Unidentified[6] Duck	Moderate	Moderate
11	Moderate	Masked Lapwing *Vanellus miles*	Low	Moderate
12	Moderate	Feral Pigeon *Columba livia*	Moderate	NA
13	Moderate	Australian Raven *Corvus coronoides*	Moderate	NA
14	Moderate	Little Corella *Cacatua sanguinea*	Moderate	NA
15	Moderate	Unidentified Cormorant	Moderate	NA
16	Moderate	White-bellied Sea-Eagle *Haliaeetus leucogaster*	Moderate	NA
17	Moderate	European Rabbit *Oryctolagus cuniculus*	Moderate	NA
18	Moderate	Great Cormorant *Phalacrocorax carbo*	Moderate	NA
19	Moderate	Wedge-tailed Eagle *Aquila audax*	Moderate	NA
20	Moderate	Sulphur-crested Cockatoo *Cacatua galerita*	Moderate	NA

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[6] Wildlife is recorded as 'unidentified' when the observer is positioned too far away from the animal during the survey to accurately identify the species.

Rank	Overall risk	Species	Diurnal risk	Nocturnal risk
21	Low	Galah *Eolophus roseicapillus*	Low	NA
22	Low	Nankeen Kestrel *Falco cenchroides*	Low	NA
23	Low	Black-shouldered Kite *Elanus axillaris*	Low	NA
24	Low	Unidentified Raptor	Low	NA
25	Low	Common Starling *Sturnus vulgaris*	Low	NA
26	Low	Royal Spoonbill *Platalea regia*	Low	NA
27	Low	Australian Magpie *Cracticus tibicen*	Low	NA
28	Low	White-faced Heron *Egretta novaehollandae*	Low	NA
29	Low	Unidentified Medium Bird	Low	NA
30	Low	Banded Lapwing *Vanellus tricolor*	Low	NA
31	Low	Brown Falcon *Falco berigora*	Low	NA
32	Low	White-necked Heron *Ardea pacifica*	Low	NA
33	Low	Red-rumped Parrot *Psephotus haematonotus*	Low	NA
34	Low	Laughing Kookaburra *Dacelo novaeguineae*	Low	NA
35	Low	Black-fronted Dotterel *Elseyornis melanops*	Very Low	Low
36	Very Low	Australasian Pipit *Anthus novaeseelandiae*	Very Low	NA
37	Very Low	Fairy Martin *Petrochelidon ariel*	Very Low	NA
38	Very Low	Welcome Swallow *Hirundo neoxena*	Very Low	NA
39	Very Low	Magpie Lark *Grallina cyanoleuca*	Very Low	NA
40	Very Low	Common Myna *Sturnus tristis*	Very Low	NA
41	Very Low	Willie Wagtail *Rhipidura leucophrys*	Very Low	NA
42	Very Low	Eurasian Skylark *Alauda arvensis*	Very Low	NA
43	Very Low	Black-faced Cuckoo-shrike *Coracina novaehollandiae*	Very Low	NA
44	Very Low	Golden-headed Cisticola *Cisticola exilis*	Very Low	NA

6.2.2 Wildlife activity

Figure 6.1 shows the average number of wildlife observed per diurnal airside survey, where there were more than 3 observed per survey. The high number of Straw-necked Ibis and Australian White Ibis, including regular critical area infringements, contributed to the high risk ranking in the species risk assessment. Active Australian White bis breeding colonies contributed to the high number of ibis observed transiting through WSI airspace during the airside surveys. Unfettered access to food, particularly anthropogenic sources such as putrescible waste at landfills and water is contributing to their local population.

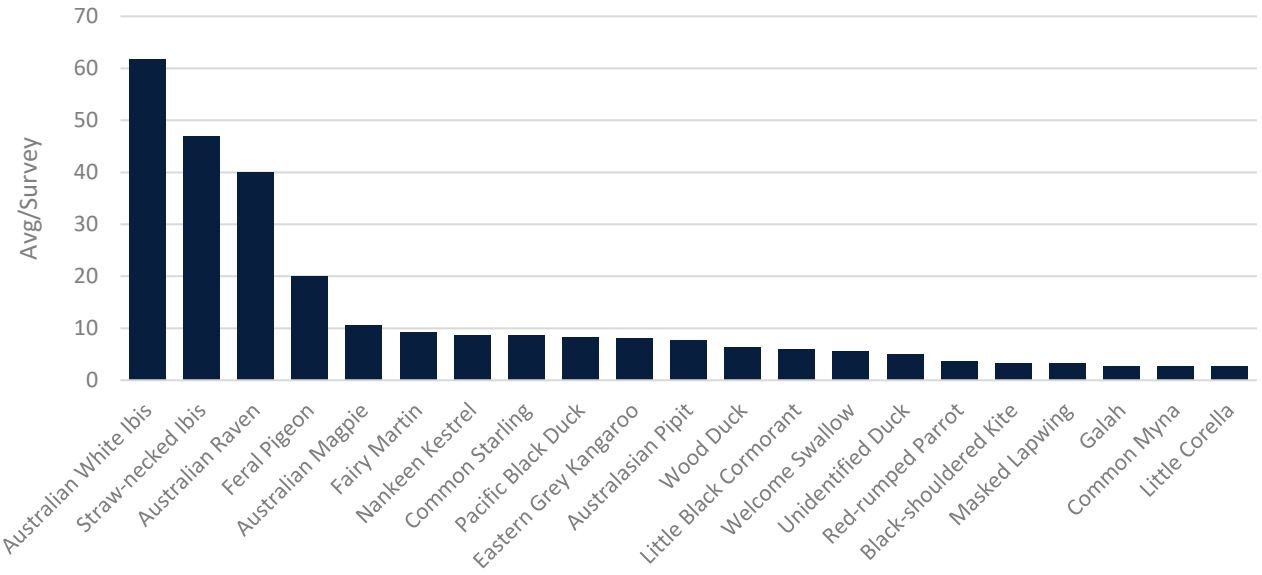


Figure 6.1 Average number of wildlife observed per diurnal airside survey (where value is ≥ 3/survey), July – October 2022, WSI

Figure 6.2 shows the average number of wildlife observed per nocturnal airside survey. The high number of Wood Duck, with 23 per cent observed in critical areas, contributed to their high risk rank in the species risk assessment. Although surveys recorded relatively low numbers of European Brown Hare during the nocturnal survey, 64 per cent were observed in critical areas which, coupled with their large body mass (4.5 kg), contributed to their high risk rank in the species risk assessment. Waterfowl are using the airside environment to forage, loaf and roost. The complex network of off-airport water sources in the form of farm ponds, wetlands, basins, creeks etc., are supporting local populations and are likely to increase duck transits through aircraft movement areas as they use water sources interchangeably.

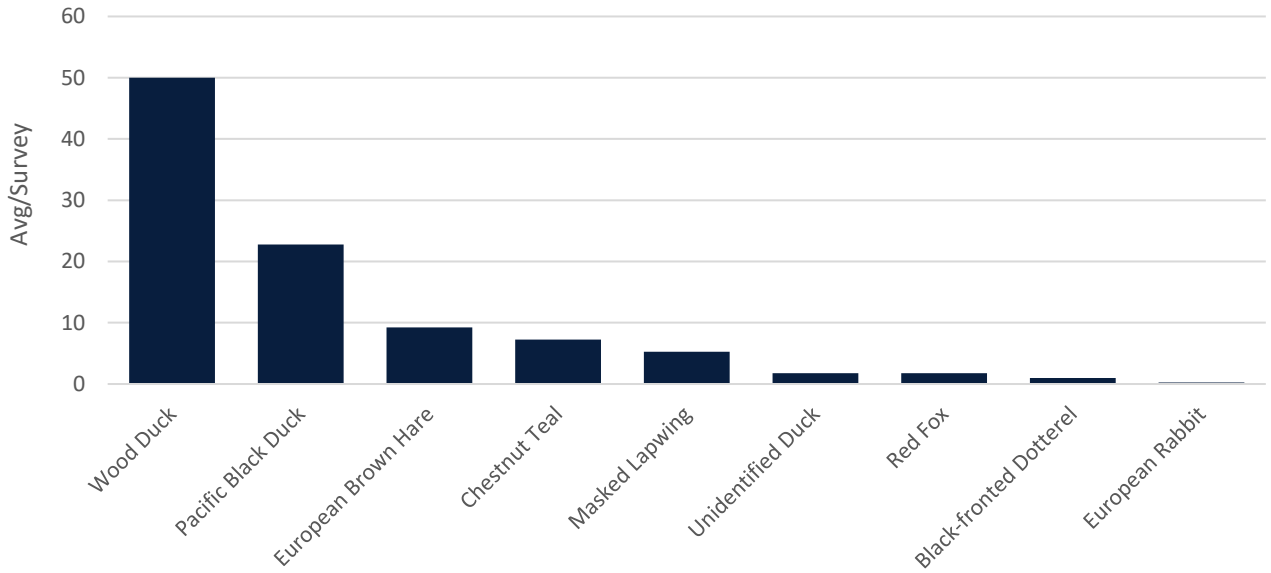


Figure 6.2 Average number of wildlife observed per nocturnal airside survey, July – October 2022, WSI

Figure 6.3 shows that more than half of wildlife observed during the airside surveys were in the air (Figure 6.4 elaborates further). This is not unexpected given the airside area was under construction at the time of surveys. Birds observed in the air is a contributing probability factor in the species risk assessment.

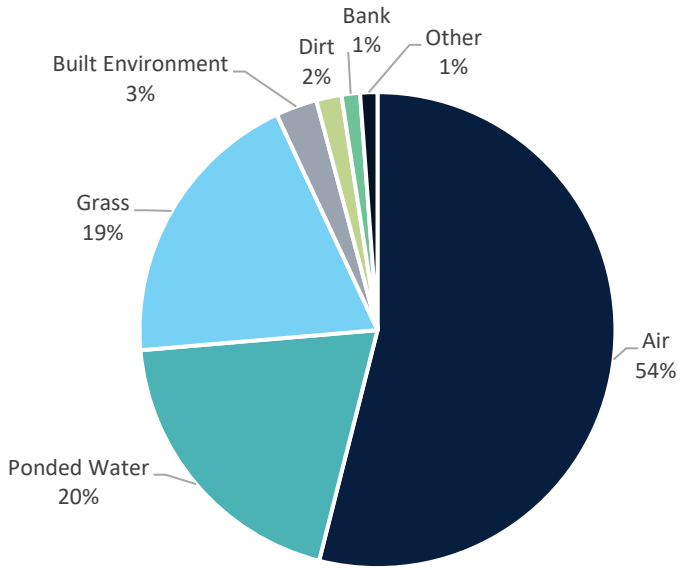


Figure 6.3 Proportion of wildlife observed during airside surveys using different habitat types ('other' includes fences, sealed areas and trees), July – October 2022, WSI

Birds flying over accounted for almost half of the in-air observations (Figure 6.4), and only include birds flying from one off-airport area to another (i.e., not using the airside area). Australian White Ibis accounted for 62 per cent of fly-over behaviours. Birds using off-airport habitats can contribute to the airport's strike risk, refer to Section 6.3 for details.

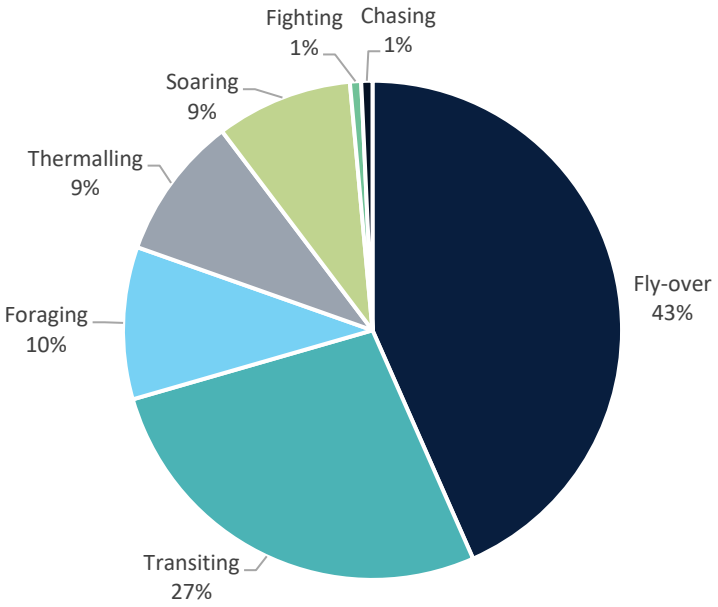


Figure 6.4 Proportion of in-air behaviour observed during airside surveys, July – October 2022, WSI

Appendix E show the density and distribution of all wildlife observed during surveys completed between July and October 2022.

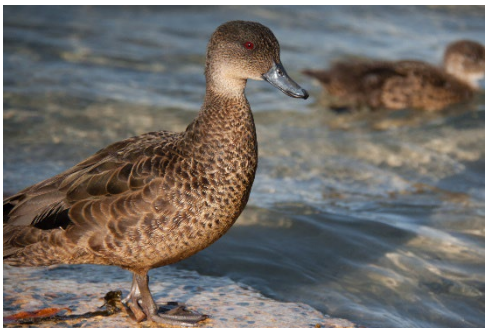
6.2.2.1 Birds

Table 6.2 comments on those species assessed as high risk and highlights the key risk contributors.

Table 6.2 High risk species and key risk contributors.

Species	Risk contributors
Straw-necked Ibis (*Threskiornis spinicollis*) 	• Their risk is linked to their large body mass (1.3 kg), tendency to flock and frequent infringements in aircraft movement areas. • Airside surveys recorded large flocks (e.g., up to 78 individuals) transiting the airfield infringing (potential) aircraft movement areas. • 97 percent of observations at off-airports sites recorded them in creeks and ponds (e.g., Duncan Creek and several farm dams in the airport's vicinity). • Assessed as moderate risk in a previous species risk assessment for WSI (Avisure, 2018).

Species	Risk contributors
Australian White Ibis (*Threskiornis molucca*) 	• All ibis observed during airside surveys flew over the airfield, with 84 per cent infringing (potential) aircraft movement areas, to access off-airport roosting, breeding and foraging sites. • Surveys recorded an average flock size of 7 ibis (max. 35). • Their risk is linked to their large body mass (1.2 kg), tendency to flock and frequent infringements in aircraft movement areas. • High numbers observed at off-airport sites, particularly at breeding colonies (e.g., Lake Gillawarna (522/survey) and Mount Annan (260/survey)) and at foraging sites (e.g., Kemps Creek Resource Recovery Park (252/survey)). • Of the 76 off-airport sites monitored, surveys recorded ibis at 35 and they accounted for 57 per cent of wildlife observed across all off-airport sites (excludes flying-fox camp data). • Assessed as low risk in a previous species risk assessment for WSI (Avisure, 2018).
Wood Duck (*Chenonetta jubata*) 	• Ninety-one per cent of airside duck observations were recorded during nocturnal surveys, where they used the airfield to forage (in newly established grass and areas of temporary ponded water), loaf and roost. • Observed at various off-airport sites that support permanent or temporary water sources (e.g., farm dams, wetlands, water treatment plants). • The network of water sources in the airport's vicinity encourages interchangeable use by ducks. • Their risk is linked to their moderate body mass (0.8 kg) and tendency to flock. • Assessed as high risk in a previous species risk assessment for WSI (Avisure, 2018).
Pacific Black Duck (*Anas superciliosa*) 	• 72 per cent of airside duck observations were recorded during nocturnal surveys, where they used the airfield to forage (in newly established grass and areas of temporary ponded water), loaf and roost. • Their risk is linked to their large body mass (1.05 kg) and tendency to flock. • See second and third points for Wood Duck (above). • Assessed as moderate risk in a previous species risk assessment for WSI (Avisure, 2018).

Species	Risk contributors
Little Black Cormorant (*Phalacrocorax sulcirostris*) 	• All cormorants observed during the airside surveys infringed (potential) aircraft movement areas. • Their risk is linked to their moderate body mass (0.87 kg) and tendency to flock. • See second and third points for Wood Duck (above). • Assessed as moderate risk in a previous species risk assessment for WSI (Avisure, 2018).
Chestnut Teal (*Anas castanea*) 	• Their risk is linked to their large body mass (0.65 kg) and tendency to flock. • Ninety per cent of airside duck observations were recorded during nocturnal surveys, where they used the airfield to forage areas of temporary ponded water. • See second and third points for Wood Duck (above). • Assessed as low risk in a previous species risk assessment for WSI (Avisure, 2018).

6.2.2.2 Flying-foxes

The airside flying-fox transit surveys did not record any flying-foxes. Four surveys over 4 months using human observation from static locations cannot adequately capture flying-fox activity moving through WSI airspace.

Section 6.3.2 details flying-fox activity in nearby camps.

6.2.2.3 Terrestrial animals

Surveys recorded 4 terrestrial animals, Figure 6.5. Unmanaged populations of vertebrate pests (e.g., fox, rabbit, hare) and macropods (e.g., kangaroo, wallaby) can conflict with aircraft during on-ground phases (landing, take-off run, taxiing). Although avifauna are the key concern to this assessment, there is a very high-risk presented by Eastern Grey Kangaroo. Airside surveys recorded an average of 1.5 kangaroos per survey, and their risk is linked to their body mass (avg. 51.5 kg). This risk should be minimal once the airport is fully contained by the secure perimeter fence and the existing airside population has been removed. WSA would be responsible for maintaining fence integrity by identifying and resolving any future breach issues. The airport would also be responsible for managing the airside population of vertebrate pests (e.g., rabbits, foxes and hares).

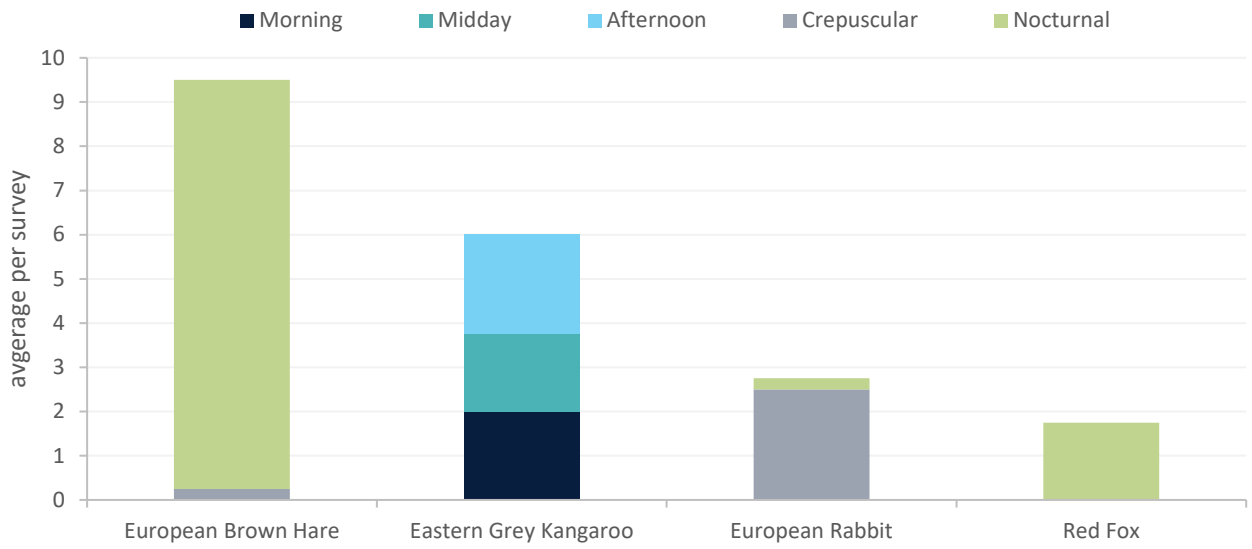


Figure 6.5 Average number of terrestrial animals per survey, July – October 2022, WSI

6.3 Off-airport wildlife

The off-airport risks are dynamic, may not be accurate predictors of future risks, and will change in response to landscape changes during airport construction and operation, as well as changing land use activity. Some sites beyond the 13 km buffer (up to 30 km) were included if wildlife activity at the site was deemed a particular hazard based on the wildlife present and their capacity to regularly travel more than 13 km to access foraging and roosting/breeding sites. The results should be viewed as preliminary. Ongoing monitoring activities are outlined in Chapter 8.

6.3.1 Off-airport risk assessment

Table 6.3 provides off-airport risk assessment results. The assessment identified one very-high risk site; Duncan Creek, and 5 high-risk sites; a pond on Elizabeth Drive, the Kemps Creek Resource Recovery Park, a pond on Wolstenholme Avenue, the Western Sydney Parklands, and the Lake Gillawarna Ibis Colony. Appendix D describes the off-airport risk assessment method, and Appendix F provides more detail on all sites monitored and assessed as part of this project.

Table 6.3 Off-airport risk, November 2022

Site	Distance from runway boundary (km)	Airspace risk rating
Jackson Road Pond	0.3	Low
Point 18 Pond	0.3	Low
Great Northern Road Pond 2	0.3	Moderate
Pond on Elizabeth Drive 2	0.4	High
Pond on Elizabeth Drive 1	0.4	Moderate
Kemps Creek Resource Recovery Park	0.4	High
Eastern Creek Landfill	0.5	Low
Pond on Elizabeth Drive 6	0.5	Low
Billabong	0.5	Moderate

Site	Distance from runway boundary (km)	Airspace risk rating
IGA Pond	0.6	Moderate
Hubertus Country Club	0.7	Moderate
Pond on Adams Road 2	1.2	Low
Pond on Adams Road 3	1.2	Low
Pond on Adams Road 4	1.2	Moderate
Western Sydney Airport Visitor Centre	1.2	Moderate
Pond on Elizabeth Drive 5	1.4	Moderate
T18 Basin	1.4	Moderate
Duncan Creek	1.5	Very High
Permanent Basin 1	1.5	Moderate
Luddenham Road Pond 4	1.7	Moderate
Pond on Elizabeth Drive 7	1.9	Moderate
Gate 7 Pond	1.9	Moderate
Luddenham Road Pond 2	1.9	Moderate
Luddenham Road Pond 1	1.9	Moderate
Northern Road Pond 1	1.9	Low
Luddenham Showground	2.0	Low
Northern Road Pond 2	2.0	Moderate
Twin Creeks Golf Course	2.2	Moderate
Pond on Elizabeth Drive 4	2.2	Moderate
Permanent Basin 3	2.4	Moderate
Wolstenholme Avenue Pond	2.4	High
Agricultural 1	2.5	Moderate
Horticultural Production	3.2	Moderate
ANL Landscaping	3.3	Moderate
Mushroom Farm	4.9	Low
Sydney Catholic Garden Cemetery	4.9	Moderate
Kemps Creek	4.9	Moderate
Luddenham Road Pond 3	5.1	Low
Warragamba Dam	5.6	Low
Wallacia Golf Club	5.7	Low
Payton’s Lane Recycling Centre and Landfill	6.7	Low

Site	Distance from runway boundary (km)	Airspace risk rating
Bents Basin	6.9	Low
Luddenham Road Ponds 5	7.2	Moderate
Erskine Business Park	7.4	Low
Erskine Business Park Landfill	7.7	Low
Belmore Road Farm Dam	7.9	Moderate
Australian Koi Farm	8.2	Low
Orchard Hills Water Treatment Plant	8.4	Moderate
Blue Hills Wetland	9.7	Moderate
Penrith Landfill	9.7	Low
Penrith Golf Course	9.8	Moderate
Shepherd Street Park	11.0	Low
Ched Town Reserve	11.1	Low
Glenmore Heritage Valley Golf course	11.4	Moderate
Glenmore Loch	12.1	Moderate
Bingo Recycling Centre and Ecology Park	12.3	Moderate
Western Sydney Parklands	12.4	High
Ropes Creek Flying-fox Camp	12.7	Moderate
Werombi Road Pond	14.3	Low
Emu Plains Flying-fox Camp	15.1	Very Low
Brownlow Hill Flying-fox Camp	15.7	Low
Wetherill Park Resource Recovery	15.8	Moderate
Nurrangingy Reserve	17.0	Moderate
Fairfield City Council Resource Recovery	17.1	Very Low
Wetherill Park Flying-fox Camp	17.5	Very Low
Macquarie Fields Flying-fox Camp	18.1	Moderate
Mount Annan Ibis Colony	19.0	Moderate
Cabramatta Flying-fox Camp	19.7	Low
Prospect Reservoir	19.9	Moderate
Spring Farm Landfill	20.5	Low
Campbelltown Flying-fox Camp	21.9	Moderate
Lake Gillawarna Ibis Colony	23.3	High
Parramatta Park Flying-fox Camp	25.8	Moderate

Table 6.4 comments on those sites assessed as high and very-high risk and highlights the key risk contributors.

Table 6.4 High and very-high risk sites and key risk contributors

Site	Risk	Risk contributors
Duncan Creek 	Very High	• Permanent water source. • Waterbirds accounted for 33 per cent of observations. • Predominant species: – Common Myna *Sturnus tristis* (risk: very low) – Common Starling *Sturnus vulgaris* (risk: low) – Australian White Ibis *Threskiornis molucca* (risk: high) – Feral Pigeon *Columba livia* (risk: moderate) – Chestnut Teal *Anas castanea* (risk: high) – Pacific Black Duck *Anas superciliosa* (risk: high).
Pond on Elizabeth Drive 2 	High	• Permanent water source. • Waterbirds accounted for 50 per cent of observations. • Predominant species: – Cattle Egret *Bubulcus ibis* (risk: not assessed[7]) – Australian White Ibis *Threskiornis molucca* (risk: high) – Pacific Black Duck *Anas superciliosa* (risk: high).
Kemps Creek Resource Recovery Park 	High	• Access to exposed putrescible waste. • Access to permanent water. • Australian White Ibis *Threskiornis molucca* (risk: high) accounted for 81 per cent of observations. • Other predominant species: – Common Myna *Sturnus tristis* (risk: very low) – Australian Raven *Corvus coronoides* (risk: moderate).
Wolstenholme Avenue Pond 	High	• Permanent water source. • Waterbirds accounted for 57 per cent of observations. • Predominant species: – Chestnut Teal *Anas castanea* (risk: high) – Australian White Ibis *Threskiornis molucca* (risk: high) – Pacific Black Duck *Anas superciliosa* (risk: high) – Grey Teal *Anas gracilis* (risk: NA).

[7] Was not observed during surveys and therefore was not assessed in the risk assessment.

Site	Risk	Risk contributors
Western Sydney Parklands 	High	• Permanent water source. • Waterbirds accounted for 30 per cent of observations. • Australian White Ibis *Threskiornis molucca* (risk: high) accounted for 46 per cent of observations. • Other predominant species: – Common Myna *Sturnus tristis* (risk: very low) – Wood Duck *Chenonetta jubata* (risk: high).
Lake Gillawarna Ibis Colony 	High	• Ibis breeding colony with permanent water source. • Australian White Ibis *Threskiornis molucca* (risk: high) accounted for 90 per cent of observations.

6.3.2 Flying-foxes

The primary concern is if flying-foxes conflict with aircraft when they infringe aircraft airspace en-route to and from foraging and roosting sites. Figures 6.6 to 6.8 present a hypothetical scenario. Figure 6.6 shows the location of flying-fox camps within 20 km of the WSI footprint relative to the airfield and the approach and departure paths for aircraft operating on 2 runways. Also shown is a hypothetical foraging location added to demonstrate potential flying-fox flights from camps to access the food source. Figure 6.7 provides more scenario detail.

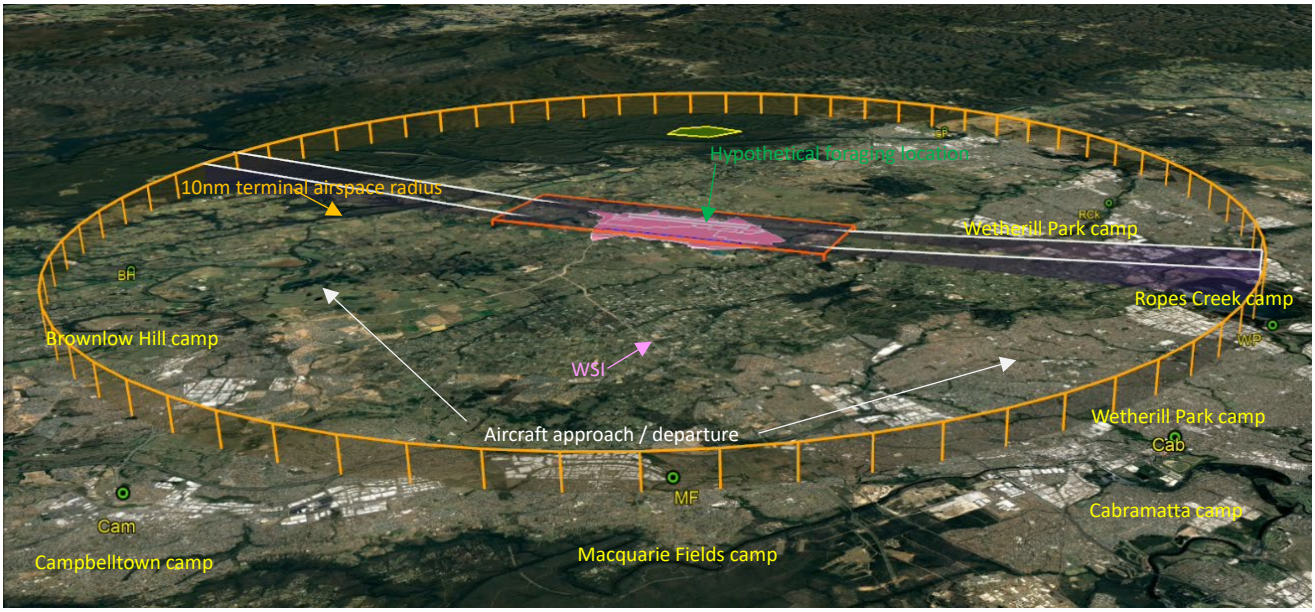


Figure 6.6 Location of flying-fox camps within 20 km of the WSI footprint

Figure 6.7 shows the flight path (indicated by the red and orange lines) of flying-foxes originating from, and returning to, their camps to access the foraging site. Red indicates a scenario where an aircraft/flying-fox conflict is likely based on the known altitude of aircraft during this flight phase and the likely altitude of the flying-fox. Orange indicates a possible conflict however flying-fox flight altitude is likely to be under aircraft altitudes at this stage of the approach or departure.

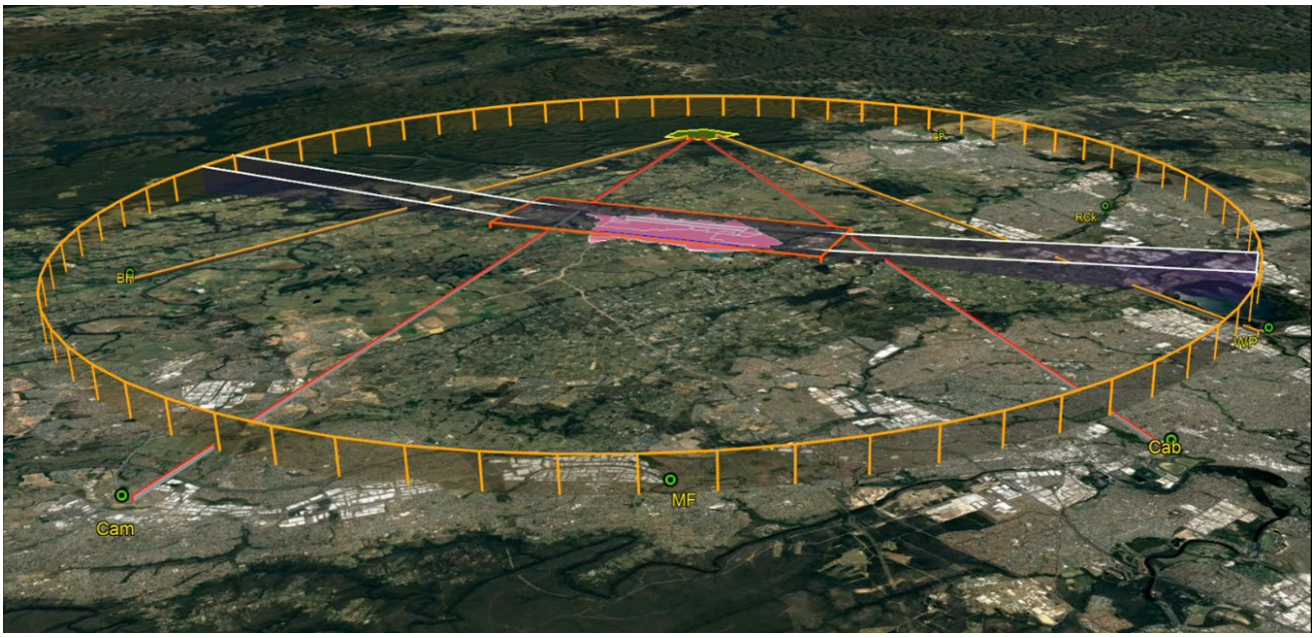


Figure 6.7 Flying-fox flight paths originating from, and returning to, their camps to access the foraging site

Figure 6.8 shows an alternative angle of the scenario detailed in Figure 6.7 above, showing the low strike risk associated with the Ropes Creek Camp given its location relative to the airfield and the aircraft approach or departure paths.

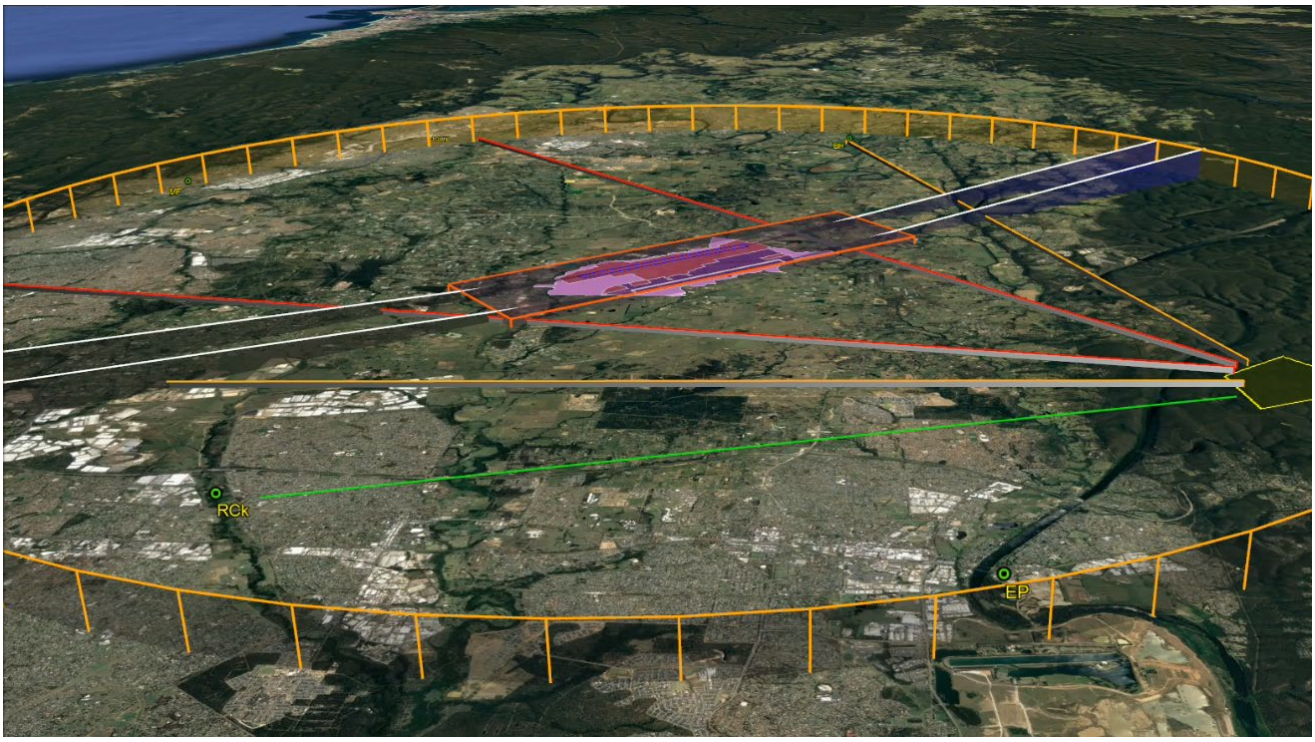


Figure 6.8 Alternative angle of the scenario detailed in Figure 6.7

The effects of air operations on *P. poliocephalus* behaviour, reproductive and nutritional status and overall population status are difficult to anticipate without long term baseline studies of the movement and foraging ecology. Such studies require mapping animal flight characteristics and population structure in detail (Meade et al. 2019) and then monitoring changes as construction and air operations increase. Anecdotal observations by trained biologists and air operations specialists reveal the following relevant details about the interactions between flying-foxes and aircraft:

- Flying-foxes and aircraft commonly collide during dawn and dusk along approach and departure corridors or airports along the eastern seaboard, usually at or below 1000 feet AGL (Parsons et al., 2008).
- Flying-foxes have poor vigilance and avoidance capability with regards to aircraft in flight.
- Struck flying-foxes are almost always killed by the collision. There are no studies examining the effect of aircraft collision on endangered species populations and no evidence to support whether it is or is not a likely threatening process. In the case of *P. poliocephalus* the precautionary principal argues mortality should be avoided.
- Flying-fox strike trends at other Sydney airports (Tables 6.5 and 6.6) may be indicative of future trends for WSI, however it is noted that each airport has their own unique strike risk profile based on wildlife species, aviation operations, off-airport land use, and wildlife access to resources. The information in the following tables does not predict WSI's future trend.

Table 6.5 Sydney Airport (YSSY) wildlife strike rates, highlighting flying-foxes 2016/17 to 2020/21

Year	Total strikes	Strikes / 10K RPT MVTS[8]	Total Flying-fox strikes	Strikes / 10K RPT MVTS	% *P. poliocephalus*
2016/17	115	3.30	13	0.37	0%
2017/18	109	3.12	12	0.34	25% (3 strikes)
2018/19	117	3.35	27	0.77	15% (4 strikes)
2019/20	85	3.17	10	0.37	10% (1 strike)
2020/21	63	4.62	13	0.95	38% (5 strikes)

Table 6.6 Bankstown Airport (YSBK) wildlife strike rates, highlighting flying-foxes 2016/17 to 2020/21

Year	Total strikes	Strikes / 10K RPT MVTS	Total Flying-fox strikes	Strikes / 10K RPT MVTS	% *P. poliocephalus*
2016/17	4	0.16	0	0.00	–
2017/18	11	0.42	1	0.04	0%
2018/19	19	0.69	0	0.00	–
2019/20	17	0.72	1	0.04	0%
2020/21	15	0.63	0	0.00	–

Notes

Species and strike reporting protocols vary at each airport.

Identification of species struck does not always occur. 68 and 62 per cent of strikes reported at YSSY and YSBK, respectively, for 2016/17-2020/21 did not adequately identify species.

The proportion of P. policephalus strikes is likely an underestimate. 80 per cent and 100 per cent of flying-fox strikes reported at YSSY and YSBK, respectively, for 2016/17-2020/21 was recorded as 'unidentified flying-fox' or 'unidentified bat'.

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8 Regular Passenger Transport (RPT) aircraft movements

- Flying-fox outbound foraging tracks are generally straight and common dispersal methods that will deter and scatter birds in flight have little effect on flying-foxes determined to reach their forage areas.
- The most practical way to minimise the likelihood of collision between flying-foxes and aircraft is to map and anticipate their movement patterns in relation to foraging activity and to notify air operations if collision probability is high.
- The only way to map flying-fox flight patterns in sufficient resolution for this purpose is with a variety of remote sensing technologies.

  In the long term, the geometry between roost sites, foraging sites and aircraft tracks below 1000 feet AGL could permanently and significantly reduce the likelihood of in-flight collision.

As at October 2022, 6 of the 8 camps monitored by Avisure were active (Cabramatta 780; Campbelltown 4100; Brownlow Hill 15; Ropes Creek 1730; Macquarie Fields 4100; Parramatta Park 15130), with flying-foxes consistently present during all 4 survey months at Campbelltown, Parramatta Park and Ropes Creek. Table 6.7 summarises camp fly-out numbers and directions. This information, when collected consistently over a long term can be indicative of flying-fox flight trends relative to the airport and to aircraft movement areas. Due to project delays, seasonal surveys were not achieved and conclusive trend analysis is not possible. Appendix G summarises all flying-fox camp monitoring data at the 8 sites since 2018, collected by either Avisure, WSI or Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW), with the latter derived from the National Flying-fox Monitoring Database.

Table 6.7 Summary of flying-fox camp fly-out surveys

Location	Jul 2022	Aug 2022	Sep 2022	Oct 2022
Brownlow Hill	0	0	0	Transit: 19:37–19:49 Flying-foxes: 15 Direction: Multiple
Cabramatta	0	0	0	Transit: 19:31-19:48 Flying-foxes: 780 Direction: 100% West
Campbelltown	Transit: 17:50–18:15 Flying-foxes: 5463 Direction: Multiple	Transit: 18:00–18:26 Flying-foxes: 2610 Direction: Multiple	Transit: 18:29–18:54 Flying-foxes: 1750 Direction: Multiple	Transit: 19:31–19:56 Flying-foxes: 4100 Direction: 100% West
Emu Plains	0	0	0	0
Macquarie Fields	0	Transit: 17:57–18:33 Flying-foxes: 3538 Direction: Multiple	Transit: 18:09–18:42 Flying-foxes: 3128 Direction: Multiple	Transit: 19:30–19:48 Flying-foxes: 4100 Direction: 100% Northeast
Parramatta Park	0	Transit: 17:30– Flying-foxes: 4997 Direction: Multiple	Transit: 18:01–18:33 Flying-foxes: 11798 Direction: Multiple	Transit: 19:05–19:55 Flying-foxes: 15130 Direction: Multiple
Ropes Creek	Transit: 17:49–18:07 Flying-foxes: 396 Direction: Multiple	Transit: 18:08–18:29 Flying-foxes: 715 Direction: Multiple	Transit: 18:23–18:43 Flying-foxes: 1697 Direction: Multiple	Transit: 19:08–19:42 Flying-foxes: 1730 Direction: Multiple
Wetherill Park	0	0	0	0

Based on the above hypothetical scenarios, the risk assessment, the presence several camps in WSI's vicinity, and the history of flying-fox strikes at Australian airports, the risk of flying-fox strike occurring is potentially significant.

6.3.3 Terrestrial animals

Terrestrial animals off-airport would not conflict with approaching or departing aircraft due to aircraft height. However, unmanaged populations of vertebrate pests (e.g., fox, rabbit, hare) and macropods (e.g., kangaroo, wallaby) can enter the airside area where fence integrity is compromised and conflict with aircraft during on-ground phases (landing, take-off run, taxiing).

6.4 Threatened and migratory species

Table 6.8 summarises the threatened and migratory species identified during wildlife surveys (Avisure surveys in 2018 and 2022, and WSI surveys as part of their current wildlife monitoring program) and an EPBC protected matters search (November 2022) within 13 km of WSI runway boundary.

Table 6.8 Protected species

Species	Status	Recorded where
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable (EPBC Act 1999)	Off-airport (within 30 km)
White-bellied Sea-Eagle *Haliaeetus leucogaster*	EPBC Migratory Species: China-Australia Migratory Bird Agreement Vulnerable (*Biodiversity Conservation Act 2016*)	Airside Off-airport (within 13 km)
Cattle Egret *Bubulcus ibis*	EPBC Migratory Species: Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement	Off-airport (within 13 km)
Glossy Ibis *Plegadis falcinellus*	EPBC Migratory Species: China-Australia Migratory Bird Agreement	Airside[9]

The conservation and animal welfare costs of strikes are hard to reliably quantify. In Australia, thousands of animals die each year as a direct result of collisions with aircraft, and more die as part of actions taken in aerodrome wildlife strike management programs. To date, the air safety implications of strike have been the sole focus of collision consequence and the wildlife attrition has been ignored; there has been little discussion on the effect of wildlife strike on conservation, endangered species management, and biodiversity. Similarly, the ethics and efficacy of culling programs aimed at preventing wildlife strike are often secondary concerns to aviation safety. As a result, some stakeholders are reviewing lethal wildlife control practices to determine if the rationale for those measures is evidence-based (Bridger 2013; Uhlfelder 2013). It is noted however that state environmental authorities require airports to apply for culling permits as part of their wildlife management control programs and these are conditional regarding species permitted, numbers, etc.

The vision of the Western Sydney Aerotropolis would see increased tree canopy cover to 40 per cent, enhanced riparian zones and wetlands and generally maximised biodiversity across the area. This is likely to attract wildlife, including protected species such as *P. poliocephalus*, and will require a balanced approach to deliver this vision while at the same time safeguarding airport operations to minimise the numbers, flock size and diversity of wildlife operating in and around the WSI airspace. The wildlife attraction is yet to be fully understood. Ongoing monitoring (Chapter 8) would be needed to determine if wildlife populations increase, and if so which ones, and if the safeguarding principles and mitigation applied by the airport and surrounding land users results in minimal impact from aircraft operations on populations, including threatened species.

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[9] WSI recorded 30 on-airport in a large drainage pond on 10/12/2020. This is the only observation of Glossy Ibis by WSI. Avisure did not record any during surveys.

6.5 Aircraft flight paths

Because the majority of strikes occur at or below 3,500 ft, of primary concern for wildlife strikes are the approach and departure paths at this altitude or below. While strikes above this altitude can occur with thermaling species such as Australian Pelican and Wedge-tailed Eagle, the frequency of high-altitude strikes is comparatively low. Therefore, the strike risk is highest below 3500 ft and safeguarding principles applied to land use on these areas, and well as WSI's wildlife management program, will be most critical.

6.5.1 Aviation safeguarding

Section 2.10.3 of the Western Sydney Aerotropolis Development Control Plan (DCP) establishes the following wildlife hazard objective:

O1. Safeguard the Airport from incompatible development that could compromise safe operations.

Table 6.9 details the DCP's Performance Outcomes (PO) and Benchmark Solutions to meet this objective.

Table 6.9 Western Sydney Aerotropolis DCP Performance Outcomes and Benchmark Solutions for wildlife hazard management: Off-airport risk

10.3.2	Performance outcome	Benchmark solution
PO1	Development does not attract wildlife which would create a safety hazard to the operations of the Airport.	1. All waste bins are designed and installed with fixed lids. 2. Any bulk waste receptacle or communal waste storage area is contained within enclosures that cannot be accessed by birds or flying-foxes. 3. Any stormwater detention within the 3 km and 8 km wildlife buffer is designed to fully drain within 48 hours after a rainfall event. 4. Buildings and structures are designed to minimise the opportunity for roosting areas.
PO2	Landscaping does not attract wildlife that could create a safety hazard to the operations of the Airport.	1. Refer to Appendix B [of the DCP] for a list of suitable landscape species. 2. In areas within the 3 km wildlife buffer but outside of the Parkland Priority Areas shown in Figure 8 [of the DCP], a report prepared by a suitability qualified and experienced ecologist is to be submitted with any application when the landscaping plan: a. incorporates alternative landscape species not listed within Appendix B [of the DCP] b. incorporates landscape species denoted within the landscape species list c. will result in more than 5 trees being planted in 1 group (group refers to touching mature canopies); and/or d. provides a spacing between a group of 5 or more trees that is less than 100 m. 3. The ecologist report is to consider building, site, and water body design outcomes and/or landscape maintenance measures that will mitigate bird and flying-fox attraction and roosting areas.

Appendix D.7 of the DCP (Aviation Safeguarding Assessment) details the matters and documents required as part of an aviation safeguarding assessment within the context of wildlife hazards, Table 6.10.

Table 6.10 Western Sydney Aerotropolis DCP Aviation Safeguarding Assessment requirements

DCP requirements: Wildlife Hazards
• Applications for the following uses within the 3 km and 8 km wildlife buffers must be accompanied with a Wildlife Hazard Assessment and Wildlife Management Plan that incorporates relevant mitigation and monitoring measures: a. Agricultural produce industry b. Agriculture c. Aquaculture d. Camping ground e. Garden centre f. Intensive livestock agriculture g. Intensive plant agriculture h. Livestock processing industry i. Plant nursery j. Recreation facility (outdoor) k. Recreation facility (major) l. Recreational area m. Sewage treatment plant n. Waste or resource management facility o. Waste or resource transfer station; and p. Water storage facility. Note: Within 3 km livestock processing industry, waste or resource management facilities and transfer stations that include any external storage, processing or handling are prohibited.
• Applications for the following uses within the 13 km wildlife buffer must be accompanied with a Wildlife Hazard Assessment and Wildlife Management Plan that incorporates relevant mitigation and monitoring measures: a. Livestock processing industry b. Waste or resource management facility c. Waste disposal facility; and d. Sewage treatment plant.
• Wildlife Hazard Assessment Reports must assess the wildlife attraction risk of the land use, the design of the building and ancillary works including proposed landscaping, water facilities (incl. stormwater infrastructure), waste management, and temporary risks associated construction activity.
• The Wildlife Management Plan must respond to the findings and recommendations of the wildlife hazard assessment.
• Where monitoring is required to be undertaken in accordance with the Management Plan, copies of the report are to be submitted to the airport lessee company within 28 days of completion.

DCP requirements: Wildlife Hazards

- A waste management plan for the operation of the use must be submitted for the following uses within the 3 km, 8 km and 13 km buffer:
  a. Agriculture
  b. Agricultural produce industry
  c. Aquaculture
  d. Camping Grounds
  e. Eco-tourist facility
  f. Food and Drink Premises
  g. Garden Centre
  h. Hotel
  i. Intensive plant agriculture
  j. Intensive livestock agriculture
  k. Kiosk
  l. Livestock processing industry
  m. Plant Nursery
  n. Recreation facility (outdoor); and
  o. Recreation facility (major).

- Landscaping within the Enterprise Zone and Agribusiness Zone must comply with Appendix B: Western Sydney Aerotropolis Landscape Species List [of the DCP], except where the property is subject to biodiversity certification conditions or identified as one of the key government commitments.

6.6 Aircraft noise and avifauna

Significant research on the effects of aircraft noise on wildlife is limited and it is not possible to generalise the response to noise disturbance over families or genera with variations observed even within species (Coffey, 2014). However, a review of the literature presents some noteworthy points:

- Regulations and requirements pertaining to noise in aviation generally only consider the human impact, and in those instances where noise impacts on natural areas, such as national parks, it is the impacts of the noise on the people using the parks, not the adverse impacts on the animals inhabiting them (Alquezar & Macedo, 2019).
- Pepper *et al.* (2003) states the most important consideration with regard to aircraft noise and wildlife is proximity to the airport (where the highest noise impacts are) and frequency of overflights.
- Landings and take-off produce the most noise (Alquezar & Macedo, 2019) with departing aircraft louder than arriving, and long-range heavy aircraft louder for longer because of the slower climb (e.g. A380, B747) (Airservices Australia, 2022).
- Noise level generated by aircraft depends on aircraft engine type (propeller, jet), size (B737, C172) and aircraft altitude (Airservices Australia, 2022).
- Pepper *et al.* (2003) suggests that wildlife previously exposed to noise may be less affected than those who have not, and the time it takes for wildlife to adapt to noise is species-specific.
- Wildlife can respond to noise disturbance by fleeing, increased alertness, lower reproductive success and changes in vocal behaviour (Alquezar & Macedo, 2019; Pepper *et al.* 2003).

- Aircraft noise could affect birds' ability to hear environmental signals and vocal cues (i.e., auditory masking) linked to predator detection, vocalisations, foraging and reproduction (Pepper *et al.* 2003). Conversely, this acoustic masking can also deter predators in noisy environment (Bonson, 2012) which may encourage wildlife to inhabit and tolerate noisy environments such as airports and their surrounds.
- Some bird species have adapted to noise in the urban environment with the use of signalling behaviours to overcome auditory masking issues (Blickley & Patricelli, 2011).
- Avisure has recorded a number of urban adapted species successfully breeding and roosting on and close to airports (e.g., Masked Lapwing *Vanellus miles*, Australian Magpie *Gymnorhina tibicen*, Australian White Ibis *Threskiornis moluccus*, Wood Duck *Chenonetta jubata*, Plumed Whistling-Duck *Dendrocygna eytoni*, Fairy Martin *Petrochelidon ariel*, Osprey *Pandion haliaetus*).
- The Grey-headed Flying-fox *Pteropus poliocephalus* show a resistance to noise disturbance (Coffey, 2014), however because noise disturbance is a tool often used to relocate flying-foxes from camps, much more research into the impacts of aircraft noise on camp selection, camp dynamics, breeding success, impacts on population health etc., is needed.
- Pepper *et al.* (2003) notes a study that showed raptors non-responsive to aircraft when >500 m away. Anecdotal evidence from Avisure supports this and suggests that raptors, in general, are largely non-responsive to aircraft even when less than 500 m away. When airborne, raptors are focused on their foraging target and are less concerned about detecting predators. This is considered a contributing factor to their relatively high strike frequency at Australian airports.
- Waterfowl (e.g. ducks) spend less than 1.4 per cent of their time responding to aircraft (e.g. alert response, fleeing) and the energetic cost to the population is apparently low (Pepper *et al.*, 2003).
- On airport populations of Australian Magpies *Gymnorhina tibicen* have shown a decreased response to aircraft noise on airports, primarily due to increased tolerance from repeated exposure (Linley *et al.*, 2018). Avisure has implemented a number of airport wildlife management programs and the data collected from these programs supports this behaviour.
- Pepper *et al.* (2003) notes a study that tested the disturbance rate on the Mexican Spotted Owl (*Strix occidentalis lucid*a) when exposed to helicopter noise with no negative impacts observed. Another study showed no long-term negative effects on reproductive output by raptors, including Peregrine Falcons (*Falco peregrinus*). However, some studies suggest that some *Branta* and *Anser* species in North America have poorer tolerance to rotary-wing noise compared to fixed-wing aircraft.

There are few studies that examine the effect of noise on insectivorous bats (suborder Microchiroptera), and none that consider the impacts of aircraft noise, however Bonson (2012) suggest that urban noise can potentially mask echolocation calls. Le Roux and Waas (2012) showed aircraft noise did not have any impact on Long-tailed Bats (*Chalinolobus tuberculatus).*

Chapter 7 Cumulative impacts

Cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variations over time and can be both positive and negative. They can be caused by the compounding effects of a single project or multiple projects in an area, and by the accumulation of effects from past, current and future activities as they arise (DPE 2022).

Potential cumulative impacts related to wildlife strikes could result from the project operating in the study area in conjunction with other existing airports in the study area.

As outlined in Section 6.1, major Australian airports between 2008 and 2017 averaged 4.8 strikes per 10,000 aircraft movements (ATSB, 2019). If WSI aligned with this rate, then based on their aircraft movement projections for the project, the addition of the project may result in increases in potential wildlife injury or mortality due to wildlife strike – estimated to be around 39 strikes per year by 2033 and 108 strikes per year by 2055.

However, it is important to note that a comparative analysis of strike rates at other airports does not account for the site-specific variables and nuances at each airport that contribute to the strike risk and managing it is directly related to the quality of wildlife hazard management programs applied on and off the airport.

The species surveyed on and off the airport to date may be indicative of the suite of species likely to occupy WSI and surrounds once the airport is operational. And it is likely that known urban adaptors, particularly those known to occupy areas on and around other Australian airports (e.g., Australian White Ibis *Threskiornis moluccus*, Australian Magpie *Gymnorhina tibicen*, Masked Lapwing *Vanellus miles*, Pacific Black Duck *Anas superciliosa*) will also occupy WSI airside/landside and in the vicinity. However, the upcoming changes to the Western Sydney landscape according to the Western Sydney Aerotropolis planning objectives, means that it is difficult to qualify, with accuracy, how wildlife populations will respond, and how this will impact the strike risk. As such, ongoing monitoring will be critical to identify trends and ensure the early detection of wildlife issues.

Chapter 8 Management and mitigation measures

8.1 Existing mitigation measures in relation to wildlife management

Regulatory planning in the vicinity of WSI has considered and incorporated the operational needs of WSI into land use planning in relation to wildlife management. This has been ongoing for over a decade in conjunction with planning for the airport and is well established in existing planning instruments.

Off-airport requirements to mitigate the wildlife strike risk for aircraft operating out of WSI are currently addressed in the SEPP (Precincts-Western Parkland City) 2021, and by extension, the WSI Airport Safeguarding Tool and the Western Sydney Aerotropolis DCP 2022.

The SEPP regulates development within 13 km of the airport, specifies consent requirements for relevant development, and identifies prohibited land use types. The DCP has established a clear wildlife hazard management objective (section 10.3) and associated Performance Outcomes and Benchmark Solutions to satisfy this objective.

Supporting these requirements for off-airport wildlife management are the recommendations and guidelines detailed in Guideline C of the NASF (Appendix A; Section A7). Despite some deficiencies (Table A.7) the NASF is an effective tool when compared to other airport safeguarding documents. It succeeds in meeting the objectives of ICAO reference documents (primarily ICAO DOC 9184 - Airport Planning Manual Part 2 – Land Use and Environmental Control) and provides enough detail to develop basic risk-based land use plans in the vicinity of airports. Off-airport, the specific types of mitigation applied will vary depending on the land use type, the nature and extent of the hazard, and the location of the hazard relative to the airport, aircraft fight paths and other nearby hazards. However, the SEPP and supporting documents, along with the NASF, will help inform approaches to mitigation.

Airside requirements to mitigate the wildlife strike risk are currently addressed in the CASR Part 139 MOS (Appendix A; Section A1). These provisions detail WSI's responsibilities for preparing and implementing a wildlife management program on airport land and liaison arrangements for local planning authorities within a radius of at least 13 km.

At operational airports elsewhere in Australia, these airport and off-airport mitigations, when conscientiously and comprehensively prepared and implemented, have contributed to effective wildlife hazard management.

8.2 Project specific mitigation measures

Table 8.1 provides a summary of mitigation and management measures identified for the project, indicating the relevant owner, timing and applicable mitigation measure.

Table 8.1 Summary of management measures

ID No.	Issue	Mitigation	Owner	Timing
HR5	Wildlife strike	WSA Co will monitor and control the presence of birds and other wildlife on or in the vicinity of WSI in accordance with Civil Aviation Safety Regulations (CASR) Part 139 MOS requirements and National Airports Safeguarding Framework (NASF) Guideline C (See Table 24.2).	WSA Co	**Operation** (Implementation, 2026 – ongoing)
HR6	Wildlife strike	WSA Co will liaise with planning authorities on matters related to the development of, or modifications to, off-airport land uses that have the potential to attract hazardous numbers or types of wildlife.	WSA Co	**Pre-operation** (Detailed design, 2024–2026) and **Operation** (Implementation, 2026 – ongoing)
HR7	Wildlife strike	WSA Co will establish a WSI Wildlife Hazard Management Committee (WHMC) that will likely comprise Western Sydney local government representatives, NSW Department of Planning and Environment and other relevant aviation stakeholders.	WSA Co	**Operation** (within 6 months of Implementation, 2026–ongoing)
HR8	Wildlife strike	The WHMC will contribute to the preparation of regional species management programs (including Australian White Ibis) as required. Regional species management plans will build on any existing management programs (e.g. the Canterbury-Bankstown Council Australian White Ibis Management Program). The regional programs will aim to: • reduce species impacts on aviation and the community in general • provide advice to landowners on how they can contribute to species management programs on non-council land • establish measurable targets for species management • maintain the long-term sustainability of the local species populations.	WSA Co	**Operation** (Implementation, 2026–ongoing)

Table 8.2 provides a summary of monitoring measures identified for the project.

Table 8.2 Summary of proposed monitoring measures

ID no.	Issue	Monitoring measure	Owner	Timing
M2	Wildlife strike	A bird and bat strike monitoring program will be conducted to monitor for the presence of wildlife on the WSI site and in vicinity of WSI. The monitoring program will: • identify wildlife hazards which must be assessed to reduce potential risk to aircraft operations • be conducted in accordance with relevant Commonwealth and State guidelines and standards including any recovery plans for threatened species • carried out under the direction of a suitably qualified person • be carried out in liaison with local government in relation to plans for proposed developments within 13 km of WSI that are likely to increase bird and bat strike • identify locations where reasonable and feasible mitigation measures to manage wildlife strike risk are required • be reviewed annually to determine its effectiveness.	WSA Co	**Operation** (Implementation, 2026–ongoing)

Chapter 9 Conclusion

The wildlife strike risk assessment identified one very-high risk species; Eastern Grey Kangaroo *Macropus giganteus* (although this risk should be minimal once the airport is fully contained by the secure perimeter fence and the existing airside population has been removed), and 8 high risk species; Straw-necked Ibis *Threskiornis spinicollis* Australian White Ibis *Threskiornis molucca,* European Brown Hare *Lepus capensis,* Red Fox *Vulpes vulpes,* Wood Duck *Chenonetta jubata,* Pacific Black Duck *Anas superciliosa,* Little Black Cormorant *Phalacrocorax sulcirostris,* and Chestnut Teal *Anas castanea.*

An off-airport risk assessment of 73 sites within 30 km of Western Sydney International Airport identified one very-high risk site; Duncan Creek, and 5 high risk sites; a pond on Elizabeth Drive, the Kemps Creek Resource Recovery Park, a pond on Wolstenholme Avenue, the Western Sydney Parklands, and the Lake Gillawarna Ibis Colony. Wildlife using an off-airport land use can affect wildlife strike risk. Aircraft overflying a site with birds in the air (e.g., thermaling or soaring) can conflict with aircraft. Birds traversing aircraft flight paths to and from land uses can conflict with aircraft. There can be significant population growth of species receiving abundant food resulting in spill over onto areas around or on the airport. Risk can increase during certain events, such as heavy rainfall or ploughing activity. For this reason, understanding how wildlife are using areas in the vicinity of the airport is just as important as wildlife using the airfield.

This report places a particular emphasis on flying-foxes and Australian White Ibis due to potentially significant issues with these species, however it is important that any species presenting an unacceptable risk to aviation is appropriately managed in a way that minimises their strike risk while conserving native wildlife populations.

Based on the wildlife risk assessment and the off-airport risk assessment, there are species that present significant strike risk at Western Sydney Airport. In addition, land uses in the vicinity of the airport attract wildlife that will intersect with aircraft operating into and out of the airport. Therefore, Western Sydney International Airport requires a rigorous and integrated wildlife management program to effectively manage wildlife strike risk. Species risks are dynamic, may not be accurate predictors of future risks, and will change in response to landscape changes during airport construction and operation, as well as changing land use activity in the vicinity of the airport. As such, the assessment results should be viewed as preliminary.

A review of wildlife survey data on and around the airport noted 4 threatened species; Grey-headed Flying-fox *Pteropus poliocephalus,* White-bellied Sea-Eagle *Haliaeetus leucogaster,* Cattle Egret *Bubulcus ibis,* and Glossy Ibis *Plegadis falcinellus.* The vision of the Western Sydney Aerotropolis will see increased tree canopy cover to 40 per cent, enhanced riparian zones and wetlands and generally improved biodiversity across the area. This is likely to attract wildlife, including protected species such as *P. poliocephalus*, and will require a balanced approach to deliver this vision and safeguard airport operations.

The impact on protected species due to strikes with aircraft is likely to be minimal, however populations must be monitored to allow for the early detection of emerging issues. Ongoing monitoring will be needed to determine wildlife population trends, identify which ones are increasing, and assess the effectiveness of safeguarding principles and mitigation applied by the airport and surrounding land users to maintain aviation safety and conserve threatened species.

How wildlife use the landscape, and how they will respond to changes in that landscape during airport construction and operation, is complex. Targeted and effective wildlife management must be informed by understanding how wildlife use this changing landscape, which can only be achieved through ongoing and standardised monitoring, including the use of radar, regular risk assessments and regular revisions of management procedures and assessment protocols.

Safeguarding the airport against wildlife hazards requires a multi-stakeholder approach. WSA will prepare, in accordance with civil aviation regulations, a wildlife management program that focuses on the airfield, however land users and relevant authorities within the vicinity of the airport must adhere to the safeguarding principles set out in the Western Sydney Aerotropolis DCP 2022.

Chapter 10 References

Airservices Australia. *Understanding Aircraft Noise*. [ONLINE] Available at: https://www.airservicesaustralia.com/community/environment/aircraft-noise/monitoring-aircraft-noise/understanding-aircraft-noise/ [Accessed 15 Nov. 2022].

Allan, J., 2002. *The Costs of Birdstrikes and Birdstrike Prevention*. in Clarke L (ed.) Human Conflicts with Wildlife: Economic Considerations pp 147-153. United States Department of Agriculture, Fort Collins.

Alquezar, R., and Macedo, R. 2019. *Airport noise and wildlife conservation: What are we missing?* Perspectives in Ecology and Conservation 17 (2019) 163–171.

Australian Transport Safety Bureau, 2019. *Australian Aviation Wildlife Strike Statistics 2008-2017*. ATSB Transport Safety Report AR-2018-035. Final – 13 March 2019.

Australian Transport Safety Bureau, 2007. *Aviation Occurrence Report – 200605807 Final Report: Birdstrike- Melbourne Airport, Vic. 3 October 2006 VH-OGJ Boeing Co 767-338*. ATSB Transport Safety Investigation Report.

Avherald.com. 2020. *Accident: Ural A321 At Moscow on Aug 15th 2019, Bird Strike Into Both Engines Forces Landing In Corn Field*. [ONLINE] Available at: http://avherald.com/h?article=4cb94927&opt=0 [Accessed 1 November 2022].

Begier, M., and Dolbeer, R., 2011. *Why we Need to Compare Wildlife Strike Data Among Airports to Improve Aviation Safety*. 2011 Bird Strike North America Conference, Niagara Falls. 12.

Biosis, 2020. *Draft Cumberland Plain Assessment Report – Summary Report*. Report prepared for the NSW Government Department of Planning, Industry and Environment.

Blickley, J., and Patricelli, G. 2011. *Impacts of Anthropogenic Noise on Wildlife: Research Priorities for the Development of Standards and Mitigation.* Journal of International Wildlife Law & Policy, 13:274–292, 2010.

Bonson, G, 2012. *Resource Selection Patterns in Microbats as a Response to Noise Pollution and Urban Development.* Honours thesis. School of the Environment Faculty of Science, University of Technology, Sydney.

Bridger, R., 2013. *Plane Truth. Aviation's Real Impact on People and the Environment*. Pluto Press 9th October 2013, ISBN: 9780745330327.

Civil Aviation Authority of New Zealand (CAANZ), 2020.

Cleary, E, Dolbeer, R, and Wright, S., 2006, *Bird Strikes to Civil Helicopters in the United States, 1990–2005 Appendix A of Wildlife Strikes to Civil Aircraft in the United States 1990-2005* Other Bird Strike and Aviation Materials. Paper 7. *http://digitalcommons.unl.edu/birdstrikeother/7.*

Coffey, 2014. *Draft Environmental Impact Statement for Flying Operations of the F-35A Lightning II RAAF Base Williamtown and Salt Ash Air Weapons Range.*

Department of Climate Change, Energy, the Environment and Water, 2022. *National Flying-fox Monitoring Viewer* [ONLINE]. Available at https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf [Accessed 25 Aug 2022].

Department of Infrastructure, Transport, Regional Development and Communication, 2021. *Western Sydney Airport – Airport Plan 2021*.

Dolbeer, R., 2011, *Increasing Trend of Damaging Bird Strikes with Aircraft Outside the Airport Boundary: Implications for Mitigation Measures*. Human-Wildlife Interactions 5(2):235-248, Fall 2011.

Dolbeer, R., 2006, *Height Distribution of Birds Recorded by Collisions with Civil Aircraft*. United States Department of Agriculture National Wildlife Research Center - Staff Publications. Paper 500.

Dutch Safety Board, 2010. *Emergency Landing after a Bird Strike: Boeing 737-4B6, Amsterdam Schiphol Airport, 6 June 2010*.

Federal Public Service Mobility and Transport (Air Accident Investigation Unit), 2009. *Final Report on the Accident Occurred on 25 May 2008 at Brussels Airport on a Boeing B747-209F Registered N704CK.*

Flight Safety Foundation, 1996. *Military Being 707 Strikes Birds after Lift-off; Damage to Engines No. 1 and No. 2 Results in Loss of Power and Impact with Terrain*. Accident Prevention, Vol. 53, No. 11. November 1996.

Greater Sydney Commission, 2018. *Our Greater Sydney 2056.Western City District Plan – Connecting Communities*.

Le Roux, S., and Waas, J. 2012. *Do long-tailed bats alter their evening activity in response to aircraft noise?* Acta Chiropterologica, 14(1): 111–120, 2012.

Linley, G., Kostoglou, K., Jit R., and Weston M. 2018. *Australian magpies exhibit increased tolerance of aircraft noise on an airport and are more responsive to take-off than to landing noises.* Wildlife Research 45(3): 282-286 (2018).

McConkey, KR, Prasad, S, Corlett, RT, Campos-Arceiz, A, Brodie, JF, Rogers, H and Santamaria, L., 2012. *Seed dispersal in changing landscapes*, Biological Conservation, vol. 146, pp. 1–13, doi:10.1016/j.biocon.2011.09.018.

Meade, J., van der Ree, R., Stepanian, P., Westcott, D., and Welbergen, J., 2019. *Using weather radar to monitor the number, timing and directions of flying-foxes emerging from their roosts*. Scientific Reports 9, Article number 10222 (2019).

Parsons, D., 2022, *Using Machine Learning to Estimate Wildlife Strike Costs in Australia*. Proceedings of the Australian Aviation Wildlife Hazard Group 2022 Forum, Adelaide, Australia.

Parsons, J., Blair, D., Luly, J., and Robson, S., 2008. *Flying-fox (Megachiroptera: Pteropodidae) Flight Altitudes Determined via an Unusual Sampling Method: Aircraft Strikes in Australia.* Acta Chiropterologica 10(2): 377-379.

Pepper, C., Nascarella, M., and Kendall, R. 2003. *A Review of the Effects of Aircraft Noise on Wildlife and Humans, Current Control Mechanisms and the Need for Further Study*. Environmental Management Vol. 32, No. 4, pp, 418-432.

Roberts, BJ, Catterall, CP, Eby, P and Kanowski, J., 2012. *Long-Distance and Frequent Movements of the Flying-Fox Pteropus poliocephalus: Implications for Management*, PLoS ONE, vol. 7, no. 8, e42532.

Shaw, P., and Dolbeer R., 2022. *Database of Human Fatalities and Destroyed Civil Aircraft Due to Wildlife Strikes, 1912 to Present* [ONLINE]. Available at: https://avisure.com/wp/serious-accident-database/ [Accessed 23 August 2022].

Uhlfelder, E., 2013. *Bloody Skies: the fight to reduce deadly bird-plane collisions*. News, Environment. National Geographic, November 7, 2013.

United Kingdom Civil Aviation Authority. 2002, *Civil Aviation Publications 680.*

Washburn, B., Cisar, P., and DeVault, T., 2014 *Wildlife Strikes with Military Rotary-wing Aircraft During Flight Operations within the United States*. Wildlife Society Bulletin. doi: 10.1002/wsb.409.

Western Sydney Airport. *Airport Safeguarding | Western Sydney Airport*. [ONLINE] Available at: https://www.westernsydney.com.au/your-airport/airport-safeguarding [Accessed 10 Nov. 2022].

Appendix A

Legislative framework

A1 Australian Civil Aviation Safety Authority

Table A.1 MOS Part 139 requirements for wildlife management on and around airports

Section	Requirement
11.08 (1)	*Information that must be included in the Aerodrome Manual* The wildlife hazard management procedures must be included or referenced in the aerodrome manual to deal with the hazards to aircraft operations caused by the presence of wildlife on or in the vicinity of the aerodrome, including details of the arrangements for the following: (e) for proposed or actual sources of wildlife attraction outside the aerodrome boundary — liaising with the relevant planning authorities or proponents to facilitate wildlife hazard mitigation.
17.01 (1)	As part of the aerodrome serviceability inspection, the aerodrome operator must monitor and record at least the following: a. the presence and behaviour of wildlife on the aerodrome b. wildlife activity that is visible: i. in the vicinity of the aerodrome; or ii. from the aerodrome.
17.01 (2)	The aerodrome operator, in consultation with the local planning authority, must attempt to monitor sites within 13 km of the aerodrome reference point that attract wildlife.
17.01 (3)	The aerodrome operator must attempt to monitor any reported wildlife aircraft strike events at, or in the vicinity of, the aerodrome.
17.02 (1)	Any detected wildlife hazard must be assessed for its potential risk to aircraft operations.
17.02 (2)	If the aerodrome operator has a safety management system, or a risk management plan, mentioned in Chapter 25 (Safety Management Systems) or 26 (Risk Management Plans) respectively, the assessment must be conducted in accordance with the system or the plan.
17.02 (3)	When conducting a wildlife hazard assessment, available data from the following must be considered: a. wildlife observations b. reported aircraft strike events c. reported aircraft near miss events.
17.03 (1)	For an aerodrome that, in the course of a financial year, has: a. 50 000 or more air transport passenger movements; or b. 100 000 or more aircraft movements the aerodrome operator must prepare and implement a wildlife hazard management plan.
17.03 (2)	The plan must be prepared and implemented not later than 6 months after: a. for paragraph (1) (a) — the date of publication, by the Department, of the air transport passenger movement numbers indicating that, for the first time under this MOS, there have been 50 000 or more air transport passenger movements for the aerodrome for the financial year; or b. for paragraph (1) (b) — the date the aerodrome operator becomes aware of information indicating that, for the first time under this MOS, there have been 100 000 or more aircraft movements at the aerodrome in the course of the financial year.

Section	Requirement
17.03 (3)	If section 17.03 paragraph (2) (a) or (2) (b): a. applied to an aerodrome operator; and b. subsequently ceased to apply to the operator; and c. subsequently would have applied to the operator again if such application were deemed to be for the first time under this MOS then the paragraph applies to the operator as if it were for the first time under this MOS.
17.03 (4)	Section 17.03 Subsection (1) does not apply if: a. for aerodromes without scheduled international operations — wildlife hazard assessment demonstrates, using statistical and other data, that the wildlife hazard risk is low; and b. CASA, in writing, approves the assessment subject to conditions (if any).
17.03 (5)	CASA may direct an aerodrome operator in writing to prepare and implement a wildlife hazard management plan if CASA considers that this is necessary in the interests of aviation safety.
17.03 (6)	A wildlife hazard management plan must be included in, or referenced in, the aerodrome manual.
17.04 (1)	A wildlife hazard management plan must be prepared in consultation with a suitably qualified or experienced person, for example: a. an ornithologist, zoologist, biologist, ecologist; or b. a person with demonstrated expertise in the management of wildlife hazards to aviation.
17.04 (2)	The wildlife hazard management plan must at least: a. identify the key aerodrome or contracted personnel and define their responsibilities or functions in the plan; and b. identify sources and locations of wildlife attraction: i. on the aerodrome; and ii. in the vicinity of the aerodrome which are likely to cause wildlife to transit the take-off, approach and transitional surfaces; and c. set out the procedures for the following in relation to wildlife hazards: i. detection ii. monitoring iii. risk assessment and analysis iv. reporting to pilots through the AIP, NOTAM and ATC (if applicable) v. mitigation, including passive and active strategies; and d. specify the liaison arrangements for local planning authorities within a radius of at least 13 km from the aerodrome reference point; and e. set out the aerodrome operator's strategy for wildlife hazard reduction; and f. include records of the qualifications and experience of key personnel identified in the plan.
17.04 (3)	The aerodrome operator must: a. implement the wildlife hazard management plan; and b. keep the plan under continuous review.

Section	Requirement
17.04 (4)	For section 17.04 subsection (3), a review of the wildlife hazard management plan must be conducted in each of the following circumstances: a. if an aircraft experiences multiple wildlife strikes b. if an aircraft experiences substantial damage following any wildlife strike c. if an aircraft experiences an engine ingestion of wildlife d. if the ongoing presence of wildlife is observed on the aerodrome in size or in numbers reasonably capable of causing an event mentioned in paragraph (a), (b) or (c) e. at least every 12 months, but if during a period of 12 months the plan was reviewed f. under paragraph (a), (b), (c) or (d), at least every 12 months after that review.
17.05 (1)	If the presence of wildlife is assessed as constituting an ongoing hazard to aircraft, the aerodrome operator must advise the Airport Information Systems provider in writing to include an appropriate warning notice in the AIP-ERSA in accordance with Chapter 5 (Aerodrome Information for the AIP and Aerodrome Manual) of this MOS.
17.05 (2)	Without affecting Section 17.05 subsection (1), if a wildlife hazard is assessed as being: a. at a higher risk than usual; and b. of a short-term or seasonal nature then the aerodrome operator must ensure that a timely NOTAM warning of the hazard is given to pilots using the aerodrome.
17.05 (3)	Without affecting Section 17.05 subsections (1) or (2), if a wildlife hazard is assessed as being a serious and imminent threat to aviation safety at an aerodrome, the aerodrome operator must ensure that pilots using the aerodrome are directly advised on Common Traffic Advisory Frequency or Universal Communications station.
17.06	The aerodrome operator must implement controls to mitigate wildlife hazard risks within the boundary of the aerodrome.
17.07 (1)	Wildlife hazard monitoring and reporting personnel must be trained to competently do the following: a. conduct wildlife observations and identify high-risk species b. assess wildlife populations and describe their behaviour c. record information d. collect any remains of a wildlife strike on the aerodrome e. attempt to facilitate the identification of: i. any wildlife involved in a strike event; and ii. any resulting damage to an aircraft f. report the outcomes of observation, monitoring and strike collection activities.
17.07 (2)	Personnel engaged in wildlife hazard mitigation must be trained to competently: a. engage in active wildlife management without causing a hazard to aviation safety; and b. assess the effectiveness of any mitigation measures that are taken.
17.07 (3)	The aerodrome operator must create training records for its monitoring and reporting personnel to show compliance with Section 17.07 subsections (1) and (2). Each record must be kept in safe custody for a period of at least 3 years after the record was created.

A2 *Environment Protection and Biodiversity Conservation Act* 1999

Whether an action is likely to impact upon animal species that are rare, endemic or otherwise valuable, such as listed threatened species and listed migratory species, either directly or on their feeding, nesting, breeding areas is of particular importance. Direct mortality of these species or removal of their habitat to remove or minimise hazards is undesirable but may be necessary where the risk to safety is deemed too significant. Each situation requires specific evaluation (see EPBC Referral Guidelines).

The EPBC Act also identifies species protected under the following international migratory treaties:

Japan-Australia Migratory Bird Agreement

Agreement between Australia and Japan to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.

China-Australia Migratory Bird Agreement

Agreement between Australia and China to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.

Korea-Australia Migratory Bird Agreement

Agreement between Australia and the Republic of Korea to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

Wildlife species listed under international conventions afford them legislative protection in order to maintain populations and individuals.

A3 *Environmental Planning and Assessment Act* 1979

Table A.2 Ministerial Directions in the *NSW Environment Planning and Assessment Act 1979*

Direction	Detail
3.5 Development Near Regulated Airports and Defence Airfields	Not allow development types that are incompatible with the current and future operation of that airport.
7.8 Implementation of Western Sydney Aerotropolis Interim Land Use and Infrastructure Implementation Plan	Objective (1) The objective of this direction is to ensure development within the Western Sydney Aerotropolis is consistent with Stage 1 Western Sydney Aerotropolis Land Use and Infrastructure Plan dated August 2018 (the Stage 1 Land Use and Implementation Plan). Where this direction applies (2) The direction applies to Liverpool City Council, Penrith City Council, Blue Mountains City Council, Blacktown City Council, Camden Council, Campbelltown City Council, Fairfield City Council and Wollondilly Shire Council. When this direction applies (3) This direction applies when a relevant planning authority prepares a planning proposal for land within the Western Sydney Aerotropolis and land affected by the obstacle limitation surface and Aircraft Noise Exposure Forecast contours for Western Sydney Airport.

A4 *Damage by Aircraft Act* 1952

Table A.3 Relevant sections of the *Damage by Aircraft Act 1952*

Section	Detail
10	• Imposes strict and unlimited liability. • Applies if a person or property on land or water suffers personal injury, loss of life, material loss, damage or destruction caused by: – impact with aircraft in flight – impact with aircraft that damaged or destroyed while in flight – impact with persons, animal or thing that dropped or fell from aircraft in flight – something that is a result of (1), (2) or (3) – if the act is applied, the owner or operator of the aircraft are jointly and severally liable. • Damages are recoverable under the Damage by Aircraft Act without proof of intention or negligence.

A5 *Work Health and Safety Act* 1952

Table A.4 Relevant sections of the *Work Health and Safety Act 2011*

Section	Detail
19	Primary Duty of Care: (2) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.

A6 State Environmental Planning Policy (Precincts-Western Parkland City) 2021

Table A.5 Relevant sections of the SEPP

Section	Detail
4.19	Wildlife Hazards (1) The objective of this section is to regulate development on land surrounding the Airport where wildlife may present a risk to the operation of the Airport. (2) Development consent must not be granted to relevant development on land in the 13 km wildlife buffer zone unless the consent authority— (a) has consulted the relevant Commonwealth body, and (b) has considered a written assessment of the wildlife that is likely to be present on the land and the risk of the wildlife to the operation of the Airport provided by the applicant, which includes— (i) species, size, quantity, flock behaviour and the particular times of day or year when the wildlife is likely to be present, and (ii) whether any of the wildlife is a threatened species, and (iii) a description of how the assessment was carried out, and (c) is satisfied that the development will mitigate the risk of wildlife to the operation of the Airport, including, for example, measures relating to— (i) waste management, landscaping, grass, fencing, stormwater or water areas, or (ii) the dispersal of wildlife from the land by the removal of food or the use of spikes, wire or nets. (3) Despite subsection (2), development for the following purposes is prohibited on land in the 3 km wildlife buffer zone— (a) livestock processing industries, (b) turf farming, (c) waste or resource management facilities that consist of outdoor processing, storage or handling of organic or putrescible waste. (4) In this section— ***3 km wildlife buffer zone*** means the land shown as the "3 kilometre wildlife buffer zone" on the Wildlife Buffer Zone Map. ***13 km wildlife buffer zone*** means the land shown as the "13 kilometre wildlife buffer zone" on the Wildlife Buffer Zone Map and includes the 3 km wildlife buffer zone. ***relevant development*** means development for the following purposes— (a) agricultural produce industries, (b) aquaculture, (c) camping grounds, (c1) cemeteries, (d) eco-tourist facilities, (e) garden centres, (f) intensive livestock agriculture, (g) intensive plant agriculture, (h) livestock processing industries,

Section	Detail
	(i) plant nurseries, (j) recreation facilities (major), (k) recreation facilities (outdoor), (l) sewage treatment plants, (m) waste or resource management facilities that consist of outdoor processing, storage or handling of organic or putrescible waste, (n) water storage facilities.
4.37C	Application of Codes SEPP, Parts 4A, 5 and 5B (3) Development specified in the Codes SEPP, Part 5, Division 1, Subdivisions 2 and 3 is complying development if the development— (a) is carried out in the Western Sydney Aerotropolis, and (b) is not carried out on land in the 13 km wildlife buffer zone under section 4.19, and (c) is not relevant development within the meaning of that section. (6) Development specified under the Codes SEPP, Part 5B is complying development if the development— (a) is carried out in the Western Sydney Aerotropolis, and (b) the container recycling facility is fully enclosed, to ensure the risks to the operation of the Airport from wildlife are mitigated

A7 National Airports Safeguarding Framework

The NASF encourages a coordinated approach between airport operators and land use planning authorities to mitigate risks, and where risks are identified for new developments, the NASF recommends:

- developing a management program
- establishing management performance standards
- allowing for design changes and/or operating procedures where the land use is likely to increase the strike risk
- establishing appropriate habitat management
- creating performance bonds should obligations not be met
- monitoring by airport authorities
- reporting wildlife events as per ATSB requirements.

Table A.6 details some key elements of the NASF.

Table A.6 NASF and land use planning recommendations

Section	Detail
18	The guidelines can also be used when considering the establishment of new airports. When a greenfield site is being considered for a new airport, selection agencies can consider the degree of incompatible land usage, including wildlife attracting land usage, in the vicinity of potential sites.
20	There are many existing locations where there would be advantages in mitigating existing risk. It is also essential that new land uses and changes to land zoning within 13 km of the airport property are regularly monitored and action plans created to mitigate any unacceptable increase in the risk of bird strike. For example, the ICAO document 'Airport Services Manual- Bird Control and Reduction' suggests that dumps[10] should not be sited within 13 km of airport property. There are many existing locations where there would be advantages in mitigating existing risk. It is also essential that new land uses and changes to land zoning within 13 km of the airport property are regularly monitored and action plans created to mitigate any unacceptable increase in the risk of bird strike. For example, the ICAO document 'Airport Services Manual – Bird Control and Reduction' suggests that dumps should not be sited within 13 km of airport property.
21	Land use planning authorities should ensure that airport operators are given adequate opportunity to formally comment on planning applications for new or revised land uses that fall within the guidance provided in Attachment 1 (of the NASF). Airport operators will be expected to respond with comments on how the proposed changes to land use might increase the risk of wildlife strike and on any regulatory actions that could increase the risk of wildlife strike, such as permits related to land uses of concern.
22	Airport operators should negotiate with land use planning authorities and land owners if required on agreed action plans for monitoring and, where necessary, reducing wildlife attraction to areas in the vicinity of airports. These plans could include: • regular monitoring surveys • wildlife hazard assessments by qualified ornithologists or biologists • wildlife awareness and management training for relevant staff • establishment of bird[11] population triggers; implementation of activities to reduce hazardous bird populations; and • adoption of wildlife deterrent technologies to reduce hazardous bird populations.
24	Where local authorities seek to establish land uses which may increase the risk of wildlife strike near existing airports, steps should be taken to mitigate risk in consultation with the airport operator and qualified bird and wildlife management experts. Risk mitigation measures that should be considered in such cases include: • a requirement for a Wildlife Management Program • the establishment of wildlife management performance standards • allowance for changes to design and/or operating procedures at places/plants where land use has been identified as increasing the risk of wildlife strike to aircraft • establishment of appropriate habitat management at incompatible land uses • creation of performance bonds to ensure clean–up and compensation should obligations not be met • authority for airport operators to inspect and monitor properties close to airports where wildlife hazards have been identified; and • consistent and effective reporting of wildlife events in line with ATSB guidelines.
27	There would be safety benefits if airport operators and land use planning authorities follow a common, coordinated approach to managing existing wildlife hazards at, and within the vicinity of, airports. Managing wildlife attractants is a key strategy in discouraging wildlife on and around airports.

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[10] In the NSW planning context, 'dumps' refers to a 'waste or resource management facility' and 'waste disposal facility'.

[11] The guideline specifies 'bird' populations but wildlife hazard studies around airports should include flying-foxes (where they occur) and terrestrial animals where applicable.

As a generic framework designed for land use planners to incorporate its principles into jurisdictional guidelines and planning frameworks, there are some deficiencies that may impede its effectiveness, as detailed in Table A.7.

Table A.7 NASF deficiencies

NASF deficiency
Difficult to embed the elements of the NASF into a planning framework. Planning frameworks require certainty for acceptable versus unacceptable practice. Wildlife strike management is based on risk, so each land use requires an understanding of the specific context of that location in relation to surrounding habitat features that cause wildlife to utilise the airspace that could be co-occupied in space and time, with aircraft. The risk presented by a land use may not only relate to the airspace above the land use, but also to the interaction of it as a habitat feature with other habitat features in the landscape, potentially causing wildlife to intersect aircraft flightpaths. A land use may also contribute to the productivity of wildlife populations, by for instance, providing an unnatural supply of food resource.
Local and state governments may be reluctant to adopt it into their planning frameworks as it is a guidance document and not bound by law. There are no penalties or implications for local, state and territory planning departments for not adopting the principles.
Ambiguity around responsibility for assessments, action plans, management, monitoring, etc.
The use of the Aerodrome Reference Point (ARP) as the point from which to measure the 3 km, 8 km and 13 km buffers is inadequate. The location of the ARP may mean the 3km buffer barely extends beyond the airport's perimeter fence.
Insufficient, or ambiguous, land use types. The generic nature of the NASF means that the available options do not account for all possible land use types or relate to terminology used in each jurisdiction.

Table A.8 NASF Guideline C

Prepared by the Australian Aviation Wildlife Hazard Group

Guideline C
Attachment 1 to Wildlife Strike Guidelines

Land Use	Wildlife Attraction Risk	Actions for Existing Developments			Actions for Proposed Developments/ Changes to Existing Developments		
		3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)
Agriculture							
Turf farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Piggery	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fruit tree farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fish processing /packing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Cattle /dairy farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Poultry farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Forestry	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Plant nursery	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Conservation							
Wildlife sanctuary / conservation area - wetland	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Wildlife sanctuary / conservation area - dryland	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Recreation							
Showground	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Racetrack / horse riding school	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Golf course	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sports facility (tennis, bowls, etc)	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Park / Playground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Picnic / camping ground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Commercial							
Food processing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Warehouse (food storage)	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Fast food / drive-in / outdoor restaurant	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Shopping centre	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Office building	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Hotel / motel	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Car park	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Cinemas	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Warehouse (non-food storage)	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Petrol station	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Utilities							
Food / organic waste facility	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - landfill	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - transfer station	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Non-putrescible waste facility - landfill	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Non-putrescible waste facility - transfer station	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sewage / wastewater treatment facility	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Potable water treatment facility	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action

A8 International Civil Aviation Organization

Table A.9 ICAO Annex 14 requirements for wildlife hazard management on and around airports

Section	Detail
9.4	**Wildlife strike hazard reduction** *Note. — The presence of wildlife (birds and animals) on and in the aerodrome, vicinity poses a serious threat to aircraft operational safety.* The wildlife strike hazard on, or near, an aerodrome shall be assessed through: a) the establishment of a national procedure for recording and reporting wildlife strikes to aircraft b) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and c) an ongoing evaluation of the wildlife hazard by competent personnel.
9.4.3	Action shall be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft. *Note. — Guidance on effective measures for establishing whether or not wildlife, on or near an aerodrome, constitute a potential hazard to aircraft operations, and on methods for discouraging their presence, is given in the Airport Services Manual (Doc 9137), Part 3.*
9.4.4	The appropriate authority shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem. Where the elimination of existing sites is not possible, the appropriate authority shall ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.
9.4.5	**Recommendation. —** States should give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.

A9 World Bird Strike Association

Table A.10 IBSC Standards for Aerodrome Bird/Wildlife Control

Reference	Recommendation
Standard 1	A named member of the senior management team at the airport should be responsible for the implementation of the bird control programme, including both habitat management and active bird control.
Standard 2	An airport should undertake a review of the features on its property that attract hazardous birds/wildlife. The precise nature of the resource that they are attracted to should be identified and a management plan developed to eliminate or reduce the quantity of that resource, or to deny birds access to it as far as is practicable. Where necessary, support from a professional bird/wildlife strike prevention specialist should be sought. Documentary evidence of this process, its implementation and outcomes should be kept.
Standard 3	A properly trained and equipped bird/wildlife controller should be present on the airfield for at least 15 minutes prior to any aircraft departure or arrival. Thus, if aircraft are landing or taking of at intervals of less than 15 minutes there should be a continuous presence on the airfield throughout daylight hours. The controller should not be required to undertake any duties other than bird control during this time. Note that for aerodromes with infrequent aircraft movements, 15 minutes may not be long enough to disperse all hazardous birds/wildlife from the vicinity of the runway. In this case the controller should be deployed sufficiently in advance of the aircraft movement to allow full dispersal to be achieved. At night, active runways and taxiways should be checked for the presence of birds/wildlife at regular intervals and the dispersal action taken as needed
Standard 4	Bird control staff should be equipped with bird deterrent devices appropriate to the bird species encountered, the numbers of birds present, and to the area that they need to control. Staff should have access to appropriate devices for removal of birds/wildlife, such as firearms or traps, or the means of calling on expert support to supply these techniques at short notice. All staff should receive proper training in the use of bird control devices.
Standard 5	Airport bird/wildlife controllers should record the following at least every 30 minutes (if air traffic is sufficiently infrequent that bird patrols are more than 30 minutes apart, an entry should be made for each patrol carried out). • areas of the airport patrolled • numbers, location and species of birds/wildlife seen • action taken to disperse the birds/wildlife • results of the action. More general information such as the name of the bird controller on duty, time on and off duty, weather conditions etc. should be recorded at the start of a duty period

Reference	Recommendation
Standard 6	Bird/wildlife incidents should therefore be defined in 3 categories: Confirmed strikes: • Any reported collision between a bird or other wildlife and an aircraft for which evidence in the form of a carcass, remains or damage to the aircraft is found. • Any bird/wildlife found dead on an airfield where there is no other obvious cause of death (e.g., struck by a car, flew into a window etc.). Unconfirmed strikes: • Any reported collision between a bird or other wildlife and an aircraft for which no physical evidence is found. Serious incidents: • Incidents where the presence of birds/wildlife on or around the airfield has any effect on a flight whether or not evidence of a strike can be found.
Standard 7	Airports should establish a mechanism to ensure that they are informed of all bird/wildlife strikes reported on or near their property. The total number of birdstrikes should never be used as a measure of risk or of the performance of the bird control measures at an airport. Airports should ensure that the identification of the species involved in birdstrikes is as complete as possible. Airports should record all birdstrikes and include, as far as they are able, the data required for the standard ICAO reporting form National Regulators should collate birdstrike data and submit this to ICAO annually.
Standard 8	Airports should conduct a formal risk assessment of their birdstrike situation and use the results to help target their bird management measures and to monitor their effectiveness. Risk assessments should be updated at regular intervals, preferably annually.
Standard 9	Airports should conduct an inventory of bird attracting sites within the ICAO defined 13 km bird circle, paying particular attention to sites close to the airfield and the approach and departure corridors. A basic risk assessment should be carried out to determine whether the movement patterns of birds/wildlife attracted to these sites means that they cause, or may cause, a risk to air traffic. If this is the case, options for bird management at the site(s) concerned should be developed and a more detailed risk assessment performed to determine if it is possible and/or cost effective to implement management processes at the site(s) concerned. This process should be repeated annually to identify new sites or changes in the risk levels produced by existing sites. Where national laws permit, airports, or airport authorities, should seek to have an input into planning decisions and land use practices within the 13 km bird circle for any development that may attract significant numbers of hazardous birds/wildlife. Such developments should be subjected to a similar risk assessment process as described above and changes sought, or the proposal opposed, if a significant increase in bird strike risk is likely to result.

Appendix B

Survey methods

B1 Airside surveys

Avisure divided the airside area into 17 sectors, assigned each an observation point, and completed 4 surveys (early morning, middle of the day, late afternoon, and post-dusk). The observation points overlooked each sector (Figure B.1).

B1.1 Diurnal surveys

The observer travelled from one observation point to the next following a set route through each sector making observations while en-route. The observer spent 5 minutes at each observation point, recording all wildlife seen. Birds in transit or thermaling in the aerodrome boundary or in aircraft flight paths are recorded regardless of whether they are in the current sector or not. Binoculars were used to assist with identification of wildlife. Information recorded in the database included: time, species, number sighted, and position, estimated height above ground level, heading and activity (breeding, chasing, foraging, perching, sheltering, thermaling or transiting). Survey records also include ambient conditions (first and last light, rainfall, temperature, air pressure, wind speed and direction).

B1.2 Nocturnal survey

The observer travelled from one observation point to the next in a continuous motion, stopping when necessary to identify species, using a spotlight and vehicle high-beams to illuminate as much of the airside habitat as possible. The observer drove the vehicle at or less than 15 kph to allow effective scanning with the spotlight. Binoculars assisted with identification of wildlife. Information recorded in the database included: time, species, number sighted, and position, estimated height above ground level, heading and activity (breeding, chasing, foraging, perching, sheltering, thermaling or transiting). Survey records also include ambient conditions (first and last light, rainfall, temperature, air pressure, wind speed and direction.

B1.3 Limitations

- Sampling was not always from independent replicates: wildlife could be counted twice if they move between sectors with common boundaries, although this was avoided where possible.
- Visibility in areas such as drainage channels and reed beds are lower, thus wildlife in these areas may be under-represented in the data.
- Observations of transiting and thermaling birds, regardless of whether or not they were inside the particular observation sector, may have increased the representation of some bird species which tend to transit or thermal. In some circumstances, transiting birds may have been missed due to the position of the observer.
- The cryptic nature of some bird species may result in the under-representation of these species in the data.
- Ideally, simultaneous all sector counts must get a true representation of species and numbers.

Despite its limitations, this method is satisfactory for good trend analysis if applied consistently between time and operators.

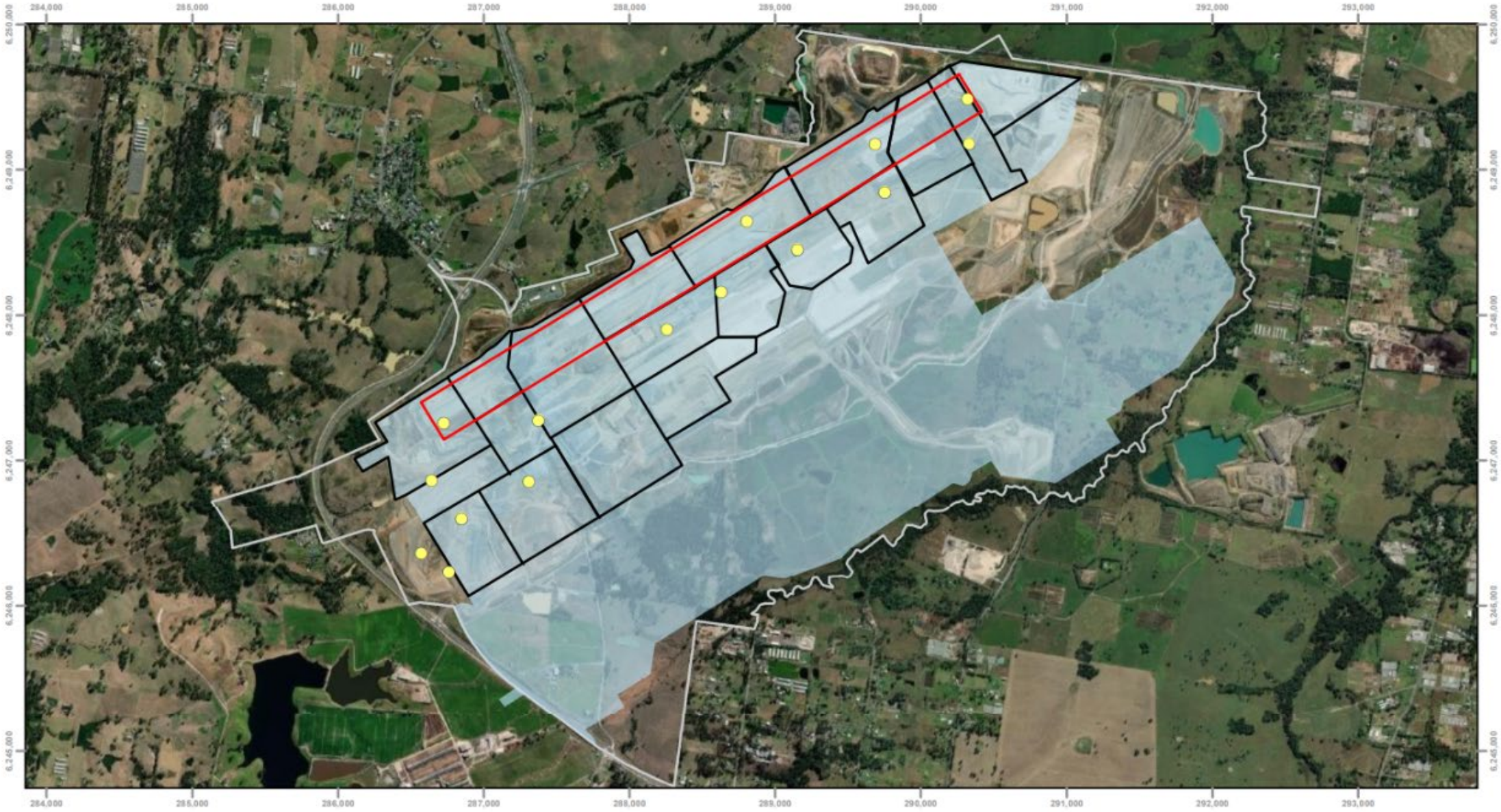

Figure B.1: Avisure airside survey sectors and observation points at WSI

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Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Survey points
Runway boundary
Survey sector boundaries
Airside boundary
Western Sydney Airport boundary

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Date: 5/04/2023

0 250 500 1,000
Metres

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

PR5664_MPX_WSA_OnairportMap_2022
A4

B2 Off-airport surveys

Following ICAO guidelines relating to radial distances from an airport, CASA and the NASF recognises land uses within 13 km of an airport are potential risk contributors. In response, Avisure devised a list of land uses within this distance that attract, or have the potential to attract, wildlife that may contribute to the airport's strike risk.

Sites were determined based on:

- sites listed as part of the WSI Wildlife Hazard Assessment completed in 2018 (Avisure, 2019), which was an extension of the sites initially noted as part of the WSI EIS in 2016 (GHD & Avisure, 2016)
- sites included in WSI's current off-airport monitoring regime
- opportunistic observations of land uses noted while completing surveys on and around WSI.

The observer entered each site[12] and recorded all wildlife seen. Binoculars were used to assist with identification of wildlife. Information recorded in the database included: time, species, number sighted, and position, estimated height above ground level, heading and activity (breeding, chasing, foraging, perching, sheltering, thermaling or transiting). Survey records also include ambient conditions (first and last light, rainfall, temperature, air pressure, wind speed and direction).

B2.1 Limitations

- Not all sites were reliably accessible over the 4 site visits.
- Sampling was not always from independent replicates: wildlife could be counted twice if they moved around the site, although this was avoided where possible.
- Some sites were too large to survey completely (due to time constraints, access issues, or overall size), however samples collected are considered indicative of wildlife occupying these sites.
- Visibility in areas such as drainage channels and reed beds are lower, thus wildlife in these areas may be under-represented in the data.
- The cryptic nature of some bird species may result in the under-representation of these species in the data.

Despite its limitations, this method is satisfactory for understanding the types of land uses within the vicinity of WSI that are attractive to wildlife who may contribute to the strike risk once the airport is operational.

Figures B.2 to B.4 show the off-airport sites surveyed, within each of the wildlife buffers (3, 8 and 13 km) at least once during the 4 site visits.

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[12] Where required, Avisure biologists completed site inductions. DITRDCA sought pre-access approval for Avisure for all private property.

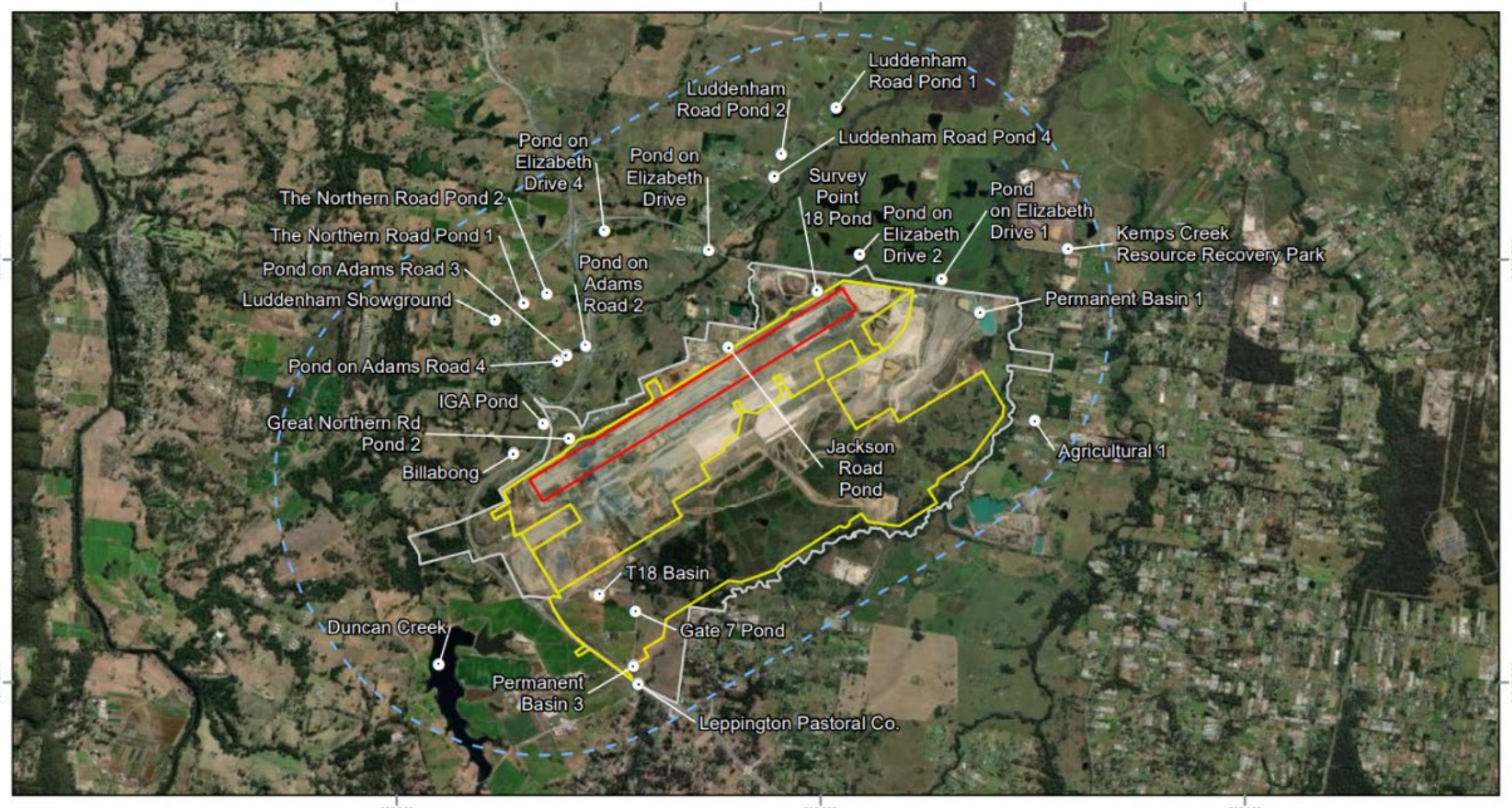

Figure B.2: Off-airport wildlife hazard locations within the 3km WSI wildlife buffer

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Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Off-airport sites
Runway boundary
Airside boundary
Western Sydney Airport boundary
3km buffer from runway

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Job number: PR5664
Revision: 3
Author: AS
Date: 5/04/2023

0 0.5 1 2 Kilometers

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

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A4

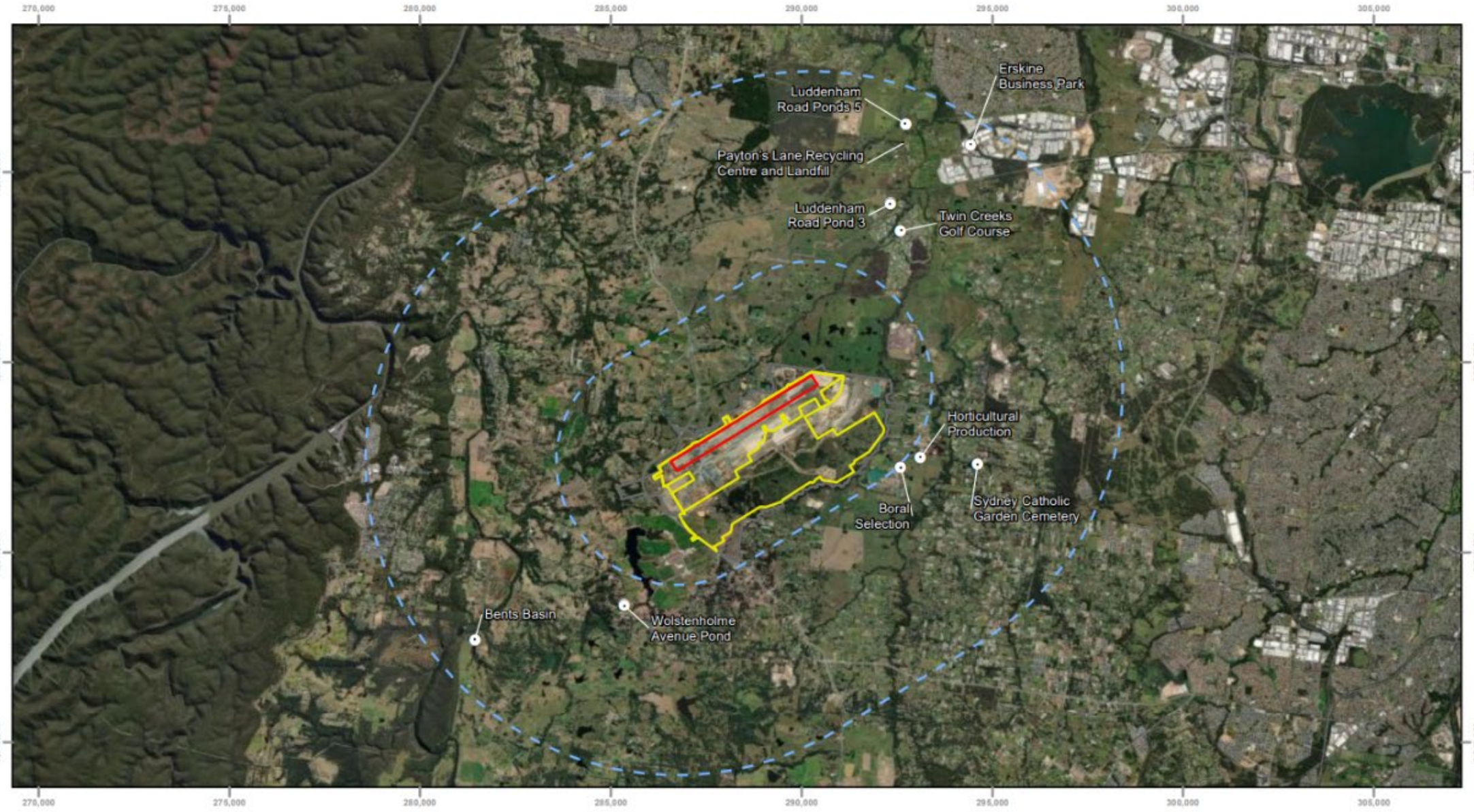

Figure B.3: Off-airport wildlife hazard locations within the 8km WSI wildlife buffer

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Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Off-airport sites
Runway boundary
Airside boundary
Western Sydney Airport boundary
3 and 8km buffers from runway

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Revision: 2
Author: AS
Date: 5/04/2023

0 1 2 4 Kilometers

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

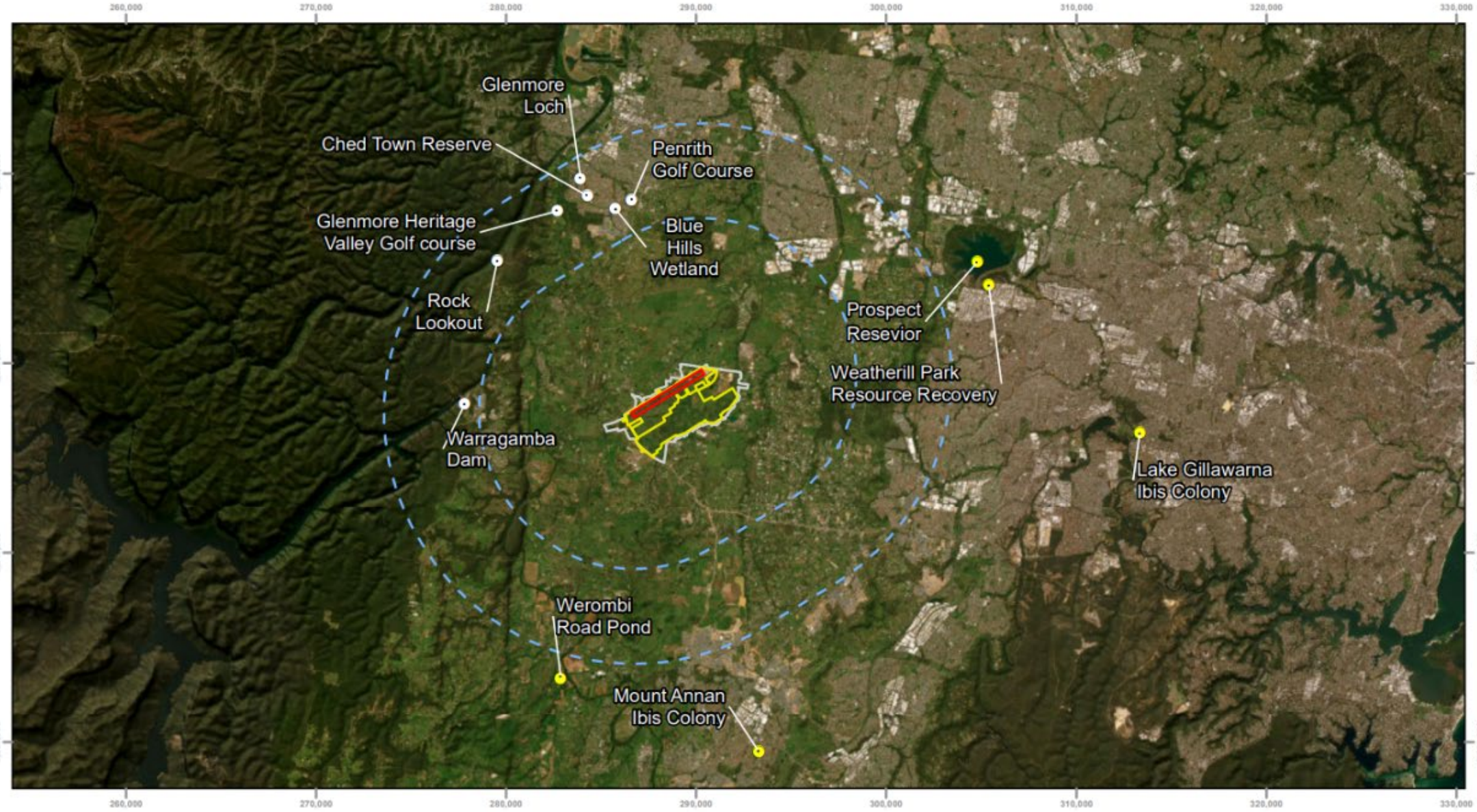

Figure B.4: Off-airport wildlife hazard locations within the 13km WSI wildlife buffer

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Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

- Off-airport sites within 13km
- Off-airport sites >13km
- Runway boundary
- Airside boundary
- Western Sydney Airport boundary
- 8 and 13km buffer from runway

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Revision: 3
Author: AS
Date: 5/04/2023

0 1.5 3 6
Kilometers

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

Data Sources: Avisure, 2023; Image: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PR5664_MPX_WSA_OffairportMap_13km_2022
A4

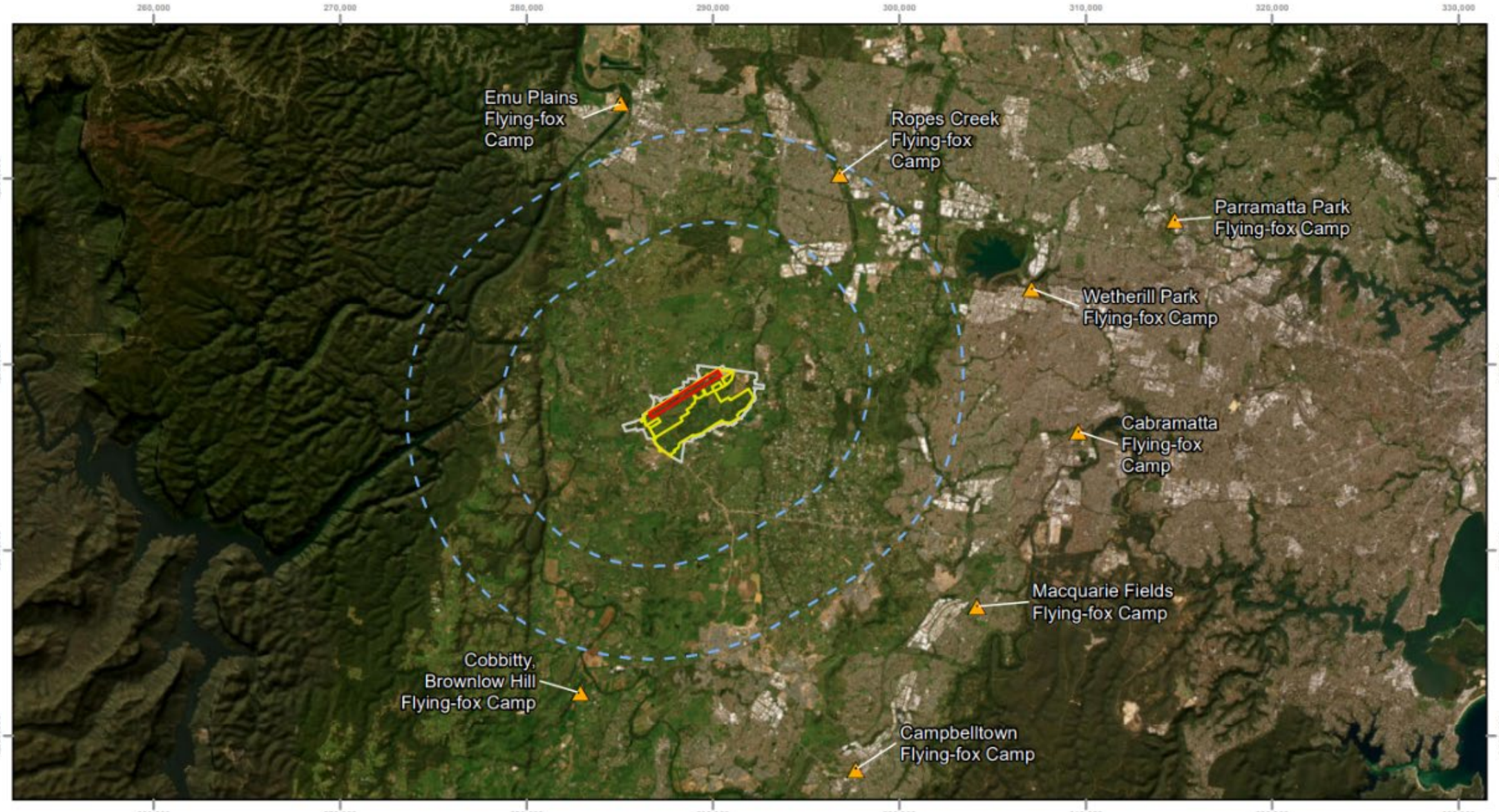

Figure B.5: Location of flying-fox camps in the vicinity of Western Sydney Airport

WSP Australia Pty Ltd

Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Flying-fox camps
Western Sydney Airport boundary
Runway boundary
8 and 13km buffer from runway
Airside boundary

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Job number: PR5664
Revision: 3
Author: AS
Date: 5/04/2023

0 1.5 3 6
Kilometers

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

PR5664_MPX_WSA_Flying-foxCamps
A4

Appendix C

Data and documents reviewed

C1 Information reviewed

C1.1 Documents

Document type	Document name	Source/description
EIS	Department of Infrastructure and Regional Development 2016 Western Sydney Airport Environmental Impact Statement	https://www.westernsydneyairport.gov.au/media-resources/resources/environmental-assessment
Assessment Report	Avisure 2016 Western Sydney Airport Environmental Impact Statement Preliminary Bird and Bat Strike Risk Assessment	https://www.westernsydneyairport.gov.au/sites/default/files/WSA-EIS-Volume-4-Appendix-I-Bird-and-bat-strike.pdf
Planning Report	Greater Sydney Commission 2018 Western Sydney District Plan	https://greatercities.au/western-city-district-plan
Planning Report	Western Sydney Aerotropolis Development Control Plan 2022 Phase 2	https://pp.planningportal.nsw.gov.au/western-sydney-aerotropolis-DCP
Planning Report	Western Sydney Aerotropolis Precinct Plan 2022	https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/Plans-for-your-area/Western-Sydney-Aerotropolis-Precinct-Plan-March-2022-final.pdf?la=en
Safeguarding	Aviation Safeguarding Guidelines Western Sydney Aerotropolis and Surrounding Areas, 2021	https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/Aviation-Safeguarding-Guidelines---Western-Sydney-Aerotropolis-and-surrounding-areas-updated.pdf?la=en

C1.2 Data

Data type	Data name	Source/description
Strikes	Wildlife strike data	ATSB National Aviation Occurrence Database
Surveys	WSI wildlife survey data 2018	On- and off-airport data collected by Avisure on behalf of WSI as part of an initial wildlife hazard assessment from January 2018 to December 2018.
Surveys	WSI wildlife survey data 2018	On- and off-airport data collected by Biodiversity Australia from September 2020 to July 2022 as a requirement of their wildlife hazard monitoring contract with WSI.
Surveys	Flying-fox camp data	Department of Climate Change, Energy, the Environment and Water: National Flying-fox Monitoring Viewer.

C2 Legislation, regulations and guidance

Type	Name	Source/description
Legislation	*Civil Aviation Act 1998*	https://www.legislation.gov.au/Details/C2004C01236
Legislation	*Environment Protection and Biodiversity Act 1999*	https://www.legislation.gov.au/Details/C2016C00777
Legislation	*Biodiversity Conservation Act 2016*	https://legislation.nsw.gov.au/view/html/inforce/current/act-2016-063
Legislation	*Environmental Planning and Assessment Act 1979*	https://legislation.nsw.gov.au/view/html/inforce/current/act-1979-203
Legislation	*Damage by Aircraft Act 1952*	https://legislation.nsw.gov.au/view/html/repealed/current/act-1952-046
Legislation	*Work Health and Safety Act 2011*	https://www.legislation.gov.au/Details/C2018C00293
Policy	State Environmental Planning Policy (Precincts—Western Parkland City) 2021	https://legislation.nsw.gov.au/view/html/inforce/current/epi-2021-0728/lh
Regulation	Civil Aviation Safety Regulations Part 139 (Aerodromes) Manual of Standards	https://www.legislation.gov.au/Series/F2019L01146
Regulation	International Civil Aviation Organization Annex 14, Volume 1 (Aerodrome Design and Operation)	https://store.icao.int/en/annex-14-aerodromes
Advisory Circular	Civil Aviation Safety Authority 2011 Advisory Circular AC 139-26(0)	https://www.casa.gov.au/sites/default/files/2021-08/advisory-circular-139-26-wildlife-hazard-management-aerodromes.pdf
Guidance	National Airports Safeguarding Framework Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports	https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/aviation-safety/aviation-environmental-issues/national-airports-safeguarding-framework/national-airports-safeguarding-framework-principles-and-guidelines
Guidance	International Civil Aviation Organization Airport Services Manual Doc. 9184: Part 2 Land Use and Environmental Control	https://store.icao.int/en/airport-planning-manual-land-use-and-environmental-management-doc-9184-part-2
Guidance	International Civil Aviation Organization Airport Services Manual Doc. 9137: Airport Services Manual Part 3, Wildlife Control and Reduction.	https://store.icao.int/en/airport-services-manual-part-iii-wildlife-hazard-management-doc-9137p3
Guidance	International Bird Strike Committee Recommended Practices No. 1 – Standards for Aerodrome Bird/Wildlife Control	https://www.worldbirdstrike.com/11-resources/36-best-practices

Appendix D

Risk assessments

D1 Species risk assessment

Avisure has a model for determining risk categories using professional airside bird survey data. The survey data is used to derive likelihood factors (population size, position on airport, time spent in air and the species ability to avoid) and consequence factors (bird mass and flock size) for all species recorded (refer to Table D.1). The combination of these likelihood and consequence factors give a numerical risk index, the Species Risk Index (SRI) (refer to Table D.2). This assessment provides near-real-time risk levels and is able to account for observed changes in airside populations and movement patterns. Variable factors in the model have been refined over the years, the most recent review and calibration occurred in 2016.

Table D.1 Species risk assessment likelihood and consequence factors and details of data derivation and contributions to risk indices

Risk characteristic	Details	% Contribution to output
Likelihood factors		
Population density	Derived from standardised airport wildlife survey data per hectare surveyed	5.7%
Wildlife avoidance	Derived from assessment of wildlife strike data compared with population data at several airports with long term datasets to identify susceptibility of species to strikes relative to abundance on airport	29.7%
Location on airport	Based on proportion of observations of species within critical areas or other areas	35.5%
Time spent in air	Based on proportion of observations of species in flight or on ground	29.1%
Consequence factors		
Mass	Derived from published data using the average mass of male and female animals	40.2%
Flock size	Expressed as the average group size from all observations	59.8%

The following tables outline the risk rating for wildlife species according to calculated SRI.

Table D.2 Species Risk Index (SRI) for determining risk categories based on survey data

SRI ranges used to rate risk for each species	
SRI	**Risk rating**
>1,000	Very high
100 to 999.9	High
10 to 99.9	Moderate
1 to 9.9	Low
< 1	Very low

The process intends to provide a transparent, logical and systematic approach to the identification and treatment of wildlife related risks at the airport. The risk assessment identifies high risk species, which allows suitable management practices to be targeted in areas where the maximum reduction in risk may be achieved.

D2 Off-airport risk assessment

Avisure has a model for determining an off-airport location's contribution to wildlife strike risk. It assesses likelihood using survey data and desktop assessments to derive values for the wildlife attracted (or potentially attracted) to a site based on the inherent wildlife attractiveness of a location. It assesses consequence based on the wildlife species attracted (or potentially attracted) to a location and the proximity of the site relative to an airport and aircraft flight paths. In addition, the risk assessment includes the connectivity of wildlife attractive (or potentially attractive) sites to determine the potential for wildlife to transit through critical airspace.

The model was developed in 2016 using long-term data sets for 7 Australian airports which included comparison of airside survey data, off-airport survey data and species strike rates to identify variables that contribute to changes in populations at each site and influence the observed strike rate or survey risk at the airport. National data for wildlife strikes was also reviewed and compared to observed strike and damage rates at these ports to refine likelihood and consequence assessment and species susceptibility to aircraft strikes.

Explanatory notes:

- This process intends to provide a logical and systematic approach to the identification of site related risks and their contribution to aircraft hazards in the vicinity of an airport.
- Site Risk considers probability of wildlife and aircraft intersecting at or above the site and the consequence of intersecting at that site. The score includes site characteristics (food, shelter, water), proximity to the airport, and type of aircraft movements at airport. In addition, the Site Risk calculation considers each location's position relative to other attractive sites and the airport.
- Wildlife Risk considers species presence or absence, abundance, strike history, strike avoidance ability, size, and flocking behaviour.
- The Airspace Risk is the accumulation of the Wildlife Risk and Site Risk, which then determines the overall Risk Ranking for each site.
- Although strike data is included in likelihood calculations, airside wildlife management activities may not reduce an off-airport location's risk score despite effective management through hazard communication, passive management, and/or active management. The model assesses the potential contribution to strike risk as a trend analysis tool. Individual airports must assess their measures for addressing wildlife strike contributions from off-airport locations.

D2.1 Wildlife risk

Wildlife Risk is scored based on likelihood (abundance, species behaviour and ability to avoid aircraft, and the number of strikes over the past 5 years) and consequence factors (group scores, mass and strike consequence rating) to give an individual risk score for species at each site (Refer to Table D.3 below).

Table D.3 Wildlife Risk factors incorporated into the wildlife risk component

Risk characteristic	Details	% Contribution to output[13]
Likelihood factors		
Strike history	Based on comparison of strike events at the airport and at other airports throughout the country	44.6%
Wildlife avoidance	Derived from assessment of wildlife strike data compared with population data at several airports with long term datasets to identify susceptibility of species to strikes relative to population on airport	29.4%
Abundance	Derived from survey data per site collected by Avisure	22.6%
Consequence factors		
Strike consequence	Consequence rating based on previous strike history and mass of species	48.3%
Group score	Score based on tendency of species to flock	42.3%

[13] Due to model assumptions (including uniform rather than normal distribution of data), there is residual variance not explained by the model and the contribution may not equal 100 per cent. Although there is residual variance, the model acceptably identifies that factors contributing to Species Risk and is a good index of changing risk contribution over time.

D2.2 Site risk

The Site Risk assessment is designed to identify key hazardous species resources in the vicinity of the airport. It scores each site based on a review of survey data, mapping data and previous reports to identify site attributes such as foraging resources, trees suitable for roosting and water on-site. Site Risk factors (proximity to runways and flight paths, aircraft movement rates and type of aircraft operations and flight paths between sites and are combined with site attribute scores) are applied to the model to give a risk ranking at each site (Refer to Table D.4 below).

Table D.4 Site Risk factors incorporated into the site risk component

Risk characteristic	Details	% Contribution to output
Likelihood factors		
Site resources	Based on presence/absence of particular resources at each site relevant to the species. Includes things such as foraging resources, trees suitable for roosting and water onsite	46.2%
Connectivity	Measure of connectivity to other relevant sites using the number of segments between sites and other resources which cross establish aircraft flight paths	20.6%
Aircraft movements	Annual aircraft movement rates	18.0%
Distance from runway	Site distance from the nearest runway end and the nearest flight path, measured perpendicular to the extended centreline	15.2%
Consequence factors		
Height of aircraft	Height of aircraft at nearest flight path point or runway adjacent to site	50.1%
Type of aircraft	Proportion of large aircraft movements	49.9%

D2.3 Airspace risk

Site Risk and Wildlife Risk scores are combined and assessed against the Airspace Risk ratings to classify each site's contribution to wildlife strike risk, Table D.5.

Table D.5 Airspace Risk ratings

Risk score	Rating
>500	Very high
250 to 5009	High
120 to 250	Moderate
60 to 120	Low
0 to 60	Very low

Appendix E

Airside survey density and distribution maps

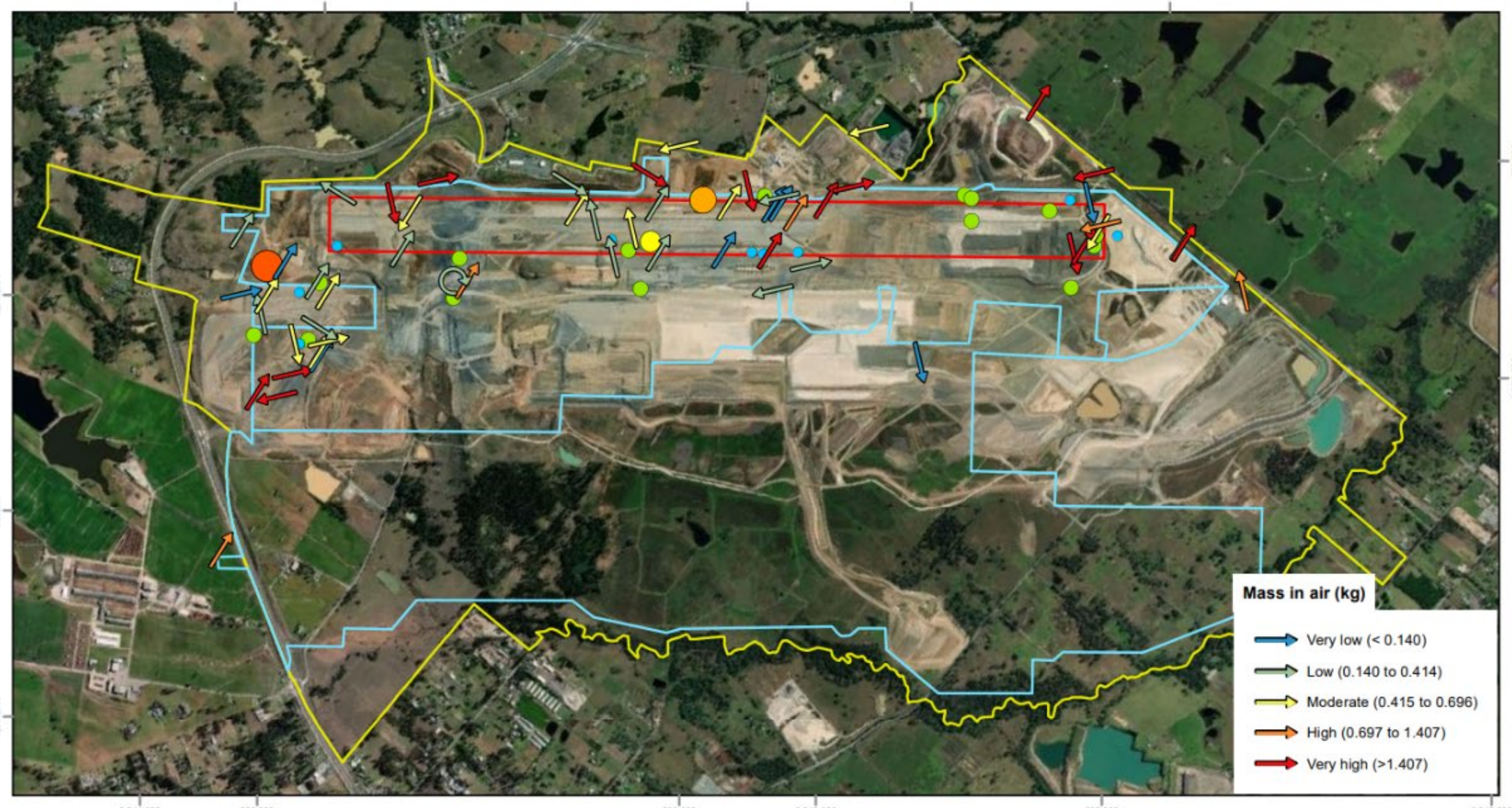

Figure E.1: Diurnal wildlife survey ground density, showing average mass recorded, WSA, July 2022

WSP Australia Pty Ltd

Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Mass recorded on ground (kg)

- 0 to 0.09kg
- 0.1 to 0.43kg
- 0.44 to 1.3kg
- 1.34 to 3.12kg
- 3.13 to 34.3kg

- Runway boundary
- Airside boundary
- Western Sydney Airport boundary

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Date: 5/04/2023

0 250 500 1,000 Metres

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

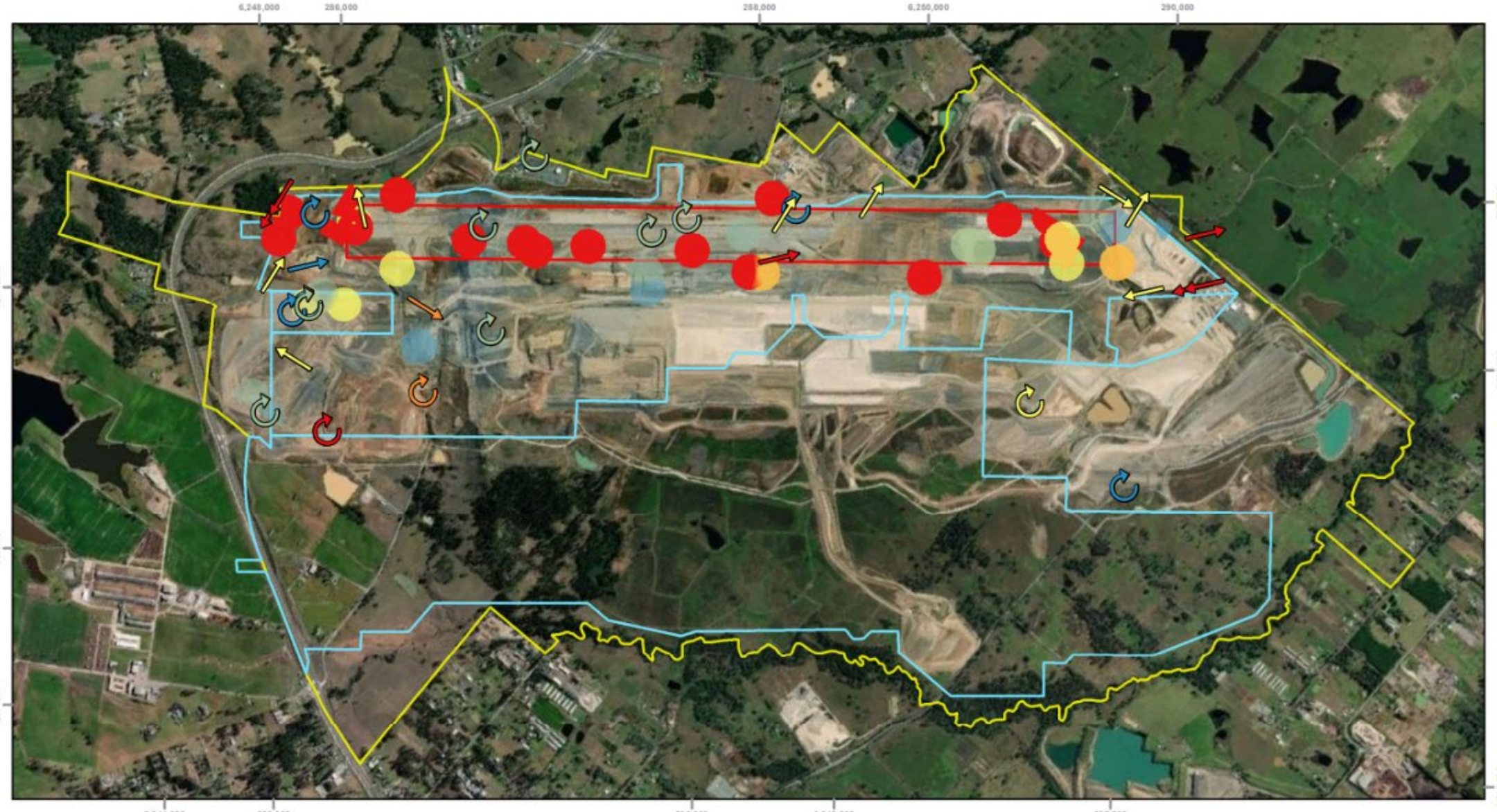

Figure E.2: WSA wildlife surveys, density and distribution, August 2022

WSP Australia Pty Ltd

Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

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aviation | wildlife | safety

Job number: PR5664
Revision: 2
Author: KF, AS
Date: 5/04/2023

0 250 500 1,000
Metres

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

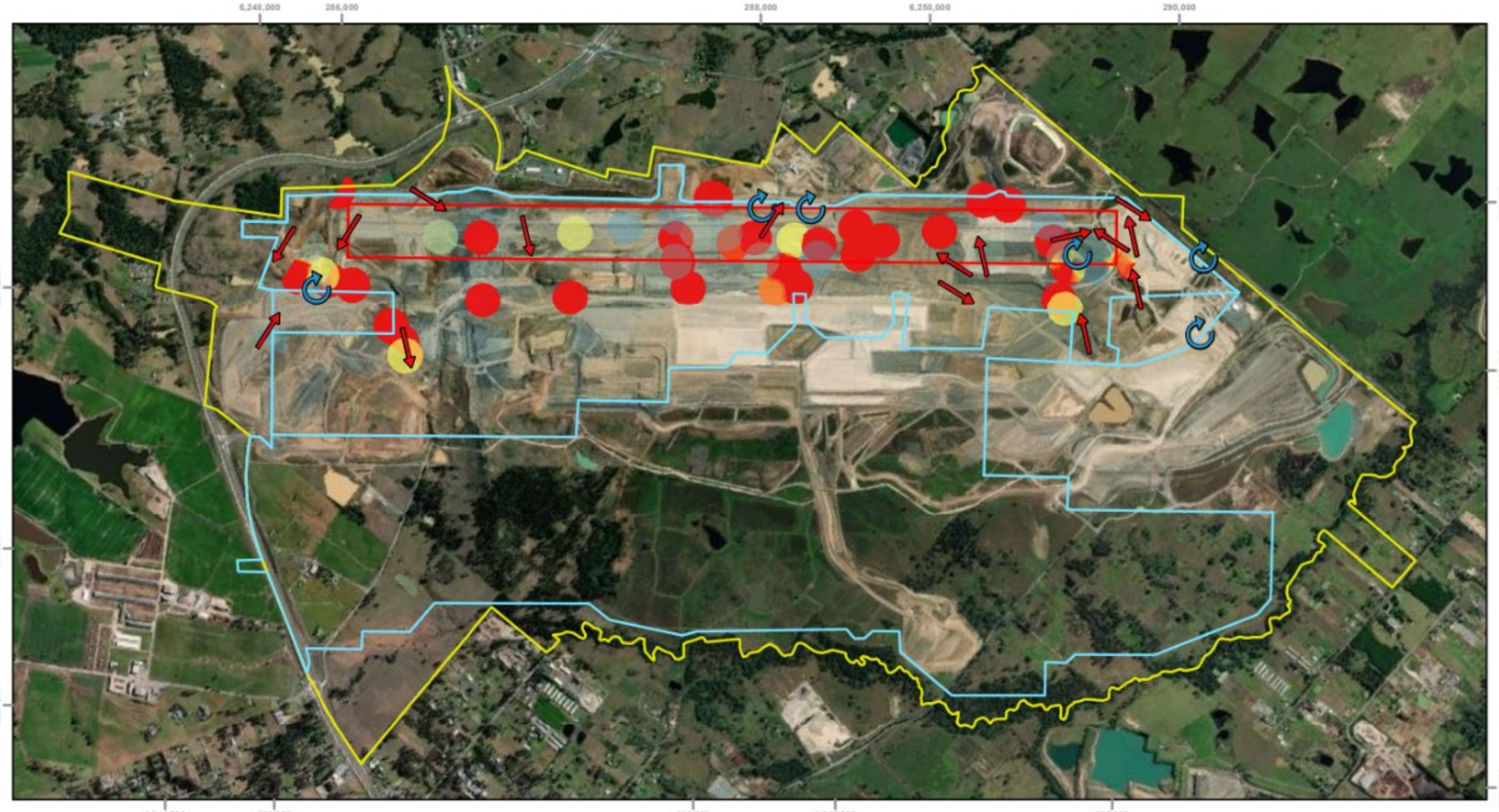

Figure E.3: WSA wildlife surveys, density and distribution, September 2022

WSP Australia Pty Ltd

Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Runway boundary

Airside boundary

Western Sydney Airport boundary

Mass recorded in air (kg)

Very low (< 0.140)

Low (0.140 to 0.414)

Moderate (0.415 to 0.696)

High (0.697 to 1.407)

Very high (>1.407)

Mass recorded onground (kg)

Very high (>1.407)

Very low (<0.140)

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Job number: PR5664
Revision: 2
Author: KF, AS
Date: 5/04/2023

0 250 500 1,000 Metres

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

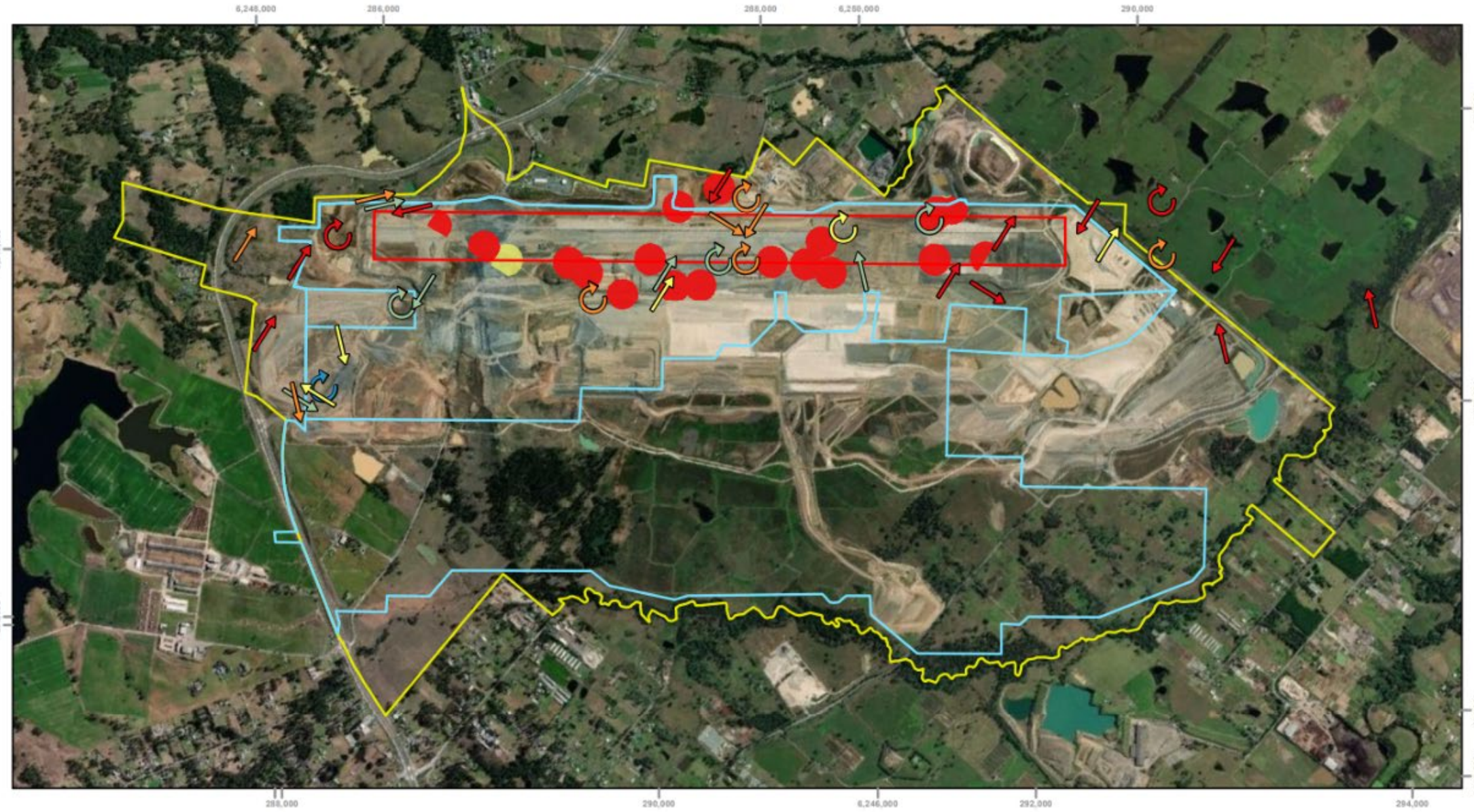

Figure E.4: WSA wildlife surveys, density and distribution, October 2022

WSP Australia Pty Ltd

Western Sydney Airport Airspace Design and Flightpaths EIS - Wildlife Strike Risk

Runway boundary

Airside boundary

Western Sydney Airport boundary

Mass recorded in air (kg)

Very low (< 0.140)

Low (0.140 to 0.414)

Moderate (0.415 to 0.696)

High (0.697 to 1.407)

Very high (>1.407)

Mass recorded onground (kg)

Very high (>1.407)

Very low (<0.140)

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Job number: PR5664
Revision: 2
Author: KF, AS
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0 250 500 1,000 Metres

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

Appendix F

Off-airport land use review

Avisure identified 58 sites within 13 km of WSI that attract, or potentially attract, wildlife and, in their current use, may contribute to the airport's strike risk once operational if left unmanaged. Fifteen sites beyond the 13 km wildlife buffer were also surveyed (up to 30 km) where wildlife activity at the site was deemed a particular hazard based on the wildlife present and their capacity to regularly travel more than 13 km to access foraging and roosting/breeding sites. Table F.1 describes each location.

Table F.1 Off-airport land uses surveyed during the study period showing risk category and NASF references

Site	Distance from runway end (km)	Site type	Avisure risk	NASF land use	NASF risk
Great Northern Road Pond 2	0.3	Pond	Moderate	N/A	N/A
Jackson Road Pond	0.3	Pond	Low	N/A	N/A
Point 18 Pond	0.3	Pond	Low	N/A	N/A
Kemps Creek Resource Recovery Park	0.4	Waste management facility	High	Putrescible waste facility – landfill	High
Pond on Elizabeth Drive 1	0.4	Farm dam	Moderate	N/A	N/A
Pond on Elizabeth Drive 2	0.4	Farm dam	High	N/A	N/A
Billabong	0.5	Billabong	Moderate	N/A	N/A
Eastern Creek Landfill (decommissioned)	0.5	Waste management facility	Low	Non-putrescible waste facility – landfill	Moderate
Pond on Elizabeth Drive 6	0.5	Farm dam	Low	N/A	N/A
IGA Pond	0.6	Farm dam	Moderate	N/A	N/A
Hubertus Country Club	0.7	Grassland area with ponds	Moderate	N/A	N/A
Pond on Adams Road 2	1.2	Farm dam	Low	N/A	N/A
Pond on Adams Road 3	1.2	Farm dam	Low	N/A	N/A
Pond on Adams Road 4	1.2	Farm dam	Moderate	N/A	N/A
Western Sydney Airport Visitor Centre	1.2	Visitor Centre	Moderate	N/A	N/A

Site	Distance from runway end (km)	Site type	Avisure risk	NASF land use	NASF risk
Pond on Elizabeth Drive 5	1.4	Farm dam	Moderate	N/A	N/A
T18 Basin	1.4	Basin	Moderate	N/A	N/A
Duncan Creek	1.5	Network of farm dams	Very High	N/A	N/A
Permanent Basin 1	1.5	Basin	Moderate	N/A	N/A
Luddenham Road Pond 4	1.7	Farm dam	Moderate	N/A	N/A
Gate 7 Pond	1.9	Pond	Moderate	N/A	N/A
Luddenham Road Pond 1	1.9	Farm dam	Moderate	N/A	N/A
Luddenham Road Pond 2	1.9	Farm dam	Moderate	N/A	N/A
Northern Road Pond 1	1.9	Farm dam	Low	N/A	N/A
Pond on Elizabeth Drive 7	1.9	Farm dam	Moderate	N/A	N/A
Luddenham Showground	2	Showground	Low	Showground	High
Northern Road Pond 2	2	Parkland	Moderate	N/A	N/A
Pond on Elizabeth Drive 4	2.2	Farm dam	Moderate	N/A	N/A
Twin Creeks Golf Course	2.2	Golf Course	Moderate	Golf Course	Moderate
Permanent Basin 3	2.4	Basin	Moderate	N/A	N/A
Wolstenholme Avenue Pond	2.4	Farm dam	High	N/A	N/A
Agricultural 1 (dam)	2.5	Agricultural property, farm dam	Moderate	N/A	N/A

Site	Distance from runway end (km)	Site type	Avisure risk	NASF land use	NASF risk
Horticultural Production	3.2	Landscaping property with native vegetation, grasslands, and pond	Moderate	N/A	N/A
ANL Landscaping	3.3	Landscaping supplies	Moderate	N/A	N/A
Kemp's Creek	4.9	Creek	Moderate	Wildlife sanctuary/conservation area – wetland	High
Mushroom Farm	4.9	Mushroom farm	Low	N/A	N/A
Sydney Catholic Garden Cemetery	4.9	Cemetery: grasslands with pond	Moderate	N/A	N/A
Luddenham Road Pond 3	5.1	Farm dam	Low	N/A	N/A
Warragamba Dam	5.6	Dam	Low	Wildlife sanctuary/conservation area – wetland	High
Wallacia Golf Club	5.7	Golf club	Low	Golf course	Moderate
Payton’s Lane Recycling Centre and Landfill	6.7	Waste management facility	Low	Non-putrescible waste facility – landfill	Moderate
Bents Basin	6.9	Dam	Low	Wildlife sanctuary/conservation area – wetland	High
Luddenham Road Ponds 5	7.2	Farm dam	Moderate	N/A	N/A
Erskine Business Park	7.4	Business park	Low	N/A	N/A
Erskine Business Park Landfill	7.7	Waste management facility	Low	Non-putrescible waste facility – landfill	Moderate
Belmore Road Farm Dam	7.9	Farm dam	Moderate	N/A	N/A
Australian Koi Farm	8.2	Koi farm	Low	N/A	N/A

Site	Distance from runway end (km)	Site type	Avisure risk	NASF land use	NASF risk
Orchard Hills Water Treatment Plant	8.4	Water treatment facility	Moderate	Sewage/wastewater treatment facility	Moderate
Blue Hills Wetland	9.7	Wetland	Moderate	Wildlife sanctuary/conservation area – wetland	High
Penrith Landfill	9.7	Waste management facility	Low	Non-putrescible waste facility – landfill	Moderate
Penrith Golf Course	9.8	Golf course	Moderate	Golf course	Moderate
Shepherd Street Park	11	Parkland	Low	Park/playground	Moderate
Ched Town Reserve	11.1	Urban reserve	Low	Park/playground	Moderate
Glenmore Heritage Valley Golf course	11.4	Golf course	Moderate	Golf course	Moderate
Glenmore Loch	12.1	Wetland	Moderate	Wildlife sanctuary/conservation area – wetland	High
Bingo Recycling Centre and Ecology Park	12.3	Waste management facility	Moderate	Non-putrescible waste facility – landfill	Moderate
Western Sydney Parklands	12.4	Parkland	High	Park/playground	Moderate
Ropes Creek Flying-fox Camp	12.7	Flying-fox camp	Moderate	N/A	N/A
Werombi Road Pond	14.3	Farm dam	Low	N/A	N/A
Emu Plains Flying-fox Camp	15.1	Flying-fox camp	Very Low	N/A	N/A
Brownlow Hill Flying-fox Camp	15.7	Flying-fox camp	Low	N/A	N/A
Wetherill Park Resource Recovery	15.8	Waste management facility	Moderate	Putrescible waste facility – transfer station	High
Nurrangingy Reserve	17	Farm dam	Moderate	N/A	N/A
Fairfield City Council Resource Recovery	17.1	Waste management facility	Very Low	Non-putrescible waste facility – landfill	Moderate

Site	Distance from runway end (km)	Site type	Avisure risk	NASF land use	NASF risk
Wetherill Park Flying-fox Camp	17.5	Flying-fox camp	Very Low	N/A	N/A
Macquarie Fields Flying-fox Camp	18.1	Flying-fox camp	Moderate	N/A	N/A
Mount Annan Ibis Colony	19	Ibis breeding colony and wetland	Moderate	Wildlife sanctuary/conservation area – wetland	High
Cabramatta Flying-fox Camp	19.7	Flying-fox camp	Low	N/A	N/A
Prospect Reservoir	19.9	Water reservoir	Moderate	Wildlife sanctuary/conservation area – wetland	High
Spring Farm Landfill	20.5	Waste management facility	Low	Non-putrescible waste facility – landfill	Moderate
Campbelltown Flying-fox Camp	21.9	Flying-fox camp	Moderate	N/A	N/A
Lake Gillawarna Ibis Colony	23.3	Ibis breeding colony	High	N/A	N/A
Parramatta Park Flying-fox Camp	25.8	Flying-fox camp	Moderate	N/A	N/A

Appendix G

Flying-fox monitoring

Table G.1 Flying-fox camp monitoring data, 2018-2022. Data source: Avisure, DCCEEW and WSI

Location	Year	Month	Total Flying-foxes	Monitored by
Brownlow Hill Camp	2018	Feb	0	Avisure
		Apr	0	Avisure
		Jul	0	Avisure
		Nov	0	Avisure
	2019	May	2500–9999	DCCEEW
	2020	Feb	500–2499	DCCEEW
		Sep	0	WSI
		Oct	0	WSI
		Nov	16000–49999	DCCEEW; WSI
		Dec	0	WSI
	2021	Mar	0	WSI
	2022	Feb	500–2499	DCCEEW
		Jul	0	Avisure
		Aug	0	Avisure
		Sep	0	Avisure
		Oct	15	Avisure
Cabramatta Camp	2018	Feb	2500–9999	DCCEEW; Avisure
		Apr	0	Avisure
		May	500–2499	DCCEEW
		Aug	500–2499	DCCEEW
		Sep	0	Avisure
		Nov	500–2499	DCCEEW
		Dec	0	Avisure
	2019	Feb	500–2499	DCCEEW
		Aug	500–2499	DCCEEW
		Nov	2500–9999	DCCEEW
	2020	Feb	2500–9999	DCCEEW
		Sep	0	WSI
		Oct	0	WSI
		Nov	0	WSI
		Dec	0	WSI

Location	Year	Month	Total Flying-foxes	Monitored by
	2021	Mar	0	WSI
	2022	Jul	0	Avisure
		Aug	0	Avisure
		Sep	0	Avisure
		Oct	780	Avisure
Campbelltown Camp	2018	Feb	500–2499	DCCEEW
		Apr	0	Avisure
		Jul	0	Avisure
		Nov	0	Avisure
	2019	May	2500–9999	DCCEEW
	2020	Feb	2500–9999	DCCEEW
		Sep	2500	WSI
		Oct	2500	WSI
		Nov	5000	WSI
		Dec	2000	WSI
	2021	Mar	12000	WSI
		Nov	2500–9999	DCCEEW
	2022	Jan	12000	WSI
		Feb	500–2499	DCCEEW
		Jul	5463	Avisure
		Aug	2610	Avisure
		Sep	1750	Avisure
		Oct	4100	Avisure
Emu Plains Camp	2018	Mar	0	Avisure
		Apr	0	Avisure
		May	1–499	DCCEEW
		Sep	0	Avisure
		Dec	0	Avisure
	2019	Feb	500–2499	DCCEEW
	2020	Sep	0	WSI
		Oct	0	WSI
		Nov	0	WSI
		Dec	0	WSI

Location	Year	Month	Total Flying-foxes	Monitored by
	2021	Mar	0	WSI
	2022	Aug	0	Avisure
		Sep	0	Avisure
		Oct	0	Avisure
Macquarie Fields Camp	2018	Feb	2500–9999	DCCEEW; Avisure
		Apr	0	Avisure
		May	500–2499	DCCEEW
		Jul	0	Avisure
		Aug	2500–9999	DCCEEW
		Nov	0	Avisure
	2019	May	50–-2499	DCCEEW
	2020	Feb	10000–14999	DCCEEW
		Sep	1000	WSI
		Oct	4500	WSI
		Nov	5000	WSI
		Dec	5000	WSI
	2021	Mar	30000	WSI
		Nov	2500–9999	DCCEEW
	2022	Jan	30000	WSI
		Feb	2500–9999	DCCEEW
		Jul	0	Avisure
		Aug	3538	Avisure
		Sep	3128	Avisure
		Oct	4100	Avisure
Parramatta Park Camp	2022	Jul	12584	Avisure
		Aug	4997	Avisure
		Sep	11798	Avisure
		Oct	15130	Avisure
Ropes Creek Camp	2018	Mar	0	Avisure
		Apr	0	Avisure
		Sep	0	Avisure
		Dec	0	Avisure

Location	Year	Month	Total Flying-foxes	Monitored by
	2019	Feb	500–2499	DCCEEW
		May	2500–9999	DCCEEW
		Aug	500–2499	DCCEEW
	2020	Feb	500–2499	DCCEEW
		Sep	10000	WSI
		Oct	2400	WSI
		Nov	16000	WSI
		Dec	5000	WSI
	2021	Mar	10000	WSI
		Nov	2500–9999	DCCEEW
	2022	Jan	15000	WSI
		Feb	2500–9999	DCCEEW
		Jul	396	Avisure
		Aug	715	Avisure
		Sep	1697	Avisure
		Oct	1730	Avisure
Wetherill Park Camp	2018	Mar	0	Avisure
		Apr	0	Avisure
		May	1–499	DCCEEW
		Sep	0	Avisure
		Dec	0	Avisure
	2019	May	500–2499	DCCEEW
	2020	Feb	1–499	DCCEEW
		Sep	0	WSI
		Oct	0	WSI
		Nov	0	WSI
		Dec	0	WSI
	2021	Mar	0	WSI
	2022	Jul	0	Avisure
		Aug	0	Avisure
		Sep	0	Avisure
		Oct	0	Avisure

Australian Government

Department of Infrastructure, Transport,
Regional Development, Communications and the Arts