VOLUME 4

Appendix K1
Biodiversity

Department of Infrastructure and Regional Development

Western Sydney Airport EIS
Biodiversity Assessment

August 2016

Limitations

GHD has prepared this report pursuant to the conditions in the Department of Infrastructure and Regional Development Deed of Standing Quotation (SON2030181), the Commonwealth RFQTS Number 2014/7540/001, the subsequent response accepted and referenced in the relevant Official Order (collectively the "Contract"): In particular, this report has been prepared by GHD for the Commonwealth and may only be used and relied on by the Commonwealth and the party or parties identified in the Contract (Other Parties) in accordance with the Contract for the purpose agreed between GHD and the Commonwealth as set out in the Contract and further Section 1.4 of this report. Other than as stated in the Contract, GHD disclaims responsibility to any person other than the Commonwealth (or the Other Parties) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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Glossary of terms

Term	Definition
Affected threatened biota	Threatened species or communities listed under the EPBC Act, which are likely to suffer a significant impact as a result of a proposal and which require biodiversity offsets having regard to the EPBC Act Offset Policy.
Airport site	The site for Sydney West Airport as defined in the Airports Act.
BBAM	The NSW *BioBanking Assessment Methodology* (OEH, 2014).
Biobank site	Land that is designated by a biobanking agreement to be a biobank site.
Biobanking agreement	An agreement entered into between the landowner and the NSW Environment Minister under Part 7A of the TSC Act for establishing a biobank site.
BioBanking Trust Fund	The Trust Fund established under Part 7A of the TSC Act to hold funds from the sale of credits.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the FBA or the BBAM. Includes ecosystem credits or species credits.
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biobanking statement; or required to offset the impacts of a Major Project in accordance with the FBA; or that would be generated through conservation and management of a biobank site under a BioBanking agreement (means the report set out in Appendix B).
Biodiversity offset delivery plan	The biodiversity offset delivery plan which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in the biodiversity offset package.
Biodiversity offset package	Appendix K2 to the EIS, which outlines the approach to the delivery of biodiversity offsets for the proposed airport, including an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
CEEC	Critically endangered ecological community.
Construction impact zone (CIZ)	The area that would be directly impacted by construction of the Stage 1 development – indicatively shown in the revised draft Airport Plan. A full description is provided in Chapter 6 of the EIS.
Department of Infrastructure and Regional Development	The Australian Government Department responsible for proposing Stage 1 of the Western Sydney Airport.
DoE	Australian Government Department of the Environment (now Department of the Environment and Energy).
DoEE	Department of the Environment and Energy.
DPI	The NSW Department of Primary Industries.
DSEWPaC	The former Department of Sustainability Environment Water Populations and Communities, now the Commonwealth Department of the Environment and Energy.

Term	Definition
Ecosystem credit	The class of biodiversity credits created or required for the impact on EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur within a vegetation type according to the BBAM.
EEC	Endangered ecological community
Environmental conservation zone	The area at the airport site that would be provided as an environmental conservation zone, as outlined in the land use plan in the revised draft Airport Plan (see Chapter 4 of the EIS).
EPBC Act	The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPBC Act-listed biota	Threatened species and communities and migratory species listed under the EPBC Act.
FBA	The Framework for Biodiversity Assessment (OEH, 2014a). The methodology to assess impacts on biodiversity that is used to assess all biodiversity values on the development site for a Major Project under the NSW *Environmental Planning and Assessment Act 1979* (EPA Act) and in accordance with The NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014a).
FM Act	The NSW *Fisheries Management Act 1994*
Food tree	A tree species that is recognised as being of value as a foraging resource for a given fauna species.
Habitat tree	A tree that is recognised as being of value as a shelter, roosting and/or nesting resource for fauna species. Includes hollow-bearing trees, stags (standing dead trees) and trees with nests or other signs of fauna occupancy.
HIAL	High Intensity Approach Lighting
Long term development	The longer term stage in the development of the proposed airport, including parallel runways and facilities for up to 82 million passengers annually (nominally occurring in 2063).
Migratory species	Species that are listed as migratory under the EPBC Act.
MNES	'Matters of national environmental significance' listed under the EPBC Act, including threatened biota, migratory species, World Heritage/National Heritage sites and Ramsar wetland sites.
NPW Act	The NSW *National Parks and Wildlife Act 1974*
NPWS	The NSW National Parks and Wildlife Service
NSW-listed biota	Threatened species, populations and communities listed under the NSW TSC Act or FM Act.
NW Act	The NSW *Noxious Weeds Act 1993*
OEH	The NSW Office of Environment and Heritage
PMST	Protected Matters Search Tool. A database administered by the Department of the Environment that contains known and predicted records of matters of national environmental significance listed under the EPBC Act.
Potential offset areas	The areas within the potential offset sites that have been identified in the offset package (Appendix K2) that would be suitable to offset impacts on affected threatened biota listed under the EPBC Act. Only includes vegetation and habitat which is appropriate to offset impacts on the affected threatened biota having regard to the EPBC Act Offset Policy and which are linked to biodiversity credits which are available for sale.
Potential offset sites	The potential offset sites that have been identified in the offset package (Appendix K2) in order to offset biodiversity impacts.

Term	Definition
Preparatory Activities	Preparatory Activities mean the following: (a) day to day site and property management activities; (b) site investigations, surveys (including dilapidation surveys), monitoring, and related works (e.g. geotechnical or other investigative drilling, excavation, or salvage); (c) establishing construction work sites, site offices, plant and equipment, and related site mobilisation activities (including access points, access tracks and other minor access works, and safety and security measures such as fencing); and (d) enabling preparatory activities such as: i. demolition or relocation of existing structures (including buildings, services, utilities and roads) provided they are demolished or relocated in accordance with applicable environmental impact mitigation measures specifically referable to demolition or relocation of the relevant structures; ii. the relocation of cemeteries in accordance with an approved cemeteries relocation management plan; and iv. application of environmental impact mitigation measures.
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Species credit-type threatened species	Threatened species that are linked to species credits according to the BBAM (rather than ecosystem credits) because they cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Stage 1 construction impact zone	The disturbance footprint for construction of the Stage 1 development, including the anticipated extent of vegetation clearing and grubbing, earthworks, drainage works and the permanent infrastructure that would be constructed for Stage 1 of the airport.
Stage 1 development	The initial stage in the development of the proposed airport, including a single runway and facilities for 10 million annual passengers. (the EIS assumes the airport could be operating at this level approximately 5 years after operations commence which for assessment purposes has been assumed to be 2030).
TAP	Threat Abatement Plan
TEC	Threatened ecological community listed under the EPBC Act and/or the TSC Act.
The EPBC Act Offsets Policy	The *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012)
The locality	Land within a 10 km radius of the airport site.
The offsets assessment guide	The spreadsheet offset calculator that accompanies the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012).
The region	A bioregion defined in a national system of bio-regionalisation. For this study this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell, 1995).
Threatened biota	Threatened species, populations or communities listed under the EPBC Act, TSC Act or FM Act.
TSC Act	The NSW *Threatened Species Conservation Act 1995*

Term	Definition
Western Sydney Airport (or ‘the airport’)	The proposed airport. The airport is referred to as Sydney West Airport under the Airports Act.

1. Introduction

1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946, with a number of comprehensive studies—including two previous environmental impact statements for a site at Badgerys Creek—having been completed over the last 30 years.

More recently, the Joint Study on Aviation Capacity in the Sydney Region (Department of Infrastructure and Transport, 2012) and A Study of Wilton and RAAF Base Richmond for civil aviation operations (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,780 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Airport operations are expected to commence in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport (referred to as the Stage 1 development) would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of approximately 10 million passengers per year as well as freight operations. To maximise the potential of the site, the airport is proposed to operate on a 24 hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site subject to relevant approvals.

While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A joint scoping study is being undertaken with the NSW Government to determine rail needs for Western Sydney and the airport. A potential final rail alignment will be determined through the joint scoping study with the New South Wales Government, with any significant enabling work required during Stage 1 expected to be subject to a separate approval and environmental assessment process.

As demand increases, additional aviation infrastructure and aviation support precincts are expected to be developed until the first runway reaches capacity at around 37 million passenger movements. At this time, expected to be around 2050, a second parallel runway is expected to be required. In the longer term, approximately 40 years after operations commence, the airport development is expected to fully occupy the airport site, with additional passenger and transport facilities for around 82 million passenger movements per year.

On 23 December 2014, the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015.

Approval for the construction and operation of the proposed airport will be controlled by the Airports Act 1996 (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan, which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. A draft Airport Plan was exhibited for public comment with the draft EIS late in 2015.

Following receipt of public comments, a revised draft Airport Plan has been developed. The revised draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The revised draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, as well as a long-term vision of the airport's development over a number of stages. This enables preliminary consideration of the implications of longer term airport operations. Any airport development beyond Stage 1, including the construction of additional terminal areas or supporting infrastructure to expand the capacity of the airport using the first runway or construction of a second runway, would be managed in accordance with the existing process in the Airports Act. This includes a requirement that, for major airport developments (defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

The Airport Plan will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

1.2 EIS requirements

EIS assessment guidelines for the proposed airport were issued on 21 January 2015. The assessment requirements are presented in Table 1 along with a reference to where each matter relevant to biodiversity is addressed in this report. For the requirements that are not relevant to this biodiversity report, reference is made to where these are addressed elsewhere in the EIS.

Table 1 EIS requirements for biodiversity assessment

No.	EIS requirement	Where addressed in this report
4	**Description of the environment**	
	The EIS must include a description of the environment, land uses and character of the airport site and the surrounding areas that may be affected by the action. It is recommended that this include the following information:	A description of the existing environment is provided in Section 4. Further detail is provided in the EIS for the proposed airport.
	(a) Listed threatened species (including suitable habitat) and ecological communities that are or are likely to be present in all areas of potential impact. To satisfy this requirement details must be presented on the scope, timing/effort (survey season/s) and methodology for studies and surveys used to provide information on the relevant listed threatened species/ecological community/habitat (as identified in Attachment 3). This includes details of: • how best practice survey guidelines have been applied • how surveys are consistent with (or a justification for divergence from) published Australian Government guidelines and policy statements.	An assessment of the likelihood of occurrence of threatened biota and migratory species is provided in Appendix A. Additional detail is provided in Section 4.4. A description of survey methodology, timing and effort is provided in Section 3.1. Details of specific survey requirements and how these have been applied or varied is provided in Appendix B.
	(b) A description of the World Heritage/National Heritage values of the Greater Blue Mountains Area World Heritage property/National Heritage Place, as described in the Statement of Outstanding Universal Value and including reference to the World Heritage criteria the area is listed for as well as the integrity of. the property.	See Sections 4.5.5 and 8.2.5.

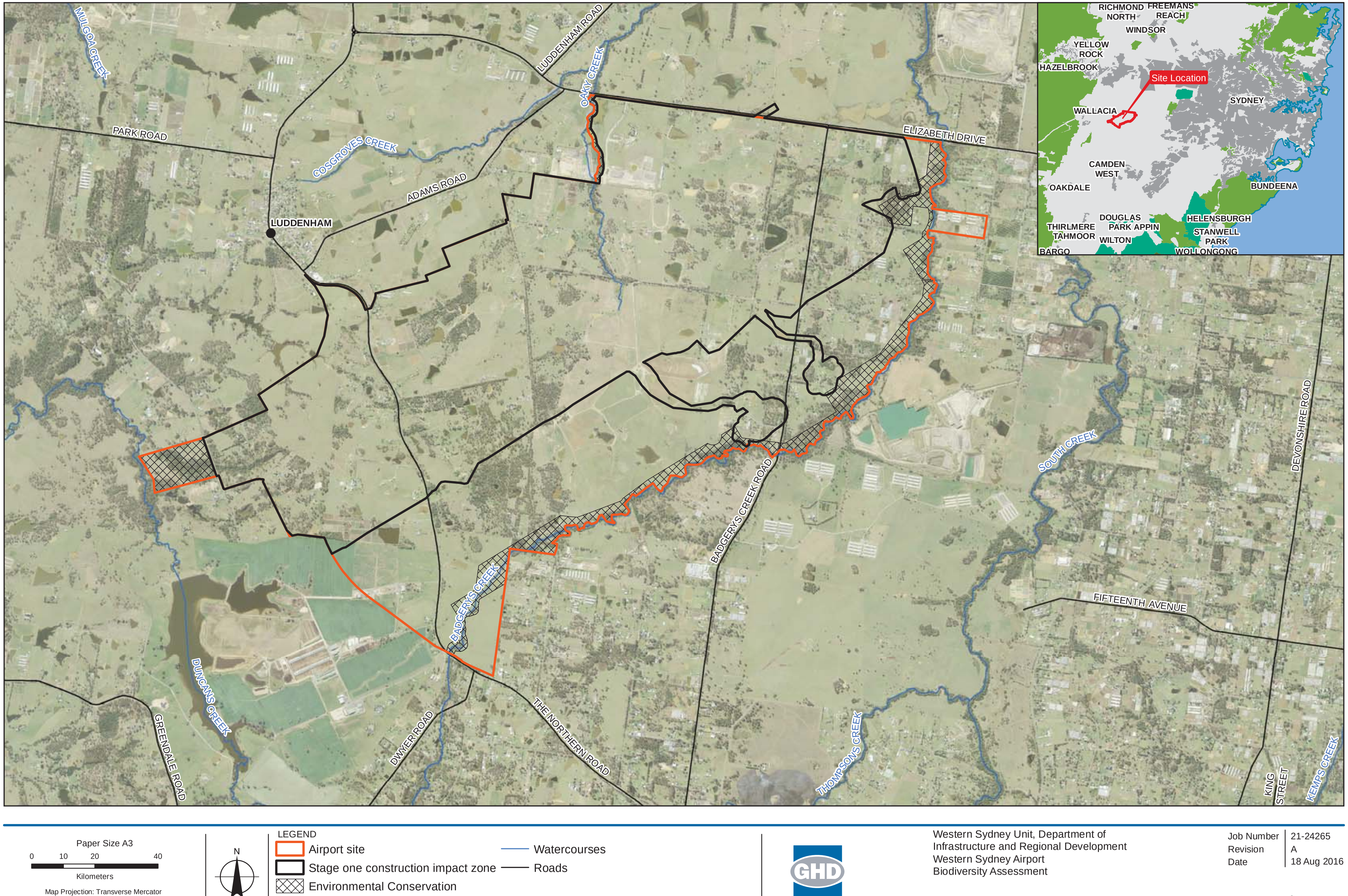
No.	EIS requirement		Where addressed in this report
	(c)	A description of the environment in all areas of potential impact, including all components of the environment as defined in s528 of the EPBC Act: • ecosystems and their constituent parts, including people and communities • natural and physical resources • the qualities and characteristics of locations, places and areas • Heritage values of places • the social, economic and cultural aspects of a thing mentioned in preceding dot points.	A description of vegetation and habitat resources present in the airport site is provided in Section 4. This includes a description of qualities and characteristics of these values. A description of the Greater Blue Mountains World Heritage Area is provided in Section 4.5.5. Social, economic and cultural aspects are addressed in relevant sections of the EIS.
5	**Relevant impacts**		
	(d)	The EIS must include a description of all of the relevant impacts of the action. Relevant impacts are impacts that the action will have or is likely to have on a matter protected by a controlling provision (as listed in the preamble of this document). Impacts during both the construction, operational and (if relevant) the decommissioning phases of the project should be addressed, and the following information provided: • a detailed assessment of the nature and extent of the likely short-term and long-term relevant impacts (detailing direct and indirect impacts); • a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; • analysis of the significance of the relevant impacts; and • any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	A description of direct and indirect construction and operation impacts (short and long-term) is provided in Sections 5 and 6. A discussion of impacts on matters of national environmental significance (MNES) listed under the EPBC Act and other threatened biota is provided in Section 8.
	(e)	The EIS should identify and address cumulative impacts, where potential project impacts are in addition to existing impacts of other activities (including known potential future expansions or developments by the proponent and other proponents in the region and vicinity). The EIS should address the potential cumulative impact of the proposal on ecosystem resilience. The cumulative effects of climate change impacts on the environment must also be considered in the assessment of ecosystem resilience. Where relevant to the potential impact, a risk assessment should be conducted and documented.	Potential cumulative impacts are assessed in Section 7. A discussion of ecosystem resilience is provided in Section 7.
	(f)	The EIS should address the potential for facilitated impacts upon MNES at the local, regional, state, national and international scale.	Potential facilitated impacts are assessed in Section 7.
	(g)	If the conclusion is made that any relevant controlling provision or element of a relevant controlling provision will not be impacted by the proposed action, then justification must be provided for how this conclusion has been reached. This includes any threatened species or ecological communities that are likely to be present on site, heritage items/places likely to be on site and other relevant elements of the environment that may be impacted by the proposed action.	Potential impacts on threatened biota and other controlling provisions are assessed in Section 8.3. Impacts on heritage items and places and other aspects of the environment are detailed in the EIS and relevant technical reports.
	(h)	To support the assessment of local historic and indigenous heritage values, the EIS must include a full heritage impact assessment and the findings of the	Not relevant to this report. Refer to the specialist reports included as Appendices to the EIS.

No.	EIS requirement	Where addressed in this report
	further programme of archaeological survey that was foreshadowed in the referral for this project.	
	(i) Further details of threatened species and ecological communities protected by the controlling provisions of Part 3 of the EPBC Act are provided at Attachment 3.	Details of threatened species indicated in Attachment 3 are discussed in Section 4.4. Impacts on MNES are discussed in Sections 5, 6 and 8.
	(g) Impacts to the environment (as defined in s528) should include but not be limited to the following: • changes to water quality on site and downstream of the site • changes to siltation • hydrological changes • removal and degradation of heritage items/places (historic, natural and indigenous) • native flora and fauna habitat removal and degradation (on site and in surrounding areas that may be affected by the action) • aircraft noise and vibration impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment). Discussion and quantification/modelling of aircraft noise impacts should include consideration of all potential flight paths, height of flights, noise exposure patterns, noise contours, the range of frequencies of the noise, cumulative exposure, peak noise, frequency of overflights and temporal variability of this (including long term trends), varying aircraft types, varying aircraft operating procedures, and variations in noise patterns due to seasonal and meteorological factors • noise and vibration from construction activities and machinery • changes to air quality during construction and operation (including consideration of seasonal and meteorological variations that influence local air quality) • potential fuel jettisoning impacts • changes in traffic movements during construction and operation (associated with both passenger movements and workers) • bird or bat airstrike • lighting impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment) • changes in recreational use and amenity of natural areas • change in qualities and characteristics of the surrounding areas and associated impacts to local communities (including land values and other economic impacts) • creation of any risks or hazards to people or property that may be associated with any component of the action.	A description of direct and indirect construction and operation impacts on biodiversity (short and long-term) is provided in Sections 5 and 6. A discussion of impacts on MNES and other threatened biota is provided in Section 8. Further detail on impacts of noise, vibration, air quality, water, hydrology, traffic, recreational use and amenity, economic impacts, and risks and hazards etc. are addressed in relevant sections of the EIS and other relevant technical reports included as appendices to the EIS.

No.	EIS requirement	Where addressed in this report
	Quantification and assessment of impacts should: • be against appropriate background/baseline levels • be prepared according to best practice guidelines and compared to best practice standards • consider seasonal and temporal variations where appropriate (including temporal changes in the sensitivity of the receptor) • be supported by maps, graphs and diagrams as appropriate to ensure information is readily understandable Guidelines and standards used to quantify baselines and impacts should be explained and justified.	The impact assessment provided in Sections 5 and 6: • is against a baseline description of the existing environment of the airport site informed by detailed desktop assessment and field survey • was prepared in accordance with the 'Matters of National Environmental Significance Significant Impact Guidelines 1.1 and 1.2 (DoE 2013a, 2013b) and other specific survey and assessment guidelines for threatened biota (see Appendix B) • is supported by GIS maps of the biodiversity values at the airport site and quantitative calculations based on design drawings. Where appropriate impact calculations have been tabulated.
6	**Avoidance and mitigation measures**	
	(j) The EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impact of the action on a matter protected by a controlling provision (as listed in the preamble of this document).	Avoidance and mitigation of impacts on biodiversity values is detailed in Section 9.
	(k) The EIS must take into account relevant agreements and plans that cover impacts or known threats to a matter protected by a controlling provision (including but not necessarily limited to): (a) any recovery plan and/or conservation advice for the affected species or ecological community (b) any threat abatement plan for a process that threatens an affected species or ecological community (c) any wildlife conservation plan for the affected species (d) any relevant strategic assessment undertaken in accordance with an agreement under Part 10 of the EPBC Act. (e) For the *Greater Blue Mountains World Heritage Area* property, the World Heritage Convention; the Australian World Heritage Management Principles; the *Greater Blue Mountains World Heritage Area Strategic Plan*, and relevant NSW National Parks and Wildlife Service/Office of Environment and Heritage Plans of Management.	This report has been prepared with reference to recovery plans, threat abatement plans, strategic plans and other relevant documents. A list of references is provided in Section 11.

No.	EIS requirement	Where addressed in this report
	(l) The EIS must include specific and detailed descriptions of the proposed avoidance and mitigation measures based on best available practices. This must include the following elements: I. A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including: • a detailed description of proposed measures; • assessment of the expected or predicted effectiveness of the mitigation measures; • any statutory or policy basis for the mitigation measures; and • the likely cost of the mitigation measures. II. A detailed outline of a plan for the continuing management, mitigation and monitoring of relevant matters protected by a controlling provision, including a description of the outcomes that will be achieved and any provisions for independent environmental auditing. III. Where appropriate, each project phase (construction and operation) must be addressed separately. It must state the environmental outcomes, performance criteria, monitoring, reporting, corrective action, contingencies, responsibility and timing for each environmental issue. IV. The name of the agency responsible for endorsing or approving each mitigation measure or monitoring programme.	Avoidance and mitigation of impacts on biodiversity values is detailed in Section 9. Further detail on avoidance and mitigation measures is provided in the EIS and other relevant technical reports included as appendices to the EIS.
7	**Residual impacts and offsets**	
	<u>Residual impacts</u> a) The EIS must provide details of the likely residual impacts upon a matter protected by a controlling provision after the proposed avoidance and mitigation measures have been taken into account. This includes: 1. the reasons why avoidance or mitigation of impacts may not be reasonably achieved 2. quantification of the extent and scope of significant residual impacts.	An assessment of measures to avoid or mitigate impacts is included in Sections 9.1 and 9.2. Significant residual impacts are described in Section 9.3.
	<u>Offset Package</u> a) The EIS must include details of an offset package to be implemented to compensate for residual significant impacts associated with the project, as well as an analysis of how the offset meets the requirements of the Department's *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy October 2012 (EPBC Act Offset Policy). b) The offset package can comprise a combination of direct offsets and other compensatory measures, as long as it meets the requirements of the EPBC Act Offset Policy. Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain. c) Offsets should compensate for an impact for the full duration of the impact.	A Biodiversity Offset Package for Western Sydney Airport has been prepared in consideration of the EPBC Act Offsets Policy (GHD 2016a). An estimate of the quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act has been calculated in accordance with the offsets assessment guide. An estimate of the quantum of biodiversity offsets required for impacts on the environment, including threatened biota listed under NSW legislation, has been calculated using the BioBanking

No.	EIS requirement	Where addressed in this report
	d) Offsets must directly contribute to the ongoing viability of the protected matter impacted by the project and deliver an overall conservation outcome that maintains or improves the viability of the protected matter, compared to what is likely to have occurred under the 'status quo' (i.e. if the action and associated offset had not taken place). e) Note: offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact. f) The EIS must provide: I. details of the offset package to compensate for significant residual impacts on a protected matter; and II. an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy. Further details of information requirements for EPBC Act offset proposals are provided at Attachment 4.	assessment methodology for a major project in NSW.
8	**Environmental record of person(s) proposing to take the action**	Refer to the EIS.
9	**Other approvals and conditions**	Refer to the EIS.
10	**Economic and social matters**	Refer to the EIS.
11	**Information sources provided in the EIS**	
	For information given in the EIS, the EIS must state: a) the source of the information b) how recent the information is c) how the reliability of the information was tested d) what uncertainties (if any) are in the information e) what guidelines, plans and/or policies have been considered during preparation of the EIS.	A list of reference material with year of publication is provided in Section 11. This includes relevant guidelines, plans and policies. Reliability of existing data at regarding flora biodiversity at the airport site was tested by conducting additional detailed surveys. Limitations of survey methods are discussed in Section 3.3.
12	**Conclusion**	
	An overall conclusion as to the environmental acceptability of the proposal on protected matters must be provided, which includes: a) a discussion on how consideration has been given to the objects of the EPBC Act, the principles of ecologically sustainable development, and the precautionary principle (as detailed at Attachment 1) b) justification for undertaking the proposal in the manner proposed, including the acceptability of the avoidance and mitigation measures c) if relevant, a discussion of residual impacts and any offsets and compensatory measures proposed or required for significant residual impacts on protected matters, and the relative degree of compensation and acceptability.	A conclusion with respect to biodiversity matters is provided in Section 10. A biodiversity offset package has been prepared in accordance with the EPBC Act Offsets Policy (GHD 2016a). Consideration of the objects of the EPBC Act, the principles of ecologically sustainable development, the precautionary principle, and justification for the proposal is provided in the EIS.



Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Site location

Figure 1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

1.3 The proposal

1.3.1 Stage 1

Stage 1 of the proposed airport would include a 3,700 metre runway on an approximate north-east/south-west orientation. The Stage 1 development would also include a single full length parallel taxiway and a range of aviation support facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of approximately 10 million domestic and international passengers per year which is consistent with approximately 63,000 air traffic movements per year. The proposed airport is proposed to operate on a 24-hour, curfew free basis.

The Stage 1 development area will be concentrated in the northern portion of the site, although some parts of the southern portion are also included in Stage 1. The existing terrain at the airport site is undulating and substantial earthworks are required to create a level surface to allow construction of the runway, taxiways and support services. The Stage 1 construction impact zone is predominantly located within the northern portion of the site following the alignment of the proposed runway. There will also be limited earthworks in the southern portion of the site during Stage 1 for the establishment of drainage swales and detention ponds as part of the water management system developed for the airport site. The airport site layout, including the approximate locations of airport infrastructure and the Stage 1 earthworks footprint are shown on Figure 2.

The Airport Plan does not propose the development of critical infrastructure outside of the Stage 1 construction impact zone. Developments proposed outside of the Stage 1 construction impact zone, including the implementation of asset protection zones to protect those developments, would be subject to further environmental assessment and approval processes under the Airports Act. As such, the southern portion of the airport site would predominantly remain uncleared during the initial stage of the airport development.

1.3.2 Long term development

The proposed airport would be progressively developed as demand increases beyond 10 million annual passengers. Additional aviation infrastructure and support services such as taxiways, aprons, terminals and support facilities would be required to service the growing demand.

The need for a second runway is expected to be triggered when the operational capacity approaches 37 million annual passengers which is equivalent to approximately 164,000 air traffic movements per year. This is forecast to occur by around 2050. The second runway is expected to be located in the southern portion of the airport site, parallel to the first runway with a centre line separation distance of approximately 1,900 metres.

The long term capacity of the proposed airport is forecast to service approximately 82 million annual passengers which is equivalent to approximately 370,000 air traffic movements per year. The final layout of the indicative long term development of the proposed airport would be confirmed as part of the development of future airport master plans and would be subject to further approval and regulation under the *Airports Act 1996*.

1.3.3 Environmental conservation zone

Portions of the airport site would remain undeveloped in the longer term to conserve riparian corridors and other features of higher environmental value. These areas have been included in the proposed ‘Environmental conservation zone’ in the draft Airport Plan and would be managed for biodiversity conservation (see Figure 2). The Badgerys Creek corridor, and environmental conservation (EC1) zones on the airport site, will be protected through the Land Use Plan outlined in the Airport Plan and reproduced in Chapter 4 of the EIS, the operation environment management plans (Section 28.6 of Chapter 28 of the EIS) and general obligations in the *Airports Environment Protection Regulations.* The Land Use Plan limits the types of activities that can take place within the EC1 zone. The Land Use Plan, as part of the Airport Plan, must be complied with in accordance with the *Airports Act 1996*. General vegetation management activities in this area will be governed by the biodiversity plans within the construction environment management framework and the operational environment management framework.

Paper Size A3

0 200 400 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
Airport site
Stage one construction impact zone
Environmental conservation

Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
Date 18 Aug 2016

Site layout

Figure 2

N:\AU\Sydney\Projects\21\24265\GIS\Maps\Deliverables\21-24265-Z032_SiteLayout_Biodiversity.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

1.4 Purpose of this report

This assessment has been undertaken in accordance with the EIS guidelines issued by the Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and specifically considers matters relevant to biodiversity. The purpose of this report is to describe the native biota and habitats at the airport site and to assess the potential impacts of the construction and operation of the proposed airport on biodiversity values.

The scope of this biodiversity assessment is to:

- complete a desktop assessment, field survey, research and consultation to describe the biodiversity values of the airport site, including native vegetation types, flora and fauna species and their habitats;
- assess the value and conservation significance of native vegetation and habitats at the airport site and the potential for threatened or migratory biota listed under the EPBC Act and threatened biota listed under the NSW *Threatened Species Conservation* Act 1995 (TSC Act) to occur at the site and/or to be affected by the proposed airport;
- describe the proposed construction and operation of the proposed airport and identify potential impacts on biodiversity values, especially matters of national environmental significance (MNES);
- identify measures to avoid or mitigate impacts on biodiversity values;
- complete impact assessments pursuant to:
  - the *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013a) for impacts on threatened biota and other MNES;
  - the *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies* (DoE 2013b) for impacts on the natural environment (for the purposes of this report, comprising impacts on plants, animals and their habitats); and
- identify appropriate biodiversity offsets to compensate for residual significant impacts on protected matters arising from the proposed airport in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC 2012) including:
  - offsets for residual significant impacts on threatened biota listed under the EPBC Act calculated using the offsets assessment guide; and
  - offsets for residual significant impacts on the environment calculated with the BioBanking assessment methodology for a major project.

1.5 Scope clarifications and assumptions

The scope described above is subject to the following clarifications and assumptions:

- with the exception of the proposed airport's High Intensity Approach Lighting (HIAL), any vegetation clearing and direct impacts that may occur outside of the airport site due to the proposed airport, such as for the Obstacle Limitation Surface (OLS) or for other significant infrastructure, have not been assessed;
- the environmental conservation zones shown on Figure 2 would be managed as open space. Native vegetation would be retained and would be available as refuge habitat for displaced fauna and translocated snails, frogs, habitat resources etc. as required;
- assessments of significance have been prepared in accordance with the *'Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999'* (DoE 2013a) for impacts on threatened biota and other MNES and the '*Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies'* (DoE 2013b) for impacts on flora and fauna. Impacts on other aspects of the environment are discussed in the EIS and relevant technical reports;
- the biodiversity offset package is for Stage 1 only and includes the preferred approach to offsetting along with the specific detail that was available at the time of publication;
- offsets on threatened biota listed under the EPBC Act have been calculated with reference to the EPBC Act Offsets Policy; and
- the suite of biodiversity credits that would be presented to offset impacts on threatened biota listed under the EPBC Act and TSC Act have been calculated with reference to the FBA.

2. Legislative context

2.1 EPBC Act

2.1.1 Project background

The Australian Government announced on 15 April 2014 that Commonwealth-owned land at Badgerys Creek will be the site of a new airport for the proposed Western Sydney Airport (proposed airport). A brief survey of the site was carried out by SMEC in September 2014 and a biodiversity report was prepared which identified the biodiversity values present at the airport site and made recommendations for further surveys and assessment (SMEC 2014). A referral for the proposed airport was submitted to the Australian Government Minister for the Environment under the EPBC Act in November 2014 (DIRD 2014). The SMEC (2014) report was included as an attachment to the referral. Based on the referral and attached information, the delegate of the Minister determined on 23 December 2014 that assessment is required as the action is a "controlled action", as it is likely to have a significant impact on the following matters of national environmental significance (MNES) and other matters that are protected under Part 3 of the EPBC Act:

- listed threatened species and ecological communities (s18 and s18A);
- the heritage values of a National Heritage place (s15B and s15C);
- the world heritage values of a declared World Heritage property (s12 and s15A); and
- the environment because the proposal is a Commonwealth action (s28).

Guidelines for the content of an environmental impact statement (EIS) for the proposed airport were issued in January 2015. An EIS has been prepared and this biodiversity impact assessment supports the EIS and address the EIS requirements relevant to biodiversity (refer to Table 1).

2.1.2 Objects of the EPBC Act

The objects of the EPBC Act include to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance (MNES) and to promote the conservation of biodiversity. Under the EPBC Act, an action includes a proposal, undertaking or activity.

The EPBC Act identifies MNES as:

- world heritage properties;
- national heritage places;
- wetlands of international importance (Ramsar wetlands);
- threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act also is concerned with actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency.

The EPBC Act has been addressed in this assessment through:

- desktop review to determine the threatened or migratory species or threatened ecological communities that have been previously recorded within the locality and hence could occur at the airport site, subject to the habitats present;
- desktop assessment and field surveys to describe the environment of the airport site, including biodiversity values and threatened biota listed under the EPBC Act or under NSW legislation (see below);
- targeted field surveys for threatened ecological communities and threatened and migratory species; and
- assessment of potential impacts on the environment and on specific MNES that could arise from the construction and operation of the proposed airport and measures to avoid or mitigate potential impacts.

2.2 New South Wales Legislation

The airport site is Commonwealth land. Consequently, the airport proposal does not require environmental assessment or approvals under various NSW environmental planning and assessment legislation. However, the EPBC Act requires protection of the environment from actions by the Commonwealth, and it is therefore appropriate to consider threatened biota that are listed under NSW legislation and other aspects of the airport site's biodiversity as part of this assessment.

The New South Wales (NSW) TSC Act and *Fisheries Management Act 1994* (FM Act) provide for the listing of threatened biota that are at risk of becoming extinct or endangered in NSW. The TSC Act also provides for the assessment of impacts on biodiversity values, the offsetting of impacts and the conservation of offset sites through BioBanking (see below).

2.2.1 Threatened Species Conservation Act 1995

The TSC Act provides legal status for biota of conservation significance in NSW. The TSC Act aims to, inter alia, 'conserve biological diversity and promote ecologically sustainable development'. The TSC Act contains schedules that list endangered, critically endangered and vulnerable species, populations, ecological communities, and key threatening processes in NSW.

Threatened biota listed under the TSC Act has been considered in this assessment through:

- desktop assessment and field survey to identify threatened biota that may be present at the airport site or affected by the proposed airport; and
- consideration of impacts on threatened biota and measures to avoid or mitigate potential impacts.

Part 7A of the TSC Act establishes the NSW Biodiversity Banking and Offsets Scheme (BioBanking), which was enabled by the *Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006*. BioBanking includes a methodology for assessing biodiversity values, establishing rules for calculating biodiversity offsets and provides a framework for managing biodiversity offset sites.

The offset package for the proposed airport has been prepared with reference to the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects* (the FBA) (OEH 2014a) and the *Credit Calculator for Major Projects and BioBanking Operational Manual*. (OEH 2016). The FBA methodology was used to assess the biodiversity offset requirements for impacts on plants, animals and their habitat on Commonwealth land. Accordingly, this biodiversity assessment has also been prepared with reference to the FBA (OEH 2014a) and operational manual (OEH 2016), including description and sampling of plant community types in accordance with the methodology (see Section 3.2.2).

2.2.2 Fisheries Management Act 1994

The objectives of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It contains schedules that list endangered, critically endangered and vulnerable aquatic species, populations and ecological communities, key threatening processes in NSW, and noxious fish and marine vegetation.

One of the objectives of the FM Act is to 'conserve key fish habitats ' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species.

The FM Act also includes provisions to ensure the maintenance and restoration of fish passage as part of the construction of new, or the modification of existing, in-stream structures.

Threatened biota listed under the FM Act has been considered in this assessment through:

- desktop assessment and field survey to identify threatened biota that may be present at the airport site or affected by the proposed airport;
- assessment of aquatic habitats, including key fish habitat, during field surveys;
- assessment of the potential for impacts on key fish habitat and threatened species, populations and ecological communities listed under the FM Act; and
- identification of suitable impact mitigation and environmental management measures to avoid or mitigate impacts on the aquatic environment.

2.2.3 Noxious Weeds Act 1993

The Noxious Weeds Act (NW Act) provides for the declaration of noxious weeds by the NSW Minister for Primary Industries. Under the NW Act, weeds may be considered noxious on a National, State, Regional or Local scale. The NW Act defines five classes of noxious weeds (Section 8 of the NW Act) and outlines particular controls applicable to each class. If present, noxious weeds should be assessed and controlled in order to help avoid economic or environmental impacts.

There are at least 12 noxious weed species present at the airport site (see Section 4.2.3). Mitigation measures are recommended in Section 9.2 to minimise the impact and spread of weeds.

3. Methodology

3.1 Literature and desktop assessment

3.1.1 Literature review

A literature review was undertaken to identify MNES listed under the EPBC Act and threatened flora and fauna species, populations and ecological communities (biota) listed under the TSC Act and FM Act that have previously been identified at the airport site. The literature review assisted with identifying gaps in field surveys conducted previously, and with focusing field survey techniques and effort. Biodiversity resources pertaining to the airport site and locality (i.e. within a 10 kilometres radius of the airport site) that were reviewed prior to conducting field investigations included:

- the previous EIS and specialist reports prepared for a proposed airport at Badgerys Creek between 1996 and 1999;
- the *Environmental field survey of Commonwealth land at Badgerys Creek Report* (SMEC 2014) and associated specialist reports;
- *Western Sydney Airport referral of proposal action* (DIRD 2014)*;*
- *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer et al 2010);
- *Native Vegetation of the Cumberland Plain, Western Sydney* (NPWS 2006);
- aerial photographs and satellite imagery of the study area; and
- management plans, ecological assessments and research papers relating to the biodiversity values at the airport site and especially the threatened biota that is known or likely to occur in the locality.

Recent baseline surveys were carried out by SMEC at the airport site over three days in September 2014. The results of these surveys were documented in a biodiversity report (SMEC 2014) that was used to inform the EPBC Act referral for the proposed airport. Prior to these surveys, a number of flora and fauna surveys were conducted by Biosis Research for the 1999 EIS. Surveys for the 1999 EIS were conducted in December 1996, January 1997 (aquatic), September 1998 and January 1999. The results of these biodiversity assessments have been reviewed, checked against current site conditions and incorporated in this report where appropriate.

3.1.2 Database review

A database review was undertaken to identify threatened species and ecological communities listed under the EPBC Act that may be affected by the proposed airport, as well as threatened species, populations and communities listed under the TSC Act and FM Act. Database records pertaining to the airport site and locality since 1980 were reviewed prior to field investigations and included:

- the Commonwealth Department of Environment and Energy ((formerly the Commonwealth Department of the Environment (DoE)) Protected Matters Search Tool (PMST) for all MNES that are known or are predicted to occur within a 10 kilometre radius of the airport site (DoE 2015a) (database queried on 2 February 2015);
- DoE online species profiles and threats database (DoE 2015b);

- Office of Environment and Heritage (OEH) Wildlife Atlas database (licensed) for records of threatened species, populations and endangered ecological communities listed under the TSC Act that have been recorded within the locality (OEH 2015a), data supplied by OEH on 2 February 2015;
- OEH threatened biota profiles for descriptions of the distribution, habitat requirements and flowering season (where relevant) of threatened biota (OEH 2015b). This resource was used to identify the suite of threatened biota that could potentially be affected by the airport and to inform habitat assessments;
- the NSW VIS Classification 2.1- Community Identification (OEH 2015c) and NSW vegetation types database (OEH 2014b) to identify matching plant community types (PCTs) at the airport site;
- mapping and descriptions of the NSW Mitchell landscapes (DECC 2008a, 2008b);
- Birdlife Australia Atlas Data for records of birds observed within a 3 kilometre radius of the airport site (Birdlife Australia 2015), data supplied by Birdlife Australia on 8 May 2015;
- Birdline NSW (2015). Birdline NSW is a site for the reporting of rare or unusual birds outside their normal range, unusually high or low numbers, early or late arrivals or departures for migrant species and interesting behaviour or unusual habitat usage. This resource was checked to determine the arrival date and movements of Swift Parrots in NSW; and
- the DPI online protected species viewer for records of threatened aquatic species listed under the EPBC Act that have been recorded within the locality (DPI 2015a) (database queried on 2 February 2015).

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats at the airport site. This was further refined following field surveys and assessment of habitat present (see Section 4). The results of this assessment are presented in Appendix A.

3.2 Field surveys: Terrestrial Biodiversity

3.2.1 Overview

Staged surveys of the airport site were conducted between February and June 2015 to inform this biodiversity assessment. Supplementary surveys were conducted between July and December 2015 and in April 2016 to support geotechnical and European cultural heritage investigations at the airport site and to help address limitations of the initial survey. Surveys were conducted by a team of suitably qualified ecologists and built on previous surveys carried out by SMEC (2014) and those undertaken by Biosis Research (1999) for the previous EIS.

The airport site was occupied by multiple landowners and featured a variety of land uses at the time of the field surveys. Direct access was not able to be obtained to the entire airport site. Figure 3a shows the 'survey area' at the airport site that was the subject of targeted biodiversity surveys and direct observations. Properties that are mapped as 'access not obtained' were not accessed on foot because of access restrictions or because they contained land uses such as mines or intensive agriculture and could be reliability discounted as containing biodiversity values without targeted survey. These properties were assessed using a combination of air photo interpretation and observations from adjoining land in the survey area.

Vegetation survey and assessment for both EPBC Act and TSC Act protected matters was carried out with reference to the FBA (OEH 2014a, 2016) in order to assess vegetation type and condition and to help calculate the quantum of offsets required for the proposed airport.

Survey methods and effort were also designed with reference to various threatened species survey guidelines. These included the Commonwealth survey guidelines for nationally threatened frogs (DEWHA 2010a) and birds (DEWHA 2010b), the survey guidelines for threatened species listed under the TSC Act (DEC 2004a), species-specific survey methods detailed by the NSW National Parks and Wildlife Service (NPWS 2000, 2002, 2003), survey methods detailed in recovery plans (e.g. for the Grey-headed Flying-fox - DECCW 2009) and referral guidelines (e.g. for the Koala - DoE 2014).

Survey methodology is discussed in Section 3.2.2 and 3.2.3, survey effort, site stratification and timing is discussed in Section 3.3, and an assessment of survey methods and effort against guidelines is provided in Appendix B. Limitations of surveys are discussed in Section 3.4.3.

3.2.2 Flora survey

Flora surveys included vegetation mapping and targeted threatened flora searches. Vegetation within the airport site was surveyed with reference to the FBA (OEH 2014a, 2016) and appropriate threatened species survey guidelines (DEC 2004a)).

The flora survey involved the following techniques:

- vegetation surveys and mapping;
- plot-transect surveys;
- wetland surveys; and
- targeted threatened flora surveys.

Survey sites were selected using air photo interpretation and field habitat assessment. The locations of plot-transect surveys completed during the flora survey are displayed in Figure 4. A summary of survey effort is provided in Table 10 (Section 3.4.1) and the breakdown of survey effort between mapped vegetation zones is provided in Table 15 (Section 4.2.2). A detailed description of the methodology is provided below.

Vegetation surveys and mapping

A high level vegetation assessment and map were prepared by SMEC (2014) based on the regional mapping included in *Native Vegetation of the Cumberland Plain, Western Sydney* (NPWS 2006). This vegetation mapping was ground-truthed in the field via driven and walked transects across the entire survey area and by walking the boundary of vegetation units where possible. Properties that are identified as ‘access not obtained’ on Figure 3a were mapped using a combination of air photo interpretation and observations from adjoining land in the survey area.

Necessary adjustments were made with reference to a GPS tablet in the field. The site was divided into vegetation zones which represented a distinct vegetation type and broad condition class according to the FBA (OEH 2014a, 2016). This approach ensured that the classification of vegetation was consistent with the methodology for BioBanking assessments and major projects in NSW.

Vegetation types were classified according to vegetation structure, species composition, soil type and landscape position. Plot/transect data was compared with Tozer et al (2010) diagnostic species lists for equivalent vegetation map units to help confirm the identity of matching vegetation types (OEH 2014b). This approach is endorsed by the NSW OEH for confirming the identity of floristically similar vegetation types and is particularly relevant for identifying vegetation that may comprise a particular threatened ecological community (TEC) (Steenbeeke, G, OEH, pers. comm.).

Terrestrial vegetation types were further split into broad condition classes with reference to the FBA to yield vegetation zones as follows:

- 'High condition', comprising Moderate/good - high or Moderate/good – medium condition vegetation which featured over storey and mid storey vegetation at benchmark levels for the equivalent vegetation type (i.e. woodland or forest structure);
- 'Poor condition', comprising Moderate/good – poor condition vegetation which featured over storey and mid storey vegetation cover substantially below benchmark levels for the equivalent vegetation type but greater than 50% of the groundcover present was native species (i.e. derived native grassland, shrubland or scrub structure);
- exotic grassland, comprising Low or Cleared condition vegetation which was dominated by perennial plant species and featured over storey and mid storey vegetation cover substantially below benchmark levels for the expected native vegetation type and less than 50% of the groundcover present was native species (i.e. exotic grassland, shrubland or scrub structure); and
- cleared land and cropland, comprising Low or Cleared condition vegetation which was dominated by annual plant species, bare earth or infrastructure and featured over storey and mid storey vegetation cover substantially below benchmark levels for the expected native vegetation type and less than 50% of the groundcover present was native species or greater than 90% of the ground surface was bare earth or infrastructure.

Wetlands were mapped as a native vegetation zone if they featured greater than 10% cover of native plant species and/or habitat features such as standing dead trees, shallow marginal water or mudflats. Waterbodies that were free of native plants or habitat features such as steep sided clay lined dams, concrete lined dams or flooded quarry pits were included in the mapped area of 'Cleared land and cropland'. Some smaller wetlands were also included in the mapped area of woodland, forest or grassland if they could not be accurately separated and defined on an aerial photo.

Plot/transect surveys

Plot/transect surveys were conducted on the airport site with reference to the FBA to confirm vegetation types and assess site condition. The site value was determined by assessing ten biometric habitat attributes against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Cover abundance data was also collected for each species within the 20 metre x 20 metre portion of each plot/transect.

Plots were used to sample potential vegetation zones (i.e. vegetation types and broad condition classes) based on the initial site stratification. Forty-three plots were sampled within the airport site as shown on Figure 3.

Species richness and biometric plot/transect data was recorded on pro forma data sheets along with a description of the landscape position, soil type, geology and disturbance history for each vegetation zone.

Wetland surveys

Wetlands were not sampled using plot/transects because of the inherent safety risk. Wetland vegetation was sampled by walking the margins of waterbodies and noting dominant plant species and percentage cover in each vegetation strata present (i.e. trees, shrubs, emergent, aquatic and fringing plants). Wetlands were defined based on observed vegetation structure, species composition and whether they were natural or artificial as inferred from geomorphic positon and presence of features such as dam walls. No natural freshwater wetlands were observed at the airport site. Artificial wetlands were matched to the closest equivalent native vegetation type.

These data were recorded on pro forma data sheets along with a description of the landscape position, soil type, geology, habitat resources present and disturbance history for each wetland sampled.

Targeted threatened flora surveys

Threatened plant surveys were conducted throughout the survey area. The suite of threatened plants potentially present was identified based on the desktop assessment results (see Appendix A). Habitat for these species was identified based on OEH threatened species profiles and the experience and judgement of GHD ecologists. Much of the airport site contains highly modified landforms that are dominated by exotic species. These areas feature very little native plant cover, do not contain natural soil profiles or soil seed banks and could be readily discounted as containing any threatened plant species. Areas of potential threatened plant habitat (i.e. near-intact native vegetation and areas with natural topsoil) were systematically traversed on foot and inspected for threatened plants.

A supplementary threatened plant survey was conducted over one day in April 2016 targeting the general location of an unregistered *Marsdenia virdiflora* subsp. *viridflora* population (i.e. not included in the NSW Wildlife Atlas) that was mentioned in some submissions on the Draft EIS.

3.2.3 Fauna survey

Fauna surveys conducted at the airport site for this biodiversity assessment included detailed habitat assessments and targeted fauna searches. Survey locations are shown on Figure 3b to 3e.

Surveys included:

- four days and four nights of targeted frog surveys in March 2015;
- eleven days and six nights of targeted fauna surveys (diurnal and nocturnal) in March-May 2015; and
- two days of targeted winter bird surveys in May-June 2015.

Fauna surveys focussed on identifying threatened and migratory fauna species likely to be impacted by the proposed airport, and providing a quantitative assessment of habitat features that would be removed. Surveys were designed with reference to various survey guidelines (see Section 3.2.1). Targeted surveys included diurnal bird surveys, searches for the Cumberland Plain Land Snail (*Meridolum corneovirens*), spotlighting, call playback, infra-red camera surveys and Anabat surveys. Opportunistic observations were also recorded throughout the surveys.

Properties that are mapped as ‘access not obtained’ on Figure 3a were assessed using a combination of air photo interpretation and observations from adjoining land in the survey area.

A more detailed discussion of the field surveys undertaken for this biodiversity assessment is provided below.

Additional fauna and habitat surveys were conducted from the 23 to the 25 of March 2015 as a component of the *Preliminary Bird and Bat Strike Risk Assessment* included as Appendix I of the EIS. These comprised the following:

- surveys for birds and Grey-headed Flying Foxes and habitats on the airport site by vehicle (using binoculars) along a set route of publicly accessible roads across three periods; morning, midday and afternoon. The purpose of the surveys was to record species presence, species numbers and attractive habitats within the airport site and to gather information on the movement of bird and bat populations to, from and over the site; and

- an inspection of key bird and bat attracting habitats accessible for survey within a 25 kilometre radius from the airport site centre point, including landfills, waste transfer stations, nature refuges, golf courses, known Australian White Ibis colonies (Ecosure 2009), and flying-fox camps (DoE, 2015g). At each site bird and/or bat species, number of individuals and behaviour were recorded.

Further detail on the methods and results of the fauna and habitat surveys conducted to assist with the preliminary assessment of bird and bat strike risk are provided in Appendix I of the EIS. The results of these surveys have been considered in this assessment.

Fauna habitat assessment

Habitat assessments were conducted to help describe the suite of native fauna likely to occur at the airport site. Particular attention was paid to habitat features and resources considered important for threatened species.

Habitat assessments included identification and assessment of:

- vegetation patch size, connectivity, age, disturbance and floristic and structural diversity (important for determining habitat suitability for many threatened birds and mammals);
- quality of substrate to provide foraging habitat and shelter for Cumberland Plain Land Snails, frogs, reptiles and ground-foraging birds, including rocks, logs, peeling bark, leaf litter and native grassland;
- presence of winter-flowering eucalypts (important for the Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) and food trees of the Koala (*Phascolarctos cinereus*) and Glossy Black-cockatoo (*Calyptorhynchus lathami*);
- hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species;
- stags and other roost sites for raptors and owls; and
- wetlands, water courses and moist grassland and other foraging or breeding habitat for waterbirds (including migratory birds), frogs, reptiles and mammals.

Evidence of animal presence was noted during the time spent on site, including specific searches for:

- mammal scats at the base of trees or along tracks and runways;
- tracks in soft substrate;
- nest/den sites within logs, tree bases or tree trunks;
- guano or moth remains at the base of hollow-bearing trees (diagnostic of the presence of tree-roosting bats);
- scratches on tree trunks (potential evidence of Koalas, gliders or goannas) and worn bark around tree hollows (diagnostic of active use of hollows); and
- owl pellets, whitewash or animal remains beneath trees (diagnostic of owl or raptor roosts).

Locations of important habitat features were captured with a handheld global positioning system (GPS) unit or a tablet.

Mapping of hollow-bearing trees was undertaken to provide an indication of the distribution and number of hollow-bearing trees as well as sizes of hollows that would be removed for the proposed airport. Given the large area of the airport site and access constraints at the time of surveys, detailed mapping was not undertaken throughout the entire site. Data collected included tree species, height, diameter at breast height, and number, size and location of hollows.

Diurnal Bird surveys

Diurnal bird surveys comprised the following methods:

- Area Searches
  - Area searches targeting all bird species were performed in the early morning within the airport site on ten mornings in March and April 2015. Surveys were conducted in two locations by either one or two ecologists each morning. A total of 13 sites were surveyed in early morning surveys. Most sites were visited once only, however a number of sites were surveyed on two occasions. Surveys comprised area searches of at least one hour duration targeting larger woodland patches and wetland areas. Grassland areas were also surveyed while moving between woodland patches or dams. Species were identified by sight and call. Incidental observations of all birds were also recorded throughout the day during general surveys.
  - Area searches targeting the Swift Parrot (*Lathamus discolor*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*) but also noting other species encountered, were carried out in many woodland patches in the mornings and afternoons of 21 May and 9 June 2015. The Swift Parrot occurs in western Sydney in winter months, foraging on winter-flowing eucalypts and lerps. Surveys were conducted with regard to the survey guidelines for the Swift Parrot included in DEWHA (2010b) and the bird survey guidelines contained in DEC (2004a). In addition, opportunistic surveys were carried out from 5 to 8 May 2015 for these species. Information on timing of the arrival of Swift Parrots in NSW was gained from Birdline NSW (2015). The first record of the species in NSW via this resource was on 28 April 2015 near Corowa. Sightings of the species in western Sydney were reported on various occasions from 14 May 2015 (Birdline NSW 2015).
- Wetland bird surveys
  - Dams were targeted during early morning bird surveys as well as general fauna surveys throughout the day. Surveys included scanning the water body, muddy edges and emergent vegetation with binoculars.
- Driven transects
  - Slow driven transects were conducted on 21 May and 9 June 2015 to target Swift Parrots and Gang-gang Cockatoos, with other birds also noted. This method combined with targeted area searches ensured as much of the airport site was covered as possible over these dates when these species were likely to be in the locality.

Microchiropteran bat surveys

Microbat ultrasonic echolocation call recordings (Anabat surveys) were undertaken using two Anabat units over ten nights and one unit on one additional night (totalling 21 Anabat unit nights). Of these, seven nights (14 Anabat unit nights) were in March (within the preferred survey season for Anabat surveys) and the remainder were in April and May. Anabats were placed at a total of twelve locations in the airport site. In most locations, Anabat units were left for two nights. In some instances, access or timing constraints meant that Anabat units were left at a location for only one night. Fixed recordings were undertaken from dusk until the following morning. Locations of survey sites are provided on Figure 3. A total of 206.5 hours from 19 nights of recording (all sites combined) was completed.

Calls were identified using zero-crossing analysis and AnalookW software (version 4.1t, Chris Corben 2015) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from published guidelines. *The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay et al 2011; Churchill 2008; van Dyck and Strahan 2008) and records from the Atlas of NSW Wildlife (OEH 2015a). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of four or more consecutive pulses of similar frequency. Calls with less than four defined pulses were excluded from the analysis. Due to variability in the quality of calls and the difficulty in distinguishing some species, the identification of each call was assigned a confidence rating (see Mills et al 1996 and Duffy et al 2000) as summarised in Table 2. Due to the absence of reference calls from the airport site, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Table 2 Confidence ratings applied to bat calls

Species Identification	Description
D - Definite	Species identification not in doubt.
P - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
Po – Possible (Species Group)	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. *Chalinolobus gouldii / Mormopterus* spp. *Nyctophilus* spp. The calls of *Nyctophilus geoffroyi* and *N. gouldi* cannot be distinguished during the analysis process and are therefore lumped together. *Scotorepens orion/Scoteanax rueppellii/Falsistrellus tasmaniensis.*

Targeted frog surveys

Targeted surveys for the Green and Golden Bell Frog (*Litoria aurea)* were conducted over four nights in March. Surveys were carried out with regard to the significant impact guidelines for this species (DEWHA 2009a) and the Commonwealth survey guidelines for threatened frogs (DEWHA 2010a). The referral guidelines recommend an initial habitat assessment followed by at least four nights of surveys between September and March, during warm and windless weather conditions following rainfall. Surveys of about an hour are recommended for wetlands up to 50 metres in width. Where possible, surveys should include use of a nearby reference site (DEWHA 2009a). The survey guidelines for threatened frogs further recommend surveys be undertaken within one week of heavy rainfall (i.e. greater than 50 mm in seven days) between October and February.

The Green and Golden Bell Frog population at Homebush was used as a reference population for the survey. This site was visited once each week prior to and during the survey at the airport site to determine the level of frog activity and confirm that conditions were likely to be suitable for the detection of the targeted species if present. Surveys at the airport site were conducted in early March, in warm and windless conditions. Surveys were not possible in February (when there were many days of heavy rain) due to property access constraints. Heavy rain fell on the afternoon of survey night 2, and for some survey dates, rainfall of about 28 mm was recorded over the previous week (see Table 3). Other frog species were calling and were active during surveys at the airport site, suggesting that if Green and Golden Bell Frogs were present, they would also be active. Green and Golden Bell Frogs were active (but not calling) at the reference site at these times.

A summary of weather conditions and observed frog activity during surveys is provided in Table 3.

Table 3 Weather conditions during targeted frog surveys

Survey	Date	Temperature		Rainfall in preceding 24 hours (mm)	Rainfall in preceding 7 days (mm)	Conditions during survey	Frog activity during survey
		(min.)	(max.)				
Reference site night 1	6/3/15	13.4	30.7	0.0	20.4	Warm and windless	Frogs calling and active
Airport site survey night 1	11/3/15	17.8	30.6	0.0	0.0	Warm and windless	Frogs calling and active
Reference site night 2	*11/3/15*	*20.1*	*30.1*	*0.0*	*0.0*	*Warm and windless*	*Green and Golden Bell Frogs active.*
Airport site survey night 2	12/3/15	17.4	28.4	28.6	28.6	Warm and windless	Frogs calling and active
Airport site survey night 3	18/3/15	15.2	30.3	0.0	28.6	Warm and windless	Frogs calling and active
Reference site night 3	*18/3/15*	*17.3*	*30.3*	*0.0*	*14.6*	*Warm and windless*	*Green and Golden Bell Frogs active.*
Airport site survey night 4	19/3/15	15.0	32.0	0.0	0.0	Warm and windless	Frogs calling and active

Note: Airport site weather data from Badgerys Creek weather station (067108) and reference site weather data from the Sydney Olympic Park weather station (66212) (BOM 2015a).

Frog surveys targeted farm dams, creeks and other water bodies which were identified during the initial one-day site inspection, by aerial photograph inspection, desktop review and during field surveys. Given the size of the airport site, targeted surveys of one hour were carried out at sites with better quality habitat, while rapid surveys were conducted at others. These are described further below. Targeted surveys were carried out each night at four of the sites, while other sites were visited once only during surveys to enable a greater coverage of the airport site.

Frog surveys were undertaken with reference to DECC (2008d) hygiene protocols. Measures adopted comprised sterilising boots between survey sites to prevent transfer or introduction of chytrid fungus, and avoiding the use of suncream and insect repellent on hands.

Frog surveys included the following methods:

- Targeted surveys
  - Diurnal inspections of selected dams were conducted in the afternoons prior to nocturnal surveys on the four nights. Searches for basking frogs and call playback were undertaken at these dams. Scans for basking frogs were also conducted at dams during general fauna surveys in late March and early April. Notes at each water body were taken, and included size, geomorphology, presence of habitat features and structure, type and species composition of wetland and aquatic vegetation.
  - Active nocturnal searches for frogs were performed for a minimum of one hour at each survey site focussing on areas of suitable habitat. Creek banks and dam edges were

systematically searched and aquatic vegetation was visually scanned using spotlights. Call playback and vocalisations imitating the call of the Green and Golden Bell Frog were broadcast at each targeted survey site, comprising a minimum of five minutes calling followed by a ten minute listening period. For larger dams, calls were broadcast at a number of locations around the dam edges. Frogs were identified by sight and call.

- Rapid surveys
  - Call playback and vocalisations imitating the call of the Green and Golden Bell Frog were broadcast at each rapid survey site, comprising a minimum of five minutes calling followed by a ten minute listening period. All frogs heard calling were recorded. Some rapid surveys were able to be completed in properties that are mapped as 'access not obtained' on Figure 3a because wetland habitat could be seen and frogs could be heard calling from adjoining land in the survey area.

Nocturnal bird and mammal surveys

Nocturnal bird and mammal surveys comprised the following:

- Call playback

Call playback was undertaken on a total of nine nights at the airport site. Calls of the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), and Masked Owl (*Tyto novaehollandiae*) were broadcast in woodland areas. Calls were broadcast through a 15 watt megaphone for a minute each with gaps of about a minute between the call of each species. Calls were then repeated. A quiet listening period of ten minutes was held prior to and following call playback. Potential roost sites were scanned with a spotlight.

- Spotlighting

Spotlighting targeting nocturnal birds and mammals was conducted over nine nights at the airport site. Spotlighting was undertaken by three ecologists using 210 lumens P14 Led Lenser torches. Each survey lasted between 1-2 hours. Surveys were carried out along road reserves and in larger woodland patches. Spotlighting for frogs was conducted separately as part of the targeted frog surveys described above, although any frogs heard or observed during other spotlighting surveys were recorded. Similarly, any nocturnal mammals and birds heard or observed during the targeted frog surveys were recorded.

Infra-red camera surveys

Two infra-red cameras were placed at four separate locations in woodland or near dams in the airport site to target cryptic species. Cameras were baited with a mixture of chicken wings and tinned sardines. Cameras were left set for a minimum of three weeks. Cameras were set to take three pictures over one minute when triggered by movement, with at least five minutes between each set of photographs.

Cumberland Plain Land Snail searches

Targeted searches for Cumberland Plain Land Snails were carried out in larger patches of vegetation (where possible with regard to access constraints) and along road reserves in the airport site. Active searches were conducted in leaf litter at the base of trees and under rubbish and logs. Searches were conducted for between half an hour to an hour in woodland patches, depending on the size of the patch. Live snails were photographed, and empty shells were collected and sent to the Australian Museum for identification and confirmation. GPS waypoints were collected for search areas, and for any snails recorded.

Koala scat searches

Targeted Koala scat searches were conducted in conjunction with the searches for the Cumberland Plain Land Snail, as both scats and snails occur in leaf litter at the base of trees. Scat searches focussed on Forest Red Gum (*Eucalyptus tereticornis*), a primary food tree in the Sydney area (DECC 2008c), and Grey Box (*Eucalyptus moluccana*), a secondary food tree in the Sydney area (DECC 2008c). Searches were conducted for between half an hour to an hour in woodland patches, depending on the size of the patch.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during the field survey. Scats, burrows and diggings were noted and mature trees (ie trees between 20 to 80 per cent of their life expectancy, rather than saplings) were scanned for roosting birds.

3.2.4 Rapid assessments

Supplementary 'rapid assessments' were conducted between March and December 2015 and in April 2016. The purpose of these supplementary surveys was to help avoid or mitigate impacts on biodiversity values arising from geotechnical or European cultural heritage investigations at the airport site, to assess impacts of proposed infrastructure on land adjoining the airport site, to identify sensitive receptors for potential downstream impacts and to help address limitations of the initial survey.

Rapid assessments comprised a combination of the following survey techniques as relevant to the site features at each location:

- visual inspection of the investigation area and assessment of vegetation type and condition patch size, connectivity, age, disturbance and floristic and structural diversity;
- assessment of the conservation significance of vegetation with reference to the identification and condition criteria for listed TECs;
- assessment of the presence and quality of fauna habitat resources such as shelter substrate for Cumberland Plain Land Snails, hollow-bearing trees and logs, stags and roost sites, wetlands and water courses;
- active searches for resident fauna in areas of suitable habitat including checking of shelter substrate for Cumberland Plain Land Snails; and
- targeted searches for threatened plants.

The investigation areas for rapid assessments are indicated on Figure 3a and comprised:

- the area potentially subject to impacts from geotechnical investigations at 103 test pit or bore hole locations each around 200m^2, two ripping trial locations each around two hectares in area and associated access tracks;
- the area for European cultural heritage investigations comprising four grave cut locations each around one to two hectares in area and associated temporary access tracks; and
- the location for High Intensity Approach Lighting (HIAL) on land adjoining the airport site.

The results of the rapid assessments were used to refine and update the biodiversity assessment, particularly in portions of the survey area that could not be accessed during the initial targeted survey period. This process included fine scale adjustments to the vegetation zone and TEC mapping. Downstream rapid assessment sites are shown in Figure 3f. These include representative sites in the South Creek, Badgerys Creek, Duncans Creek and Cosgrove Creek catchments downstream of the airport site. The results of the downstream rapid assessments built on the results of the downstream aquatic surveys and were used to identify sensitive receptors for potential downstream impacts arising from the proposed airport and to help assess the likely magnitude of impacts.

3.3 Field surveys: Aquatic Biodiversity

3.3.1 Overview

An aquatic survey was carried out from 13 to 16 March 2015 (inclusive) covering 12 sites located at upstream and downstream locations on waterways that traverse the airport site. A second survey was carried out on 20 May 2015 and covered locations within the airport site as well as an upstream control site not able to be sampled in the first survey due to access constraints. Aquatic survey sites are indicated on Figure 3e. Survey site locations are provided in Table 4.

At each survey site a detailed habitat assessment was undertaken to determine the existing environment and to assess the potential presence of native aquatic flora and fauna, including species and or communities listed as threatened under the EPBC Act or FM Act.

Sampling was undertaken of stream habitat and at two representative farm dams, as the latter are a dominant feature of the waterbodies in the study area. A general description of habitats, including macrophytes and riparian vegetation, was made using the NSW AUSRIVAS Habitat Assessment protocols. Water quality was assessed using *in situ* measurements and grab samples were tested for nutrients. Sampling targeted fish and macroinvertebrate fauna.

Table 4 Aquatic survey site locations

Site Code	Location	Latitude	Longitude	Date sampled
BCUS	Badgerys Creek upstream	-33.91463	150.70589	14/03/2015
BCMC	Badgerys Creek mid-catchment	-33.89892	150.73856	13/03/2015
BCDS	Badgerys Creek downstream	-33.87381	150.75488	13/03/2015
SCUS	South Creek upstream	-33.87575	150.76785	13/03/2015
SCDS	South Creek downstream	-33.83548	150.76577	
SCREC	South Creek Recovery	-33.80503	150.76668	15/03/2015
OCUS	Oaky Creek upstream	-33.88443	150.722935	28/05/2015
OCDS	Oaky Creek downstream	-33.86935	150.72107	15/03/2015
CCUS	Cosgrove Creek upstream	-33.86897	150.71779	15/03/2015
CCDS	Cosgrove Creek downstream	-33.83435	150.75961	
TCUS	Thompson Creek upstream	-33.93454	150.72919	13/03/2015
DCDS	Duncans Creek downstream	-33.90046	150.70448	16/03/2015
DCUS	Duncans Creek upstream	-33.89971	150.67655	28/05/2015
OCDAM	Oaky Creek Dam	-33.88338	150.72171	28/05/2015
OSDAM	On Site Dam	-33.88896	150.72912	28/05/2015

3.3.1 Aquatic habitat assessment

An assessment of the in-stream physical habitat was conducted at all survey sites based on the NSW AUSRIVAS habitat assessment sheet. This also included a reference site assessment. This entailed detailed assessments of the substrata and water channel and an on-site assessment of hydraulic habitat features and suitability for threatened taxa identified from the database and literature searches.

3.3.2 Water quality

Water quality sampling was conducted in accordance with the National Association of Testing Authorities (NATA) certification standards at all sites. A calibrated YSI 600 QS MSP water quality meter was used to record in-situ parameters, while alkalinity was obtained through the use of field titration kits. These in-situ parameters were compared to the ANZECC & ARMCANZ (2000) guidelines and the *Airports (Environment Protection) Regulations 1997* (AEPR) trigger values to determine which sites were outside of the recommended ranges. Additional water quality grab samples were collected for confirmation of conductivity and to test for metals, nutrients, BTEX (benzene, toluene, ethylbenzene and xylenes), additional hydrocarbons and other constituents.

3.3.3 Macroinvertebrate sampling and analysis

Macroinvertebrates were sampled in accordance with the NSW AUSRIVAS sampling protocols (Turak et al 2004). Representative macroinvertebrate samples were collected from edge, pool bed and riffle areas where adequate habitat was present to ensure the best chance of capturing the full range of taxa likely to be present at each site. Samples were predominantly collected in pool and edge habitats given an absence of riffle habitat at most sites (Table 5). Samples were not collected at two sites due to very low volumes of surface water and limited habitat (DCUS) and unsafe access (DCDS).

Table 5 Summary of the habitat sampled for macroinvertebrates at each aquatic survey site

Site	Edge	Pool	Riffle
BCUS	✓	-	-
BCMC	✓	-	-
BCDS	✓	✓	-
SCUS	✓	✓	-
SCDS	✓	-	-
SCREC	✓	✓	✓
OCUS	✓	-	-
OCDS	✓	-	-
CCUS	✓	-	-
CCDS	✓	-	-
TCUS	✓	✓	-
DCDS	-	-	-
DCUS	-	-	-
OCDAM	✓	✓	-
OSDAM	✓	✓	-

Samples were collected using a framed net (350 millimetres wide) with 250 micrometre mesh size. The nets and all other associated equipment were washed thoroughly between sampling sites to remove macroinvertebrates. Samples were collected by sweeping the collection net along the edge habitat at the sampling site. The operator worked systematically over three 10-metre sections covering overhanging vegetation, submerged snags, macrophyte beds, overhanging banks and areas with trailing vegetation.

Samples were then live picked, following the methodology of Turak et al (2004). The collected material from each 10 metre section was placed into a sorting tray and the macroinvertebrates were picked for a minimum of 40 minutes. If new taxa were found between 30 and 40 minutes, sorting was continued for a further 10 minutes. If no new taxa were found, after an additional 10 minute period, then this process ceased. If new taxa were found, this process continued up to a maximum of one hour.

Following collection and sorting of macroinvertebrates, the results were entered into the NSW AUSRIVAS model. AUSRIVAS is a predictive model based on standardised sampling protocols that uses macroinvertebrate communities to assess the biological health of rivers and streams. Specifically, the model uses site-specific information to predict the macroinvertebrate fauna expected (E) to be present in the absence of environmental stressors. The expected fauna from sites with similar sets of predictor variables (physical and chemical characteristics which cannot be influenced due to human activities, e.g. altitude) are then compared to the observed fauna (O). A ratio between the expected and observed fauna values is derived to indicate the extent of any impact (referred to below as the 'O/E ratio'). The ratio derived from this analysis is compiled into bandwidths (i.e. X, A-D) which are used to indicate the overall health of a particular site using the classification shown in Table 6. Data are presented using the AUSRIVAS O/E 50 ratio (Observed/Expected score for taxa with a >50% probability of occurrence) and the previously mentioned rating Bands (Table 6).

Table 6 AUSRIVAS Band widths and interpretations for the NSW autumn edge and riffle models

Band	RIFFLE O/E Band width	EDGE O/E Band width	Explanation
X	>1.13	>1.17	More diverse than expected. Potential enrichment or naturally biologically rich.
A	0.84-1.13	0.81-1.17	Similar to reference. Water quality and / or habitat in good condition.
B	0.6-0.84	0.46-0.81	Significantly impaired. Water quality and/ or habitat potentially impacted resulting in loss of taxa.
C	0.34-0.6	0.11-0.46	Severely impaired. Water quality and/or habitat compromised significantly, resulting in a loss of biodiversity.
D	0-0.34	0-0.11	Extremely impaired. Highly degraded. Water and /or habitat quality is very low and very few of the expected taxa remain.

The Stream Invertebrate Grade Number – Average Level (SIGNAL 2) biotic index (Chessman, 2003) was also used to determine the ecological quality of sampling sites. This method assigns a score between 1 (most tolerant) and 10 (most sensitive) to each macroinvertebrate family. The SIGNAL index is then calculated as the average grade number for all families present in the sample. The resulting index score can then be interpreted using the following guidelines (source: Gooderham and Tsyrlin 2005):

- SIGNAL > 6 = Healthy habitat;
- SIGNAL 5-6 = Mild pollution;
- SIGNAL 4-5 = Moderate pollution; and
- SIGNAL < 4 = Severe pollution.

A useful and commonly used method to interpret SIGNAL 2 scores is to plot the SIGNAL 2 scores against the number of families collected at a given site. The plotting region is divided into four quadrants, which can be interpreted as:

- Quadrant 1 – indicates favourable habitat and chemically dilute water;
- Quadrant 2 – indicates high salinity or nutrient levels – these may be natural;
- Quadrant 3 – indicates toxic pollution, harsh physical conditions or inadequate sampling; and
- Quadrant 4 – indicates urban, industrial or agricultural pollution, or can indicate downstream effects of dams

Selecting the boundaries in the scatterplot requires consideration of the local geography, land use and sampling method. If reference sites are used in the study design, the boundaries can be set so that these sites all fall within Quadrant 1. However, in the current study design, reference sites were not included, so the taxa richness boundary was chosen as the median number of taxa collected during this sampling period (11) while the SIGNAL 2 boundary was chosen as the lower limit for the mild pollution category (SIGNAL 2 score of 5).

In addition to the AUSRIVAS and SIGNAL score assessments, simple biological metrics were also used as descriptors of each survey site. The metrics used in this assessment were:

- taxa richness;
- Ephemeroptera-Plecoptera-Trichoptera (EPT) richness; and
- a description of the community composition at each site.

Taxa Richness

The number of taxa (taxa richness) was counted for each site and other descriptive measures such as the number of pollution-sensitive taxa (Ephemeroptera, Plecoptera and Trichoptera – EPT) were examined at the family levels. Taxa richness refers to the number of different taxa contained in the sample. Unlike some biological indices a higher number does not always indicate better in-stream conditions. In some cases, higher values of this metric may indicate favourable conditions in terms of availability of food and/or the quality of habitat. However, high richness values can also occur when altered conditions provide habitats or additional resources that may not occur naturally (e.g. additional food supply due to increased nutrient levels).

Ephemeroptera-Plecoptera-Trichoptera (EPT) Richness

EPT is a widely used index based on the number of families within the Ephemeroptera, Plecoptera and Trichoptera orders to assess stream condition. These three orders have been identified as being intolerant to pollution and their use as indicators of disturbance has also been tested in NSW.

Community Composition

Total invertebrate abundance and the number of taxa and dominant taxa were calculated as percent composition of the overall total as well as on a site by site basis. Special consideration has been given to the Odonata because of the possible, albeit unlikely, occurrence of larvae of two dragonfly species listed as threatened under the FM Act:

- Adam’s Emerald Dragonfly (*Archaeophya adamsi*); and
- Sydney Hawk Dragonfly (*Austrocordulia leonardi*).

Laboratory Identification

Macroinvertebrate specimens were identified to family level where possible using the latest taxonomic keys. A total of 15 macroinvertebrate samples were analysed with the resulting samples stored in site specific vials for retention by GHD for internal quality assurance procedures.

Given the particular interest in assessing whether Adam's Emerald Dragonfly or Sydney Hawk Dragonfly were present at the survey sites, all Odonates were identified to species level where possible.

Macroinvertebrate Quality Control

A number of quality control procedures were undertaken during the identification phase of this programme, including:

- organisms that were heavily damaged were not selected during sorting. To overcome losses associated with damage to intact organisms during vial transfer; attempts were made to obtain significantly more than 200 organisms;
- identification was performed by qualified and experienced aquatic biologists with more than 100 hours of identification experience;
- reference collections were also used where necessary;
- NSW AUSRIVAS QA/QC protocols were followed;
- an additional 5% of samples were re-identified by another senior taxonomist and these QA/QC results are presented in Appendix B; and
- very small, immature, damaged animals or pupae that could not be positively identified were not included in the dataset.

3.3.4 Fish surveys

Electrofishing was to be undertaken at each site to identify and describe the composition of the fish communities residing within the waterways of the footprint area. This method was chosen initially because it is non-lethal, repeatable, is not size or species specific and does not require extended time at each site through waiting until soak times for nets and traps have been completed. However, this sampling method does not work in high electrical conductivity waters and these were encountered at all but one site surveyed in March and May 2015. Hence, alternative fish sampling (fyke netting and bait trapping) was carried out.

At each site where the waterway could be fully accessed, one dual wing fyke net (1.2m x 0.8m opening, 6mm mesh, 10m wings) and five bait traps were set for a period of between 3 and 4 hours per site. Both fyke nets and bait traps were able to be deployed at a majority of sites as shown in Table 7. Fish sampling was not undertaken at one site (DCUS) where there was no safe access to the water.

Table 7 Fish survey method used at each site

Site	Electrofishing	Fyke Net	Bait Traps
BCUS	-	-	✓
BCMC	-	-	-
BCDS	-	✓	✓
SCUS	-	✓	✓
SCDS	-	✓	✓
SCREC	-	✓	✓
OCUS	-	✓	✓
OCDS	-	-	✓
CCUS	-	-	✓
CCDS	-	-	✓
TCUS	-	-	✓
DCDS	-	-	✓
DCUS	-	-	-
OCDAM	-	✓	✓
OSDAM	-	✓	✓

Fish captured were identified to species level using appropriate keys (Allen et al 2002). Native species were returned to the waterway unharmed, while non-native species were euthanized in accordance with ethics permit requirements.

The sensitivity of key fish habitat and the functionality of the waterways at the airport site was classified according to the *Policy and guidelines for fish habitat conservation and management* (DPI 2013) as indicated in Table 8 and Table 9. Aquatic habitat was also compared with known habitat requirements of threatened aquatic fauna known to occur in the region according to Department of Primary Industries threatened species profiles (DPI 2015a).

Table 8 Key fish habitat and associated sensitivity scheme (DPI 2013)

Key Fish Habitat Type	Description
Type 1 - highly sensitive fish habitat	Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants. Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act. SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia.
Type 2 - moderately sensitive key fish habitat	Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1. Weir pools and dams up to full supply level where the weir or dam is across a natural waterway.
Type 3 - minimally sensitive key fish habitat	Coastal and freshwater habitats not included in TYPES 1 or 2. Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation.
Not key fish habitat	First and second order streams on gaining streams (based on the Strahler method of stream ordering). Farm dams on first and second order streams or unmapped gullies.

Table 9 Classification of waterways for fish passage (DPI 2013).

Fish Habitat Classification	Characteristics of Waterway Type
Class 1 Major key fish habitat	Permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.
Class 2 Moderate key fish habitat	Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi - permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
Class 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi - permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.
Class 4 Unlikely key fish habitat	Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools after rain events (e.g. dry gullies or shallow floodplain depressions with no permanent aquatic flora present).

3.4 Survey effort, timing, limitations and staff

3.4.1 Survey stratification, effort and timing

Field survey methods and effort were designed with reference to the Commonwealth survey guidelines for threatened species listed under the EPBC Act (DEWHA 2010a, b, c, d), the NSW draft Threatened Species Survey Guidelines (DEC 2004a), and any relevant survey and habitat information in recovery plans and environmental impacts assessment guidelines for relevant threatened species (see Section 3.2.1 and the references provided in Section 11). A summary of survey effort is provided in Table 10 and a detailed assessment of survey effort against the guidelines is provided in Appendix B.

Table 10 Survey effort and timing

Survey focus	Dates	Survey method	Effort
Initial survey	13/02/2015	Site familiarisation	1 day
Targeted frog surveys	11-12/03/2015 18-19/03/2015	Diurnal inspections of dams for basking frogs	4 afternoons
		Targeted surveys of dams for frogs, call playback	4 nights
		Rapid aural surveys, call playback	4 nights
Vegetation mapping and threatened flora surveys	Feb-May 2015	BioBanking plot/transect surveys	43 plot/transects
		Targeted flora searches	18 days
		Wetland assessments	7 sites

Survey focus	Dates	Survey method	Effort
	April 2016	Targeted flora searches	1 day
Fauna surveys	Feb-May 2015	Habitat assessment	18 days
		Diurnal bird surveys	16 days
		Early morning bird surveys	10 mornings (2-3 people for 1-2 hours on each morning) – 13 sites visited at least once
		Microchiropteran bat surveys (Anabat)	21 Anabat unit nights over 12 locations
		Targeted frog surveys	2 people for 4 afternoons and nights (80 person hours)
		Spotlighting (birds and mammals)	3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours)
		Call playback (owls)	9 nights (0.25 hour per night, followed by spotlighting survey of 1 hour)
		Infra-red cameras	2 cameras, each at two locations for 4 weeks each
		Active searches for the Cumberland Plain Land Snail, other ground fauna and scats	11 days (35 sites, about 25 person hours)
		Koala scat searches	11 days (35 sites, about 25 person hours)
		Opportunistic observations	18 days
	May and June, 2015	Winter bird surveys	2 people for 2 days
Aquatic surveys	March and May, 2015	Aquatic habitat assessment Macroinvertebrate sampling Fish surveys Water quality sampling	2 people for 5 days (sampling at 12 sites, of which 6 were in the airport site)

Survey focus	Dates	Survey method	Effort
Stage 1 geotechnical investigation locations	April and May 2015	Rapid assessment	47 sites over 4 days
European cultural heritage investigation locations	November 2015	Rapid assessment	4 sites over one day
Stage 2 geotechnical investigation locations	October and November 2015	Rapid assessment	56 sites over 6 days
High Intensity Approach Lighting (HIAL) sites	April 2016	Rapid assessment	½ day
Downstream surveys	April 2016	Downstream rapid assessments	1 day

Targeted surveys at the airport site were stratified between vegetation and habitat types as required by the NSW draft Threatened Species Survey Guidelines (DEC 2004a). Stratification is necessary to ensure that the full range of potential habitats and vegetation types are systematically sampled. The survey area should be initially stratified on biophysical attributes (e.g. landform, geology, elevation, slope, soil type, aspect), followed by vegetation structure (e.g. forest, woodland, shrubland), and then floristics (e.g. species) (DEC 2004a).

The airport site has relatively uniform biophysical attributes, comprising either rolling low hills on shale substrate or riparian corridors on alluvium. These units were further split based on vegetation structure to yield four broad habitat types which comprised the stratification units for the field survey as follows:

- woodland, comprising grassy eucalypt woodlands on rolling hills and flats on shale or shale-gravel substrate;
- riparian forest, comprising grassy eucalypt forest or closed woodlands on flats on alluvial substrate;
- grassland, comprising native and exotic grassland in a variety of geomorphic positions; and
- wetland, comprising freshwater wetlands and farm dams in a variety of geomorphic positions.

Survey stratification units are mapped on

Figure 3. Cleared land and cropland is also shown, which comprises extensively modified land with minimal native vegetation cover or habitat resources. Cleared land and cropland was not sampled with targeted survey techniques but was sampled by broad survey techniques such as vegetation mapping and habitat assessments as well as opportunistic fauna observations.

Targeted fauna survey techniques were purposefully split between these stratification units based on the total area of each habitat type at the airport site and the likelihood of the targeted species occurring in each habitat type. The survey effort that was conducted in each stratification unit is summarised in Table 11.

Vegetation plot/transects were further stratified between individual vegetation zones based on floristics and condition. The split of plot/transects between vegetation zones is summarised in Table 11.

Aquatic survey sites were stratified to survey major streams that cross or rise within the airport site as well as South Creek and two dam sites. For each stream, survey sites included sites upstream and downstream of the airport site to provide control and impact sites.

Table 11 Survey site stratification according to habitat type

	Woodland	Riparian forest	Grassland	Wetland
Total Area of habitat type within the airport site (hectares)	**160.8**	**92.3**	**1137.3**	**35.4**
Survey technique and number of survey sites				
Active searches	28	7		
Anabat recording (sites)	4	2	1	5
Call playback	6	3		
Camera trap	3	1		
Diurnal bird surveys (sites)	8	4		4
Plot/transect	23	9	11	
Rapid frog survey		1		15
Targeted frog surveys				11
Spotlighting	4	5		
Wetland assessments				7
Winter bird surveys	16	7		

The site stratification and survey effort should be considered along with the following considerations and qualifications:

- the point location for targeted fauna surveys shown on Figure 3 indicates the starting point for a survey that sampled a broader area, including:
  - active searches within the entire patch of treed vegetation surrounding the point over at least one hour;

- diurnal bird surveys and winter bird surveys over around one hectare of treed vegetation, one kilometre of edge habitat or an entire wetland over at least one hour; and
- targeted frog surveys around the margins of an entire wetland for at least one hour.

- call playback events were stratified between woodland and riparian forest in order to increase the variety of locations and habitat features sampled. However the airport site was considered a single 'site' for the purposes of calculating the total number of nights of survey effort. This is based on the fact that calls broadcast with a 100W megaphone may be heard at least a kilometre away (DEC 2004a) and that the home ranges of threatened forest owls typically range from 500 to over 1000 hectares (DEC 2006a). The nine nights of call playback performed at the airport site is sufficient to achieve a 90% chance of detection of each of the forest owl species that were targeted (DEC 2004a);
- anabat recording, bird surveys and spotlighting events that were mainly focussed on woodland or riparian forest also sampled adjoining areas of grassland and nearby dams. Similarly, sampling focussed on dams also sampled adjacent woodland and grassland areas;
- early morning bird surveys were conducted at the same location on different days on some occasions, thus the survey effort identified on Figure 3 and in Table 11 is an underestimate of the total number of times the different stratification units were visited; and
- habitat assessments, targeted searches for threatened plants and opportunistic fauna observations were performed in all native vegetation at the airport site during all time spent on site.

3.4.2 Weather conditions

Terrestrial field surveys

Weather conditions were generally conducive for field surveys and the detection of fauna and flora. Frog survey conditions have been discussed in Section 3.2.3. Weather was generally sunny and mild to warm during the biodiversity surveys. Rain fell on seven days during the biodiversity surveys, but most days were dry. Rainfall was well above average across the Sydney region during summer and autumn. Badgerys Creek had a new rainfall record of 83.6 millimetres in one day in late April. Minimum temperatures were above average across the city during summer and autumn and nights were particularly warm in early May (BOM 2015b). These conditions were generally suitable for the detection of the species likely to occur at the airport site. Plants were generally healthy and not dormant and most species had above ground vegetation, flowers and/or fruit that permitted positive identification to the species level. Fauna species were active and calling.

Weather details for the Badgerys Creek weather station (BOM 2015a) during the survey period are summarised in Table 12.

Table 12 Weather conditions during terrestrial surveys

Survey	Date	Temperature (°C)		Rainfall (millimetres)
		(min.)	(max.)	
Initial survey	13/02/2015	18.9	26.7	7.6
Frog surveys	11/03/15	17.8	30.6	0
Frog surveys	12/03/15	17.4	28.4	28.6
Frog surveys	18/03/15	15.2	30.3	0
Frog surveys	19/03/15	15.0	32.0	0
Terrestrial biodiversity surveys	24/03/15	17.1	24.7	0
Terrestrial biodiversity surveys	25/03/15	11.8	24.4	10.8
Terrestrial biodiversity surveys	26/03/15	13.4	28.1	0
Terrestrial biodiversity surveys	27/03/15	8.2	26.7	0
Terrestrial biodiversity surveys	31/03/15	15.8	22.9	4.2

Survey	Date	Temperature (°C)		Rainfall (millimetres)
		(min.)	(max.)	
Terrestrial biodiversity surveys	1/04/15	15.5	26.1	3.6
Terrestrial biodiversity surveys	2/04/15	14.7	28.9	0
Terrestrial biodiversity surveys	5/05/2015	12.9	25.8	0.2
Terrestrial biodiversity surveys	6/05/2015	10.4	19.3	0
Terrestrial biodiversity surveys	7/05/2015	4.7	18.5	0
Terrestrial biodiversity surveys	8/05/2015	6.6	20.4	0
Winter bird surveys	20/05/2015	10.3	23.7	3.8
Winter bird surveys	10/06/2015	6.3	14.9	0

Aquatic field surveys

The weather conditions during the aquatic field surveys were fine although approximately 28 millimetres of rain fell in the region on 12 March 2015 prior to the initial surveys. Daily temperatures ranged from 10.1°C to 26.1°C during the initial March survey and ranged from 10.3°C to 21.0°C on the return visit in May (see Table 13).

Table 13 Weather conditions during aquatic surveys

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall (millimetres)
13th March 2015	14.2	26.1	0.0
14th March 2015	14.2	24.8	0.0
15th March 2015	13.2	24.1	0.0
16th March 2015	10.1	23.0	0.0
20th May 2015	10.3	21.0	0.8

3.4.3 Survey limitations

Flora and fauna field surveys conducted for the proposed airport would not be expected to detect all of the species present, however given the many days and various seasons over which surveys have been conducted, these would have recorded a large proportion of species that would occur. Flora and fauna surveys were conducted by GHD at the airport site between March and June 2015. Previously, surveys were conducted by SMEC at the airport site in September 2014 and these built upon surveys conducted for the previous EIS (Biosis 1999). The current field surveys were appropriately stratified to sample representative habitats on sites and conducted in accordance with survey effort and seasonal requirements of relevant survey guidelines (DEC 2004a; DEWHA 2010a, b, c, d). The majority of the terrestrial survey effort was conducted in March, during the nominated survey period for most fauna groups (DEC 2004a; DEWHA 2010a, b) and in April when conditions were still warm and fauna were still active.

Some species that may occur in the locality or region on a seasonal basis, use habitats periodically (as part of a wider home range) or become active at different times of the year may not have been recorded. These species may include flora species that are difficult or impossible to locate or identify at certain times of year due to a lack of reproductive material and/or their seasonal nature (in particular, native orchids and forbs). Field surveys aimed to identify areas of suitable habitat for cryptic species and where necessary to assess the likelihood of occurrence at the airport site.

The targeted Green and Golden Bell Frog surveys were conducted towards the end of the nominated September-March survey period because of property access restrictions. On no occasion did a total of greater than 50 mm of rain fall in the week prior to a given survey as is specified in the EPBC Act significant impact guidelines for the species (DEWHA 2009a). However conditions were warm, humid and still and other frog species were calling and were active and easily detected during surveys at the airport site. Green and Golden Bell Frogs were active (but not calling) at the reference site and were readily observed. Given these considerations it is likely that the targeted Green and Golden Bell Frog surveys would have detected the species if a population was present at the airport site.

The airport site was occupied by multiple landowners and featured a variety of land uses at the time of the field surveys. Access was not able to be obtained to the entire airport site. Figure 3a shows the ‘survey area’ at the airport site that was the subject of targeted biodiversity surveys and direct observations. Properties that are mapped as ‘access not obtained’ were not accessed on foot because of access restrictions or because they contained land uses such as mines or intensive agriculture and could be reliability discounted as containing biodiversity values based on a desktop assessment. As described above, these properties were assessed based on a combination of air photo assessment, direct observations from adjoining properties or public land and extrapolation of results from the survey area.

For the above reasons, the impact assessment and conclusions of this report draw upon information obtained from a variety of sources in addition to the field survey data. Where it is considered that the likelihood of observing a particular threatened species was diminished due to the extent of survey effort or seasonal or climatic factors, then this has been indicated. An assessment of the likelihood of occurrence of threatened species has been provided, on the basis of known distributional ranges, previous records in the locality, and habitat and resource availability at the airport site. The assessment of impacts includes those threatened species recorded at the airport site during the field surveys as well as those species not detected but considered likely to occur or to be impacted by the proposed airport.

Sampling for macroinvertebrates during autumn is ideal for analysing the data using the single season AUSRIVAS model. However, the completion of sampling during this season alone does not account for natural seasonal variation, which could result in some taxa not being collected as they are not present in the sampled habitats during this time of year. The sampling carried out has provided a sufficient indication of taxa and habitat conditions associated with areas potentially impacted by the proposal to enable a robust assessment of potential impacts on aquatic habitats.

3.4.4 Staff qualifications

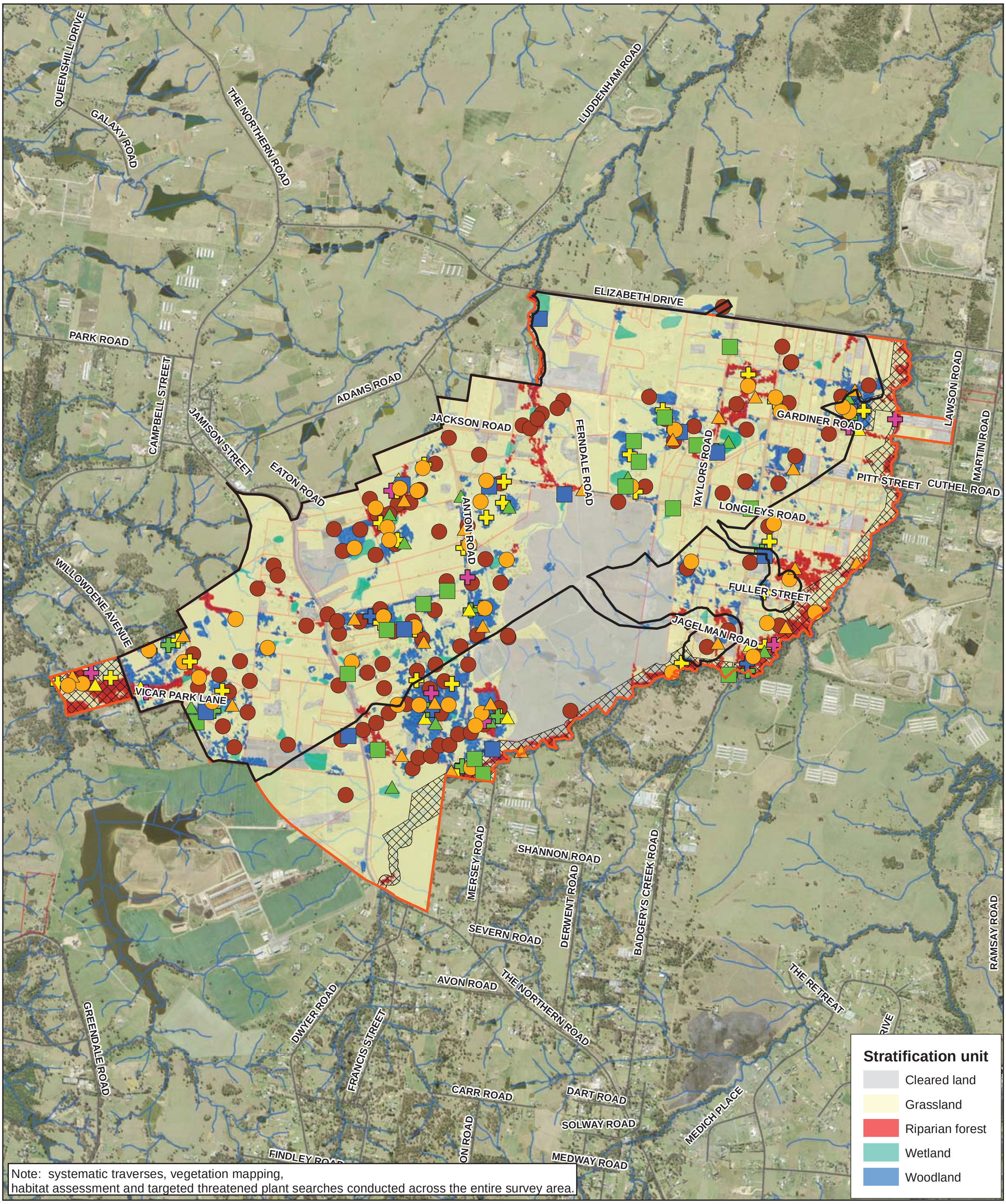
Qualifications of staff that undertook recent field surveys and prepared this report and the offset strategy are provided in Table 14. Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD’s animal ethics permit requirements. All aquatic sampling was carried out with current scientific research permits under Section 37 of the FM Act (permit number P01/0081(C)) and complied with GHD’s ethics permit requirements.

Table 14 Qualifications of staff

Name	Position/Role	Qualifications	Years' Experience
Ben Harrington	Senior Ecologist / desktop assessment, site surveys, credit calculations and reporting	BSc, MSc (Physical Geography) NSW BioBanking Assessor Accreditation (number 0073)	10+ years
Kirsten Crosby	Senior Ecologist / desktop assessment, site surveys, reporting	BSc, PhD (Zoology) NSW BioBanking Assessor Accreditation (number 160)	10+ years
Malith Weerakoon	Graduate Ecologist / desktop assessment, data processing.	BSc, MPhil. (Zoology)	2+ years
Jayne Tipping	Principal Ecologist/direction and technical review	BSc (Ecology), MEnvLaw	20+ years
Phil Taylor	Senior Aquatic Ecologist / reporting, analysis, impacts assessment	BSc, MSc (Ecology and Evolution)	10+ years
Tara Steele	Aquatic ecologist/ field surveys, macrophyte identifications	BA (Geographic Sciences), BSc (Ecology)	5 years
Josh Cox	Aquatic Ecologist/ field surveys, reporting	BSc (hons.)	5 years
Gavin Williams	Senior Aquatic Taxonomist / macroinvertebrate and fish identifications	Advanced Diploma Aquatic Resource Management	10+ years
Jamie Corfield	Principal Aquatic Ecologist / direction and technical review	Ph.D (Coastal management)	15 years

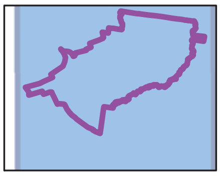
3.5 Assessment of likelihood of occurrence

Following the collation and review of database records and species and community profiles, a 'likelihood of occurrence' of threatened biota assessment was prepared with reference to the broad habitats contained within the airport site. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DoE 2015b, OEH 2015b), recovery plans, journal articles, and the field staff's knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened biota and migratory species occurring at the airport site was assessed based on the presence of records from the locality since 1990, species distribution and habitat preferences, and the suitability of potential habitat present. The results of this assessment are provided in Appendix A.



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Plot/transect
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey



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Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
Date 18 Aug 2016

Survey effort

Figure 3A

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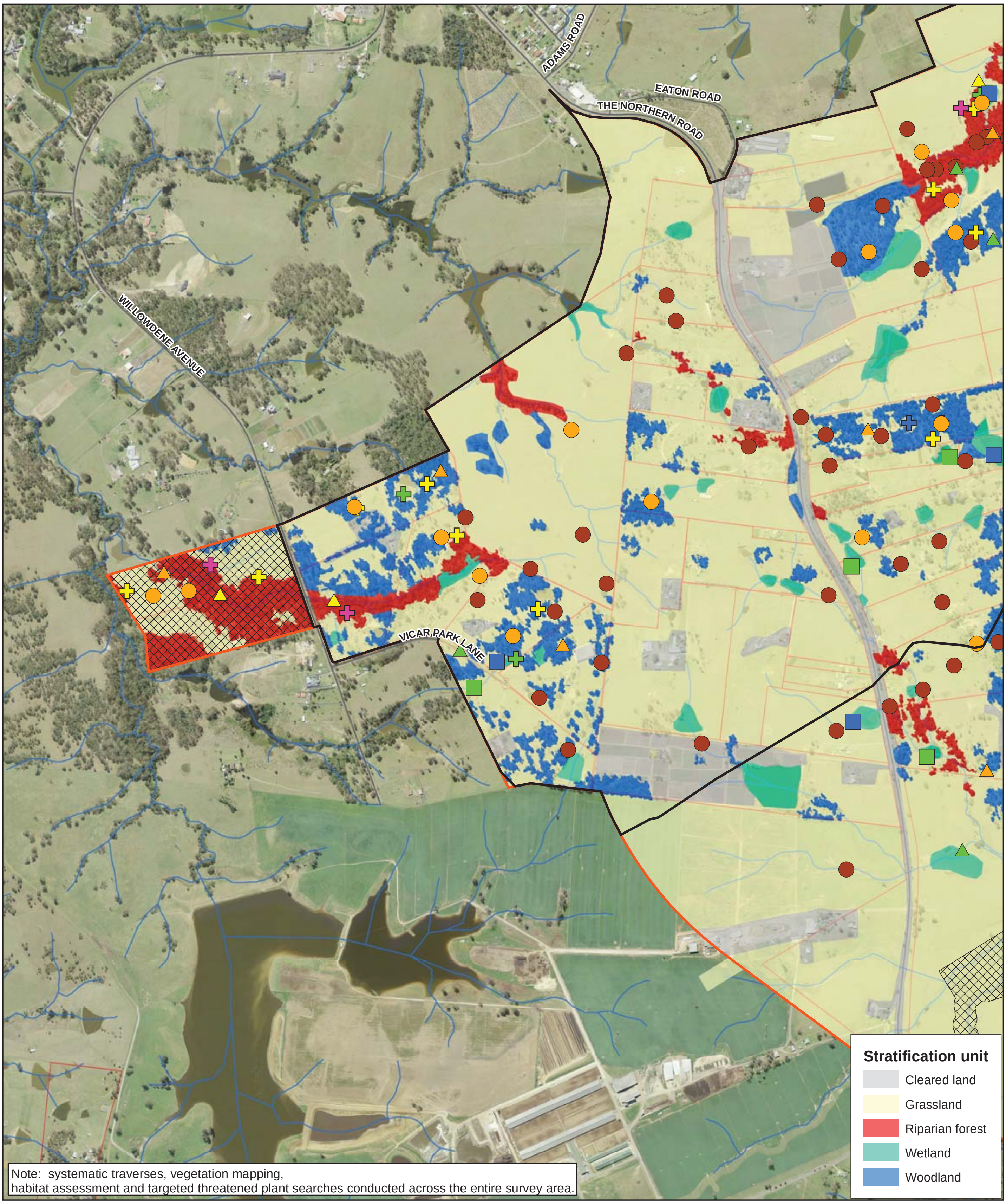
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Note: systematic traverses, vegetation mapping, habitat assessment and targeted threatened plant searches conducted across the entire survey area.

Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Plot/transect
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
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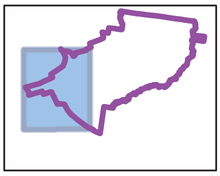
- Rapid frog survey
- Targeted frog survey



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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Survey effort

Figure 3B

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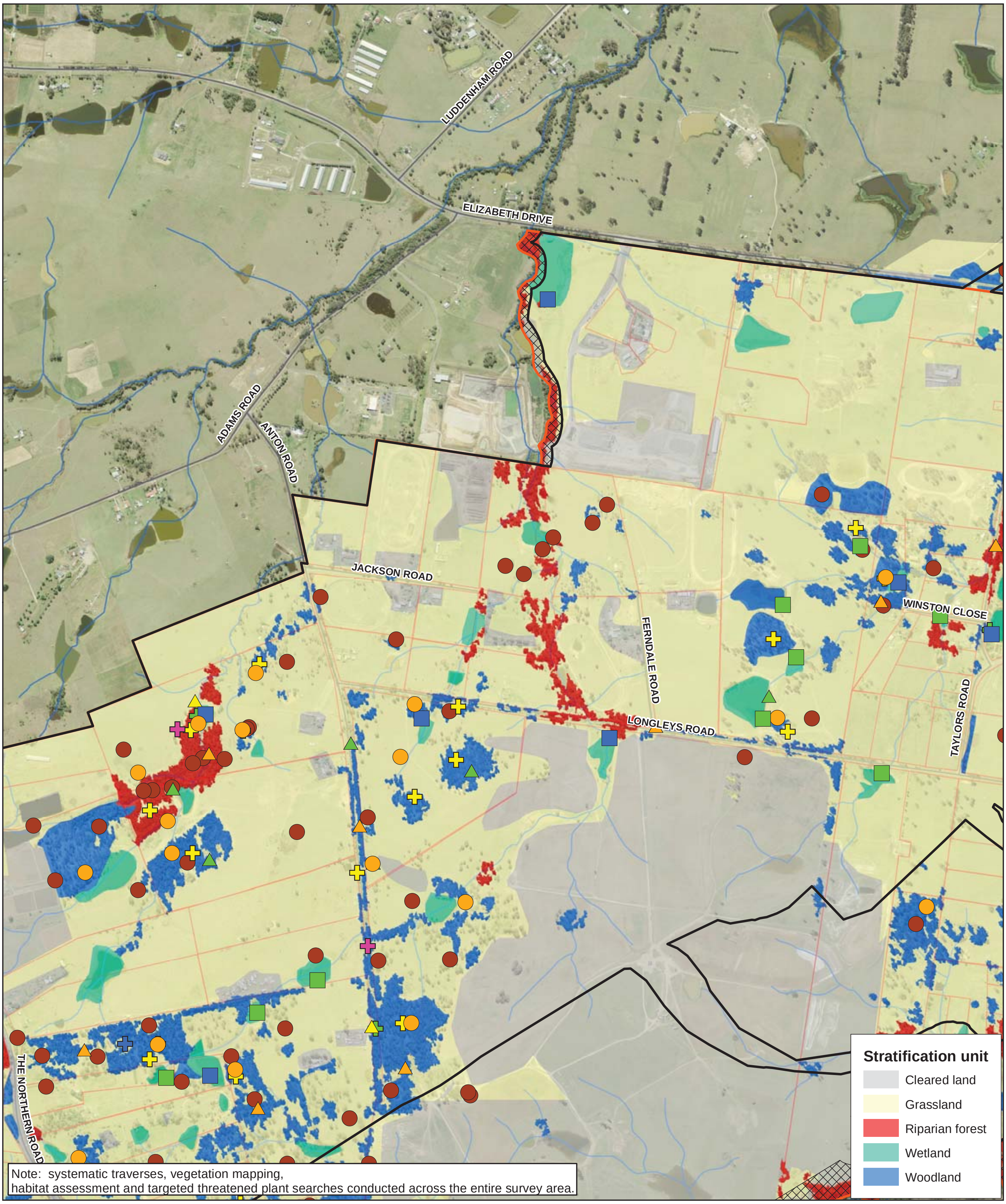
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
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- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
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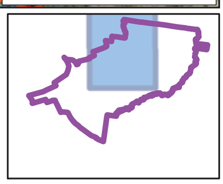
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey



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Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Survey effort

Figure 3C

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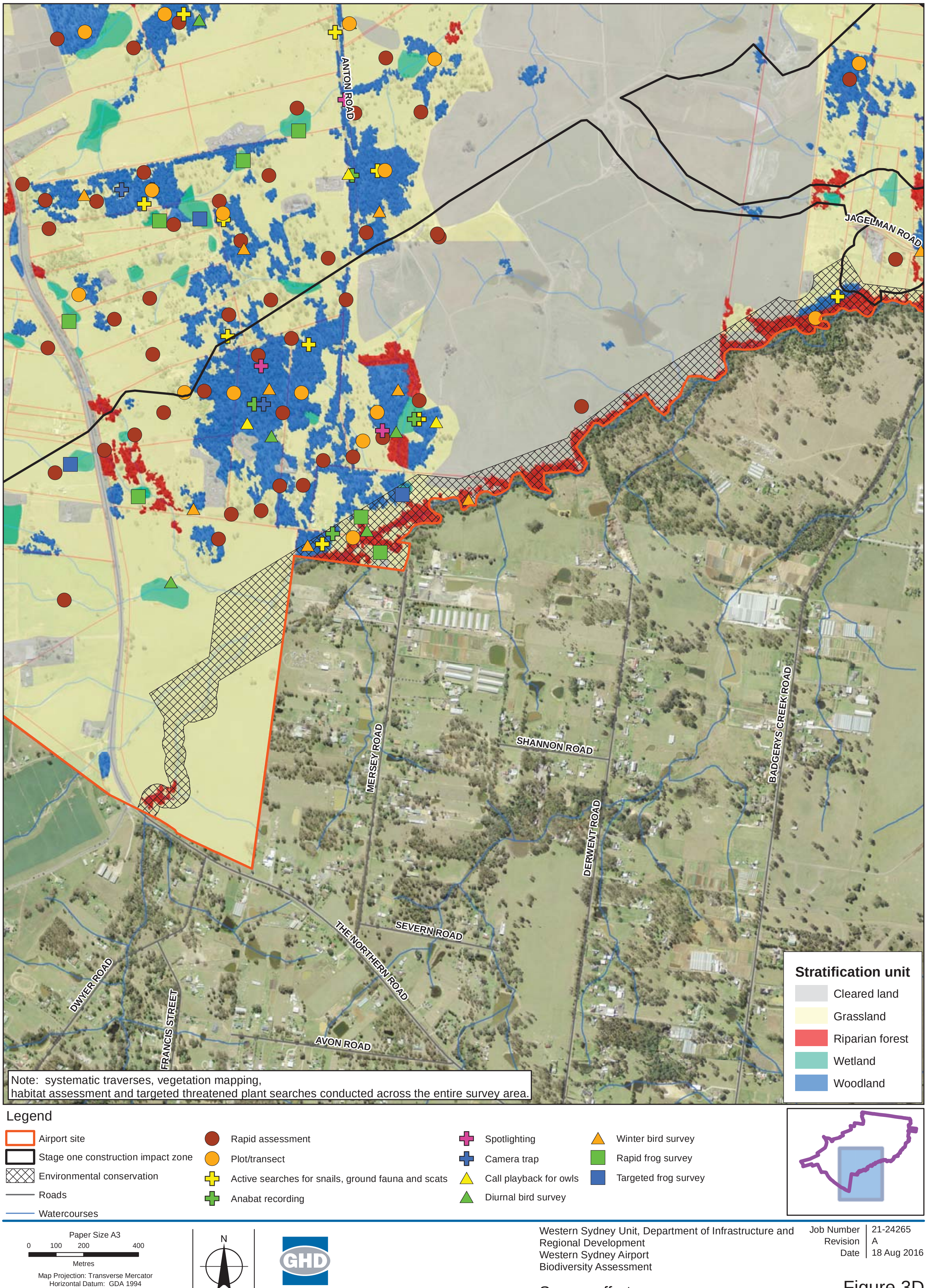
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



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Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Survey effort

Figure 3D

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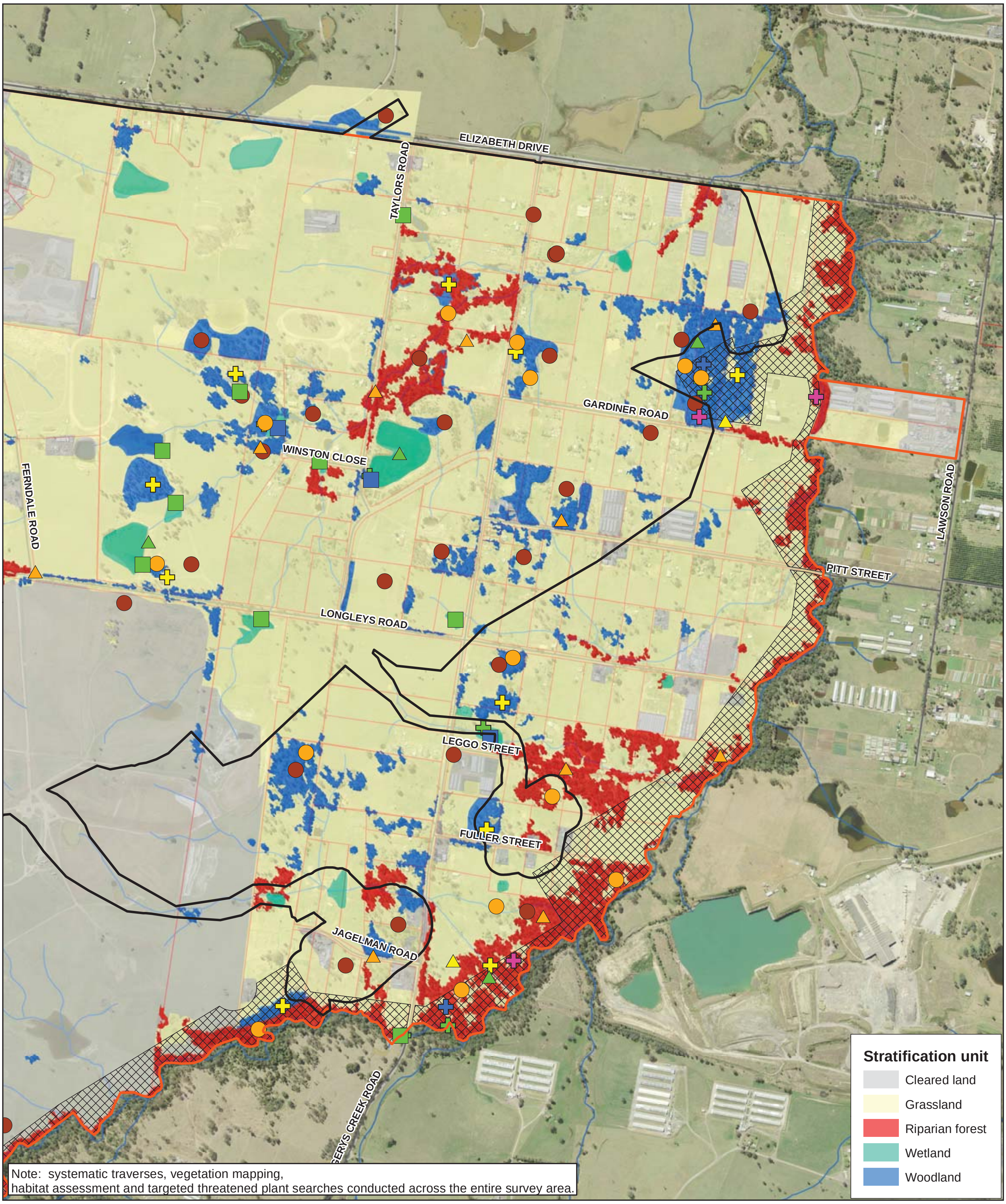
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Plot/transect
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- Camera trap
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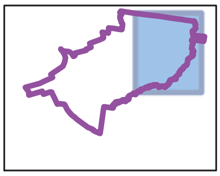
- Rapid frog survey
- Targeted frog survey



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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Survey effort

Figure 3E

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

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4. Existing environment

4.1 Physical environment

4.1.1 Topography and landscape

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The site is characterised by rolling landscapes typical of the Bringelly Shale (see Section 4.1.2) with a prominent ridge in the west of the site, reaching an elevation of about 120 metres AHD, and smaller ridge lines in the vicinity with elevations of about 100 metres AHD. The topography of the airport site generally slopes away from the ridges in the west, with elevations between 40 metres and 90 metres AHD.

The airport site features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural residential development.

The airport site is contained within the 'Cumberland Plain' Mitchell Landscape (DECC, 2008a). This landscape comprises low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast, with vegetation characterised by grassy woodlands and open forest dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*) and poorly drained valley floors with forests of Cabbage Gum (*E. amplifolia)* and Swamp Oak (*Casuarina glauca*) (DECC 2008b).

4.1.2 Geology and soils

The dominant geological formations beneath the airport site are Bringelly Shale, the Luddenham Dyke and Alluvium (Bannerman & Hazelton 1990). Bringelly Shale is a Triassic age geological unit mainly comprising claystone and siltstone and some areas of sandstone underlying parts of the airport site. The dyke outcrops toward the peak of the ridge in the west of the airport site. Alluvium at the airport site comprises Quaternary age sedimentary deposits along Cosgrove Creek and Badgerys Creek (refer to Chapter 17 of the EIS).

Geotechnical investigations at the airport site generally indicated surficial silt and/or clay topsoils overlying firm residual clays from the weathering of Bringelly Shale, with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek. The airport site is categorised as the Blacktown, Luddenham and South Creek soil landscapes. Kurosols (soils with strong texture contrast between the topsoil horizon and strongly acid subsoils horizon) occur over the majority of the airport site. Hydrosols (soils that are saturated for prolonged periods) occur in the vicinity of Badgerys Creek (refer to Chapter 17 of the EIS).

4.1.3 Hydrology

Within the broader catchment, the airport site lies in the Badgerys Creek, Cosgroves Creek and Duncans Creek sub-catchments. Badgerys Creek and Cosgroves Creek are tributaries of South Creek.

Badgerys Creek starts about two kilometres south-west of the airport site and flows north-easterly along its southern boundary before joining South Creek about four kilometres downstream. South Creek ultimately drains to the Hawkesbury River. Between the airport site and the confluence, the creek traverses agricultural land and passes the Elizabeth Drive landfill site.

The headwaters of Oaky Creek are located on the airport site and it flows north to Cosgroves Creek, before its confluence with South Creek about seven kilometres downstream. Cosgroves Creek starts about one kilometre north of the airport site and flows north-easterly before joining South Creek about six kilometres north-west. In the reach between Oaky Creek and South Creek, Cosgroves Creek passes through rural lots, the Twin Creeks Golf and Country Club and beneath an above-ground Sydney Water Corporation water pipeline. The creek catchments are largely rural and without residential development downstream of the site, with the exception of the Twin Creeks Golf and Country Club residential estate downstream of the site towards Cosgroves Creek’s confluence with South Creek.

Duncans Creek starts about three kilometres south-west of the airport site and flows north-westerly before joining the Nepean River about nine kilometres downstream from the airport site. This creek is located just outside the airport site at the western end. Duncans Creek receives flows from a number of unnamed tributaries at the airport site. The Duncans Creek catchment downstream of the site is rural and zoned for primary production (plant or animal cultivation).

Drainage lines at the airport site are shown on Figure 1.

The majority of watercourses are first and second order, accounting for approximately 70% of the total length of the mapped watercourses on the airport site. Badgerys Creek attains the highest stream order on the site, being fourth order for most of its length along the eastern boundary of the airport site. Downstream of the airport site, Badgerys and Cosgrove Creeks are 4th order watercourses, Oaky Creek is a 3rd order watercourse and Duncans Creek is a 5th order watercourse.

Badgerys, Oaky, Cosgroves and Duncans Creeks and their tributaries both through and downstream of the airport site are highly modified and in poor condition as a result of historical and current land use and disturbance. Despite having a generally well-vegetated riparian zone in some areas, these watercourses are considered to be in moderate geomorphic condition due to past clearing, the construction of online dams and ongoing agricultural activities (GHD 2016b).

All of the affected reaches on the airport site are small and ephemeral and largely intermittent. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats.

The riparian and aquatic habitat values of creeklines on the airport site and up and downstream of the site are discussed in more detail in Section 4.4. The potential impacts of alterations in hydrology and water quality (as a result of construction and operation of the airport) on receiving watercourses downstream of the airport site are discussed further in Sections 5 and 6.

All native vegetation types at the airport are likely to be groundwater dependent to some degree (BOM 2015c) The creeklines on the airport site and in the immediate vicinity are not likely to be groundwater dependent (see Section 4.2.4).

There are no wetlands of significance on the airport site or immediately downstream.

4.1.4 Climate

The airport site is located in Western Sydney, which has a humid subtropical climate, and is generally a few degrees warmer than the Sydney central business district, although nights are cooler. The mean maximum temperature occurs in January, and is about 30 degrees Celsius on average. July is the coolest month, with the mean maximum being about 17 degrees Celsius. Rainfall occurs throughout the year, with summer being the wettest season. Annual rainfall is about 700 millimetres on average.

4.1.5 Land uses

The local Badgerys Creek environment has remained largely unchanged since the late 1990s with land use characterised by large and small rural holdings and residential allotments (SMEC 2014). Existing activities at the site include residential, agriculture, light commercial and demolition works. Associated disturbance at the site includes use of pesticides and fertilisers, chemical storage tanks and drums, rubbish dumping, stockpiled demolition waste, and stockpiled fill material of unknown origin.

The airport site is surrounded by low density rural residential, light industrial and mixed agricultural land uses. The Western Sydney Priority Growth Area plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands (DoP 2016).

4.2 Plant species and vegetation zones

4.2.1 Plant species

A total of 280 species from 72 families were recorded at the airport site, comprising 202 native species and 78 exotic species. The Poaceae (grasses, 48 species, including 15 exotics), Asteraceae (31 species, including 16 native species), Fabaceae (25 species, including 22 native species) and Cyperaceae (16 species, of which only one was exotic) were the most diverse families recorded. The list of plant species recorded at the airport site is provided in Appendix C.

A total of 43 plot/transects was sampled across the site along with additional wetland assessments and opportunistic observations of native plant species. This survey is likely to have revealed the majority of the native plant species present at the site. There is a chance that some cryptic and/or seasonally flowering species were not detected, potentially including threatened species as discussed in Section 4.5.2. The airport site contains a considerable greater diversity of exotic plant species than are listed in Appendix C, mainly associated with residential gardens or cropland. These areas were not a focus of this biodiversity assessment, beyond visual inspection to confirm that they did not contain native vegetation communities. No formal sampling of the plant species present in these areas was undertaken.

Based on the results of the field surveys, the airport site contains only moderate native plant species richness. Biometric plot/transect data revealed that 21 out of the 43 plots sampled in native vegetation featured native plant species richness that was below benchmark values for an undisturbed example of the equivalent plant community type. The majority of the native vegetation at the airport site has been previously cleared, grazed or otherwise modified and is in moderate or poor condition.

The suite of plant species at the airport site is representative of shale-derived soils, transitional shale-gravel soils, alluvial soils and wetlands. The airport site does not contain any sandstone outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any plant species that have habitat requirements specific to these soil types. Many of the threatened plant species known or predicted to occur in the locality have these specific habitat requirements and would not occur at the airport site (see Appendix A).

4.2.2 Vegetation zones

Field surveys confirmed the presence and distribution of five NSW plant community types at the airport site. Stands of these plant community types include near-intact vegetation in ‘moderate/good – high’ condition, partially cleared or regrowth vegetation in ‘moderate/good – poor’ condition and extensively modified areas in ‘cleared’ condition (according to the FBA OEH 2014a). Accordingly nine vegetation zones (plant community types and broad condition classes) were identified and mapped at the airport site as shown on Figure 4. Attributes of these vegetation zones are summarised in Table 15 and described in Table 16 to Table 24 below.

The most extensive vegetation zone at the airport site is exotic grassland. This vegetation contains no native over storey or mid storey and less than 50% of the ground cover vegetation is native. Grassland areas contain occasional isolated paddock trees that are remnants of adjoining native woodland and forest. Exotic grassland areas are described in Table 25 below. There are also extensive areas of buildings, hard stand, bare earth, crop land and waterbodies that feature minimal vegetation cover that have been collectively mapped as ‘cleared land and cropland’. Cleared land and cropland areas are described in Table 26 below.

Grey Box - Forest Red Gum grassy woodland on flats is associated with mid and lower slopes, on shale derived soils across the airport site and is the most extensive native plant community type. It comprises an open forest or woodland of Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*Eucalyptus moluccana*) with a grassy understorey and occasional dense patches of the shrub species Native Blackthorn (*Bursaria spinosa spinosa*).

There are small areas of tertiary gravel influenced soils in the east of the airport site that support Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest with a canopy of Forest Red Gum and Grey Box along with Broad-leaved Ironbark (*Eucalyptus fibrosa*), a characteristic mid storey of Honey Myrtle (*Melaleuca decora*) and a shrub and grass understorey.

There is a volcanic intrusion in the central western portion of the site which is associated with steeper terrain, rock fragments in soil profiles and some rock outcropping. In other parts of the Cumberland Plain this geology is often associated with Moist Shale Woodland and Western Sydney Dry Rainforest (NPWS 2002a; Tozer et al 2010). However, at the airport site it contains Grey Box - Forest Red Gum grassy woodland on hills with relatively few species representative of these other communities. Plot/transect data was compared with Tozer et al (2010) diagnostic species lists to confirm the identity of this vegetation type. The observed vegetation may be because of frequent and/or recent fire and other disturbance at the airport site, which has prevented a succession towards rainforest species.

The above vegetation types grade into Forest Red Gum - Rough-barked Apple grassy woodland along the riparian corridors of Badgerys Creek and other drainage lines through the airport site. This community is a closed woodland or forest of Forest Red Gum, Grey Box and Cabbage Gum (E*ucalyptus amplifolia)* along with Swamp Oak (*Casuarina glauca*), Broad-leaved Apple (*Angophora subvelutina)* and paperbarks (*Melaleuca* spp.). Understorey vegetation is similar to Shale Plains Woodland along with additional moisture loving species such as rushes and sedges.

The condition of these plant community types varies across the airport site as a result of previous land uses and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. There is moderate to severe weed infestation throughout, with linear remnants along roads and isolated patches in agricultural land the most severely affected. Notwithstanding the generally moderate to poor condition of vegetation at the airport site it has high conservation significance as a result of the presence of threatened biota and the generally limited extent and quality of similar vegetation in the Western Sydney region.

There are patches of derived native grassland at the airport site that comprise poor condition forms of the native vegetation communities described above. These areas contain at least 50% native groundcover, mainly comprising native grasses such as Kangaroo Grass (*Themeda australis*). There is a moderate species richness, but relative low cover and abundance of understorey herbs associated with the woodlands and forests described above. Exotic grasses and herbs are present throughout.

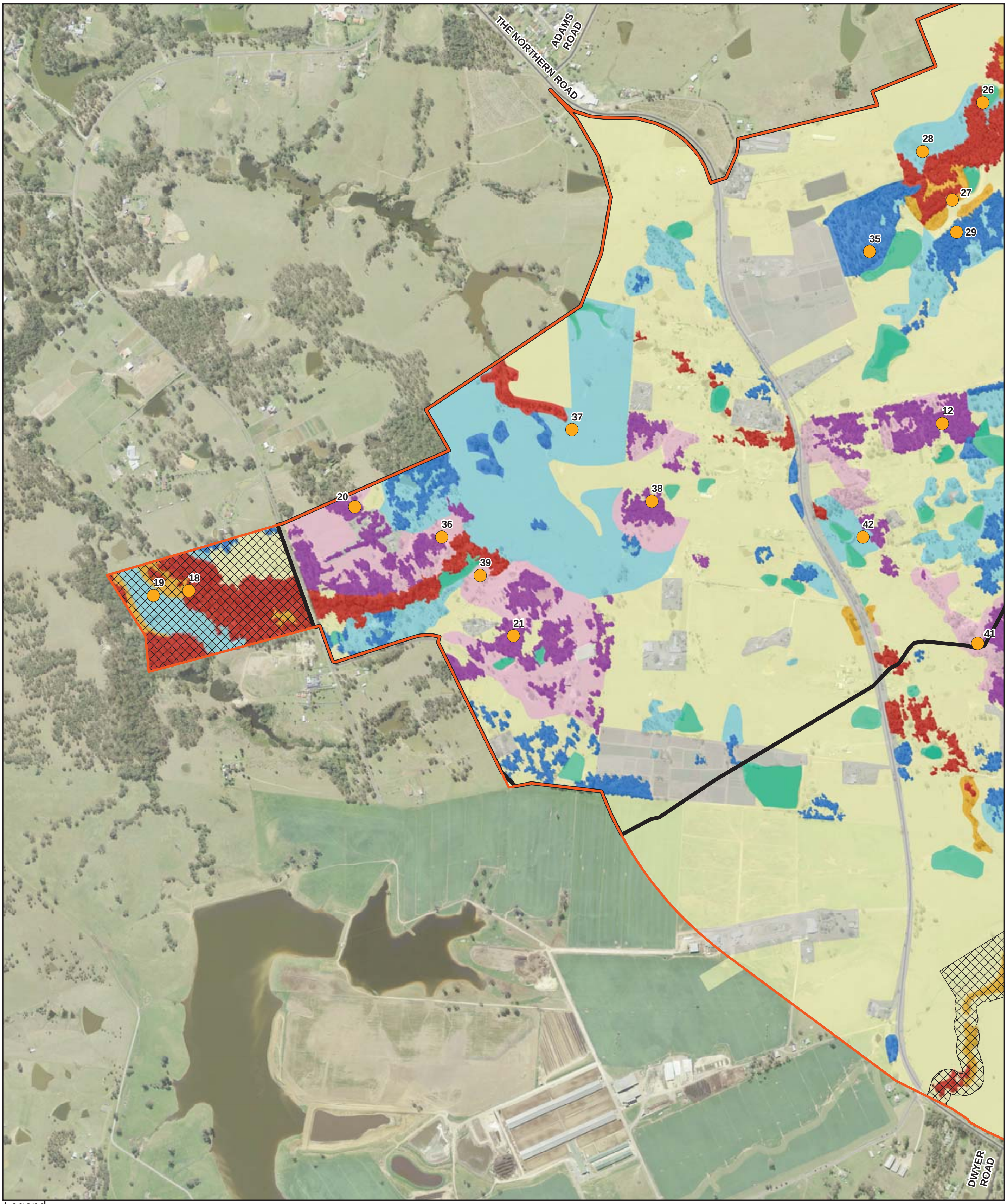
There are a large number of dams and flooded depressions throughout the airport site formed by the construction of barriers across small drainage lines. These water bodies contain a moderate diversity and abundance of native wetland plants.

There are local occurrences of one threatened ecological community (TEC) listed under the EPBC Act and three TECs listed under the TSC Act at the airport site as described in Section 4.5.1. The distribution of plant community types in the airport site is closely tied to soil type, underlying geology and drainage, all of which are correlated with geomorphic position.

Table 15 Vegetation zones within the airport site

Vegetation Zone	Condition	EPBC Act Status	TSC Act Status	Area at the site (hectares)	Survey effort
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Cumberland Plain Woodland (CEEC)	119.9	Plot/transects 2, 5, 6, 7, 10, 11, 12, 16, 22, 23, 25, 31, 32, 35
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor		Cumberland Plain Woodland (CEEC)	131.0	Plot/transects 8, 19, 24, 28, 30, 37, 42
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Cumberland Plain Woodland (CEEC)	30.2	Plot/transects 20, 21, 36, 38, 40
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor		Cumberland Plain Woodland (CEEC)	31.0	Plot/transects 39, 41
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good – medium or high		River-flat Eucalypt Forest (EEC)	92.3	Plot/transects 9, 13, 15, 17, 18, 26, 29, 33
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor		River-flat Eucalypt Forest (EEC)	18.4	Plot/transects 14, 27, 34
Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Shale-Gravel Transition Forest (EEC)	8.3	Plot/transect 1
Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good - poor		Shale-Gravel Transition Forest (EEC)	2.3	Plot/transect 43
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			35.4	Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9, 10, 11
Total native vegetation				**468.9**	
Exotic grassland	Cleared			956.8	Plot/transect 3, 4
Cleared land or cropland	Cleared			348.2	General observations
Total				**1773.9**	

EEC – endangered ecological community. CEEC – critically endangered ecological community.



Legend

- Airport site
- Environmental conservation
- Roads
- Plot/transect

- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
Date 18 Aug 2016

Vegetation zones

Figure 4A

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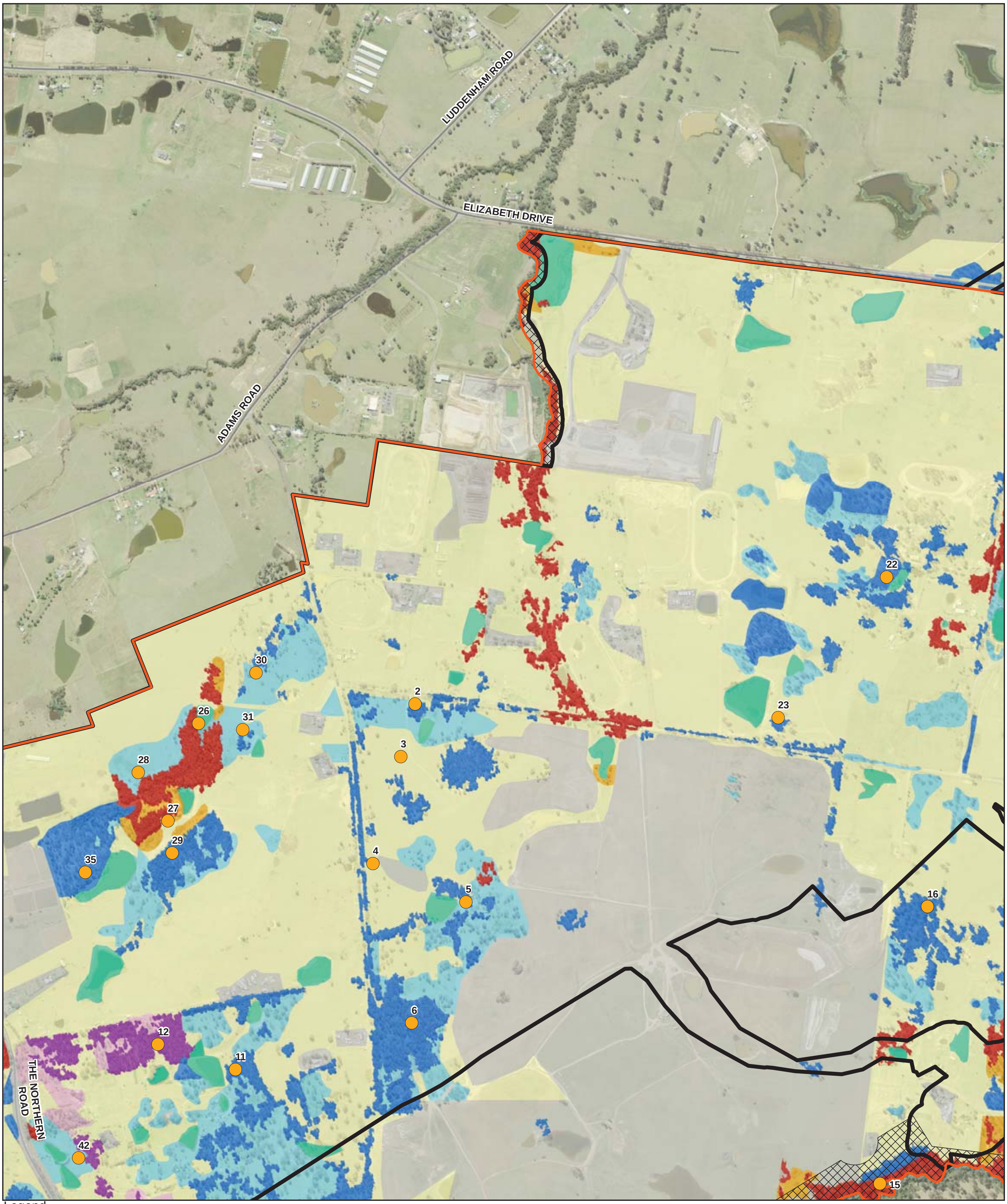
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Environmental conservation
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
Date 18 Aug 2016

Vegetation zones

Figure 4B

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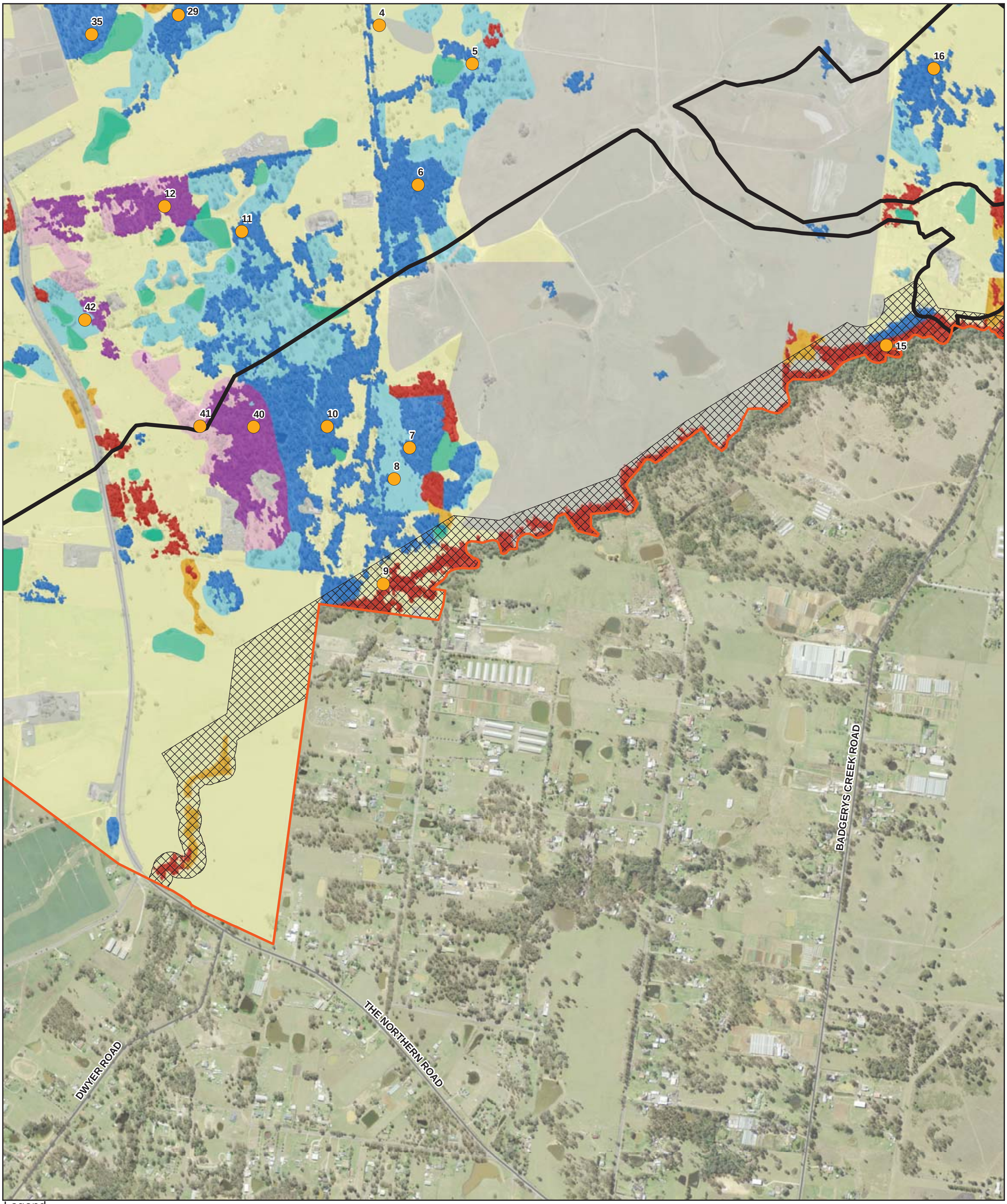
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Environmental conservation
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Vegetation zones

Figure 4C

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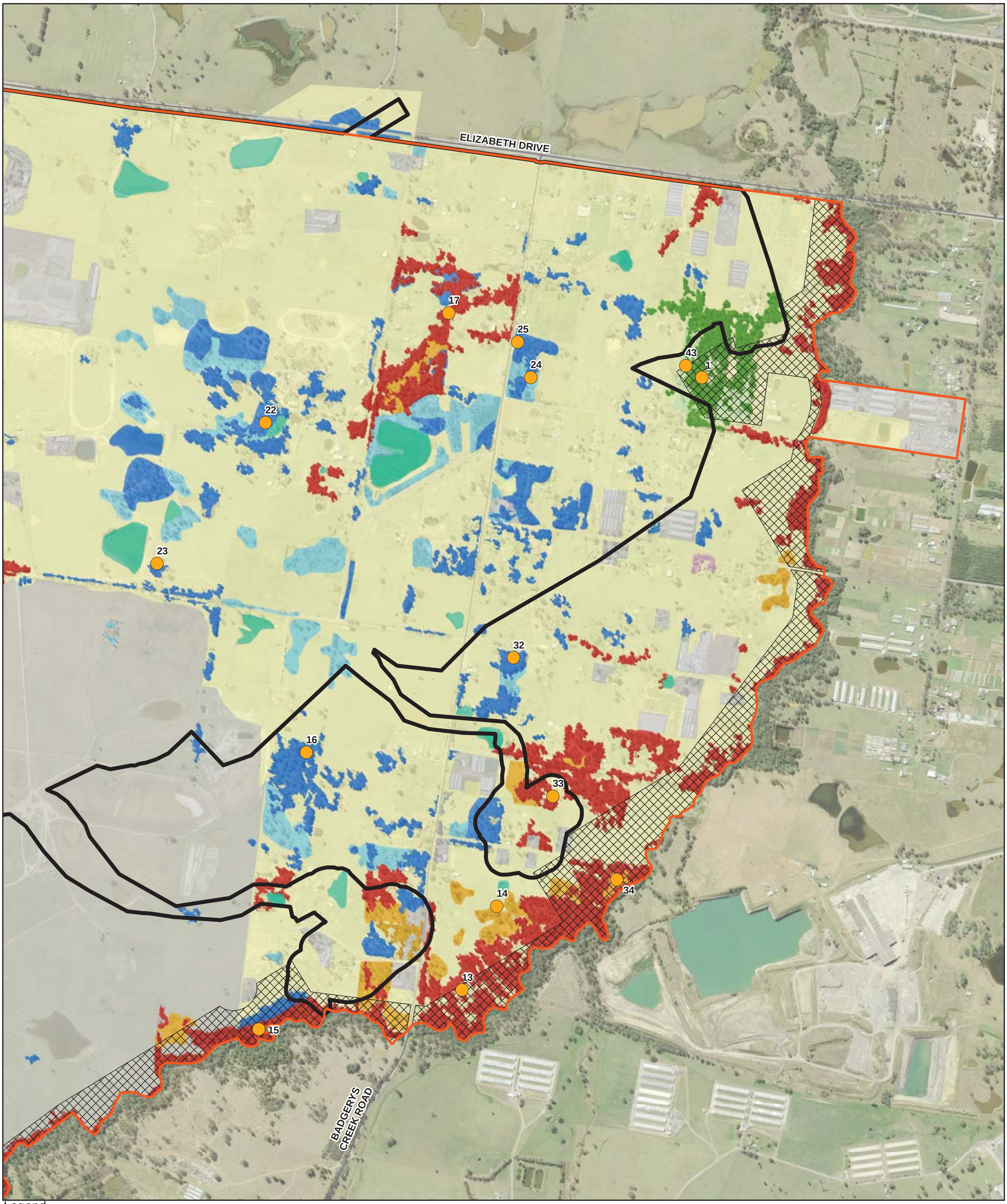
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Environmental conservation
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)
- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	18 Aug 2016

Vegetation zones

Figure 4D

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

Table 16 Good condition Grey Box - Forest Red Gum grassy woodland on flats

Good condition Grey Box - Forest Red Gum grassy woodland on flats	
Plant community type (OEH, 2015c)	HN528- Grey Box - Forest Red Gum grassy woodland on flats, Sydney
Equivalent Map Units	Cumberland Shale Plains Woodland (GW p29) (Tozer et al 2010); Shale Plains Woodland (NPWS 2002).
Area	119.9 hectares
Survey effort	Plot/transects 2, 5, 6, 7, 10, 11, 12, 16, 22, 23, 25, 31, 32, 35.
Condition (DECC, 2008)	Moderate/good – medium or high. Remnant or regrowth native vegetation with near-intact over storey. Species richness was above benchmark in eight of the 14 plots and most native vegetation cover attributes were at benchmark values for this plant community type in the majority of plot/transects sampled. All canopy species were observed regenerating. Few hollow-bearing trees were recorded, including only one in the 14 plots sampled. There were generally low quantities of fallen woody debris, including none in five of the 14 plots sampled. There is frequently high exotic plant cover (10-84 per cent in plot/transects sampled) mainly consisting of grasses and herbs in the under storey.
Conservation significance	Comprises a local occurrence of ‘Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest’ (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of ‘Cumberland Plain Woodland’ which is listed as a CEEC under the TSC Act.
Landscape position	On shale derived soils on mid and lower slopes and flats in gently undulating terrain across the airport site.
Structure	Woodland or open forest with a sparse mid storey and a generally sparse shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn (*Bursaria spinosa spinosa*).
Over storey	Continuous, around 15-25 metres tall and around 20 per cent cover. Features a mixed canopy of Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*) with occasional Thin-leaved Stringybark (*E. eugenioides*).
Mid storey	Patchy and variable (<1 per cent to 26.5 per cent cover). Generally sparse cover of tall shrubs such as *Dillwynia sieberi* or Gorse Bitter-pea (*Daviesia ulicifolia*) but with occasional very dense patches of Native Blackthorn, Black Wattle *(Acacia decurrens)* or Parramatta Wattle *(Acacia parramattensis)* to five metres tall and 50-80 per cent cover.
Groundcover	Dense and dominated by grasses and grass like plants such as Kangaroo Grass (*Themeda australis*), Weeping Grass (*Microlaena stipoides* var. *stipoides*), Threeawn Speargrass (*Aristida vagans*), Paddock Love Grass (*Eragrostis leptostachya*) and *Lomandra filiformis* subsp. *filiformis*. Other understorey species include: occasional shrubs such as Peach Heath (*Lissanthe strigosa*); moderate cover and species richness of herbs such as *Caesia parviflora var. vittata*, Kidney Weed (*Dichondra repens*), Native Wandering Jew (*Commelina cyanea*) and Blue Trumpet (*Brunoniella australis*); locally high cover of chenopods such as Climbing Saltbush (*Einadia nutans* subsp. *nutans*) and Berry Saltbush (*Einadia hastata*); and moderate cover and species richness of scramblers such as Amulla (*Eremophila debilis*) and *Glycine* species. There are occasional patches of leaf litter and bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include small trees and tall shrubs such as African Boxthorn (*Lycium ferocissimum*) and African Olive (*Olea europaea* subsp. *cuspidata*); pasture grasses such as *Setaria parviflora,* Kikuyu (*Pennisetum clandestinum*) and Paspalum (*Paspalum dilatatum*); weedy grasses such as African Lovegrass (*Eragrostis curvula*) and Panic Veldtgrass (*Ehrharta erecta*); widespread wind borne herbs such as Fireweed (*Senecio madagascariensis*) and Dandelion (*Taraxacum officinale*); opportunistic herbs of disturbed areas such as Greater Beggar's Ticks (*Bidens subalternans*), Black-berry Nightshade (*Solanum nigrum*) and *Solanum sisymbriifolium*; and climbers such as Moth Vine (*Araujia sericifera*) and Bridal Creeper (*Asparagus asparagoides*).

Good condition Grey Box - Forest Red Gum grassy woodland on flats	
Good condition woodland with a grassy understorey.	
Good condition woodland with a shrub/grass understorey and dense patches of Native Blackthorn.	

Table 17 Poor condition Grey Box - Forest Red Gum grassy woodland on flats

Poor condition Grey Box - Forest Red Gum grassy woodland on flats	
Plant community type (OEH, 2015c	HN528- Grey Box - Forest Red Gum grassy woodland on flats.
Equivalent Map Units	Closest equivalents are Cumberland Shale Plains Woodland (GW p29) (Tozer et al 2010) and Shale Plains Woodland (NPWS 2002A) though poor condition patches are generally not mapped.
Area	31.0 hectares
Survey effort	Plot/transects 8, 19, 24, 28, 30, 37, 42.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with minimal over storey cover (0 per cent in six of the seven plots sampled). Species richness, mid storey and native ground forb cover attributes were below benchmark values for this plant community type in the majority of plot/transects sampled. Native grass cover was consistently well above benchmark values. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived native Blackthorn shrub land or sub-mature over storey regeneration over exotic groundcover. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees and very little fallen woody debris (zero in six of the seven plots sampled). There is frequently high exotic plant cover (6-82 per cent in plot/transects sampled) mainly consisting of exotic grasses.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines (DEWHA 2010d). Comprises a local occurrence of 'Cumberland Plain Woodland' listed as a CEEC under the TSC Act and defined in relevant guidelines.
Landscape position	On shale derived soils on mid and lower slopes and flats in gently undulating terrain across the airport site.
Structure	Mainly a derived grassland with a sparse mid storey and very occasional, isolated trees. Some patches of derived shrubland or scrub with a very dense mid storey.
Over storey	Absent other than occasional isolated Grey Box or Forest Red Gum.
Mid storey	Patchy and variable. Generally sparse cover of tall shrubs such as *Dillwynia sieberi* but with occasional very dense patches of Native Blackthorn, Hickory wattle (*Acacia implexa),* Black Wattle or Parramatta Wattle to five metres tall and 25 per cent cover.
Groundcover	Dense and dominated by grasses and grass like plants especially Kangaroo Grass, along with Bladey Grass (*Imperata cylindrica*), Common Couch (*Cynodon dactylon)* Weeping Grass, Speargrasses (A*ristida* sp.) and *Lomandra filiformis* subsp. *filiformis*. Other understorey species include: very occasional shrubs such as Peach Heath; low cover and moderate species richness of herbs such as Kidney Weed, Native Wandering Jew and Blue Trumpet; and scramblers such as *Glycine* species. There are occasional patches of bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include shrubs and woody vines such as African Boxthorn and Blackberry (*Rubus fruticosus* species aggregrate); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as African Lovegrass and Panic Veldtgrass; widespread wind borne herbs such as Fireweed and Dandelion; and opportunistic herbs of disturbed areas such as Cobbler's Pegs (*Bidens pilosa*), Spear Thistle (*Cirsium vulgare)* and *Solanum sisymbriifolium*.

Poor condition Grey Box - Forest Red Gum grassy woodland on flats	
Derived native grassland with occasional shrubs and regenerating eucalypts.	
Kangaroo Grass dominated derived native grassland.	

Table 18 Good condition Grey Box - Forest Red Gum grassy woodland on hills

Good condition Grey Box - Forest Red Gum grassy woodland on hills	
Plant community type (OEH, 2015c	HN529- Grey Box - Forest Red Gum grassy woodland on shale, Sydney Basin (Grey Box - Forest Red Gum grassy woodland on hills).
Equivalent Map Units	Cumberland Shale Hills Woodland (GW p28) (Tozer et al 2010); Shale Hills Woodland (NPWS 2002).
Area	30.2 hectares
Survey effort	Plot/transects 20, 21, 36, 38, 40.
Condition (DECC, 2008)	Moderate/good – medium or high. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values in all but one of the plot/transects sampled. Native mid storey cover was well below benchmark values in four out of the five plot/transects. Species richness, shrub, grass and forb cover attributes and woody debris were at or above benchmark values for this plant community type in the majority of plot/transects sampled. All canopy species were observed regenerating. There are few hollow-bearing trees, including only one in the five plots sampled. There is frequently high exotic plant cover (26-44 per cent in plot/transects sampled) mainly consisting of woody weeds in the mid storey.
Conservation significance	Comprises a local occurrence of ‘Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest’ (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of ‘Cumberland Plain Woodland’ which is listed as a CEEC under the TSC Act.
Landscape position	On shale derived soils on mid and upper slopes and ridges in undulating terrain, mainly in the west and south west of the airport site.
Structure	Woodland or open forest with a sparse mid storey and a generally sparse shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn.
Over storey	Continuous, around 15-25 metres tall and around 18 per cent cover. Features a mixed canopy of Grey Box and Forest Red Gum with occasional Thin-leaved Stringybark.
Mid storey	Patchy and variable. Generally sparse but with occasional very dense patches of Native Blackthorn or Hickory Wattle (*Acacia implexa)* to five metres tall and up to 10 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses and grass like plants such as, Weeping Grass, Two-colour Panic (*Panicum simile*), Red Grass (*Bothriochloa macra*), Threeawn Speargrass, Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*) and *Lomandra filiformis* subsp. *filiformis*; occasional shrubs such as Wedge Guinea Flower (*Hibbertia diffusa*); moderate to high cover and species richness of herbs such as Indian Weed *(Sigesbeckia orientalis subsp. orientalis), Plectranthus parviflorus*, Native Wandering Jew, Forest Nightshade (*Solanum prinophyllum*) and Blue Trumpet; locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp*. trigonos*; and moderate cover and species richness of scramblers such as Amulla (*Eremophila debilis*) and *Glycine* species. There are occasional patches of leaf litter and bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana (*Lantana camara)* and especially African Olive; pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as African Lovegrass and Panic Veldtgrass; widespread wind borne herbs such as Fireweed and Dandelion; opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne *(Sida rhombifolia),* including localised severe infestations; and climbers such as Moth Vine.

Good condition Grey Box - Forest Red Gum grassy woodland on hills	
Medium condition woodland with a grassy understorey and moderate weed infestation.	
Good condition woodland with a shrub/grass understorey and dense patches of Native Blackthorn.	

Table 19 Poor condition Grey Box - Forest Red Gum grassy woodland on hills

Poor condition Grey Box - Forest Red Gum grassy woodland on hills	
Plant community type (OEH, 2015c	HN529- Grey Box - Forest Red Gum grassy woodland on hills.
Equivalent Map Units	Closest equivalent is Cumberland Shale Hills Woodland (GW p28) (Tozer et al 2010) and Shale Hills Woodland (NPWS 2002a) though poor condition patches are generally not mapped.
Area	31.0 hectares
Survey effort	Plot/transects 39, 41.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with no over storey cover (0 per cent in both plots sampled). Species richness was at or below benchmark values, with very low native midstorey cover in both of the plot/transects sampled. Native grass cover was consistently well above benchmark values. Species richness and forb cover were also at benchmark values in ungrazed paddocks or near refuges such as rock outcrops. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived native Blackthorn shrub land or sub-mature over storey regeneration over exotic groundcover. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees or fallen woody debris. There is moderate exotic plant cover (34-40 per cent in plot/transects sampled) consisting of either exotic grasses and herbs in the groundcover or dense woody weeds in the mid storey.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines ((DEWHA 2010d). Comprises a local occurrence of 'Cumberland Plain Woodland' listed as a CEEC under the TSC Act and defined in relevant guidelines.
Landscape position	On shale derived soils on mid and upper slopes and ridges in undulating terrain, mainly in the west and south west of the airport site.
Structure	Mainly a derived grassland with a sparse mid storey and very occasional, isolated trees. Some patches of derived shrubland or scrub with a very dense mid storey.
Over storey	Absent other than occasional isolated Grey Box or Forest Red Gum.
Mid storey	Patchy. Very low cover of tall shrubs such as Native Blackthorn but with occasional patches of Native Blackthorn or Hickory wattle to five metres tall and 0.5 per cent cover.
Groundcover	Dense and dominated by grasses and sedges especially Kangaroo Grass, along with Weeping Grass, Two-colour Panic, Red Grass, Paddock Love Grass and Common Fringe-sedge (*Fimbristylis dichotoma*). Other understorey species include: very occasional shrubs such as Peach Heath; moderate cover of Rock Fern (*Cheilanthes sieberi* subsp. *sieberi*); moderate cover and species richness of herbs such as Kidney Weed, Common Woodruff (*Asperula conferta*), and Blue Trumpet; and scramblers such as *Glycine* species. There are occasional patches of bare earth and rock outcropping.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include; dense patches of African Olive; shrubs and woody vines such as African Boxthorn and Blackberry (*Rubus fruticosus* species aggregrate); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as Rhodes Grass (*Chloris gayana*) and African Lovegrass; widespread wind borne herbs such as Fireweed and Dandelion; and opportunistic herbs of disturbed areas such as Cobbler's Pegs, Purpletop (*Verbena bonariensis*), Spear Thistle and *Solanum sisymbriifolium*.

Poor condition Grey Box - Forest Red Gum grassy woodland on hills	
Derived native grassland with no mid storey	
Derived native grassland with occasional patches of Native Blackthorn.	

Table 20 Good condition Forest Red Gum - Rough-barked Apple grassy woodland

Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Plant community type (OEH, 2015c	HN526- Forest Red Gum - Rough-barked Apple grassy woodland on floodplains, Sydney Basin (Forest Red Gum - Rough-barked Apple grassy woodland).
Equivalent Map Units	Cumberland River-flat Forest (FoW p33) (Tozer et al 2010); Alluvial Woodland and Riparian forest (NPWS 2002a).
Area	92.3 hectares
Survey effort	Plot/transects 9, 13, 15, 17, 18, 26, 29, 33.
Condition (DECC, 2008)	Moderate/good – medium or high. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values in all eight plot/transects sampled. Native mid storey cover was well below benchmark values in four out of eight plot/transects. Species richness and shrub cover was generally above benchmark values for this plant community type in the majority of plot/transects sampled, while grass and forb cover was highly variable. All canopy species were observed regenerating. Hollow-bearing trees are present, including seven in the eight plots sampled. There is frequently high exotic plant cover (16-78 per cent in plot/transects sampled) consisting of woody weeds in the mid storey, herbs in the groundcover and dense vine thickets.
Conservation significance	Comprises a local occurrence of 'River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' (River-flat eucalypt forest) which is listed as an EEC under the TSC Act.
Landscape position	On alluvial soils on banks and terraces of drainage lines throughout the site, including Badgerys Creek, Oaky Creek and their tributaries.
Structure	Closed woodland or forest with a variable, locally dense mid storey and a patchy shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn, Paperbarks (*Melaleuca* species), Swamp Oak (*Casuarina glauca)* or Acacia species.
Over storey	Continuous, around 15-25 metres tall and around 17 per cent cover. Features a mixed canopy of Forest Red Gum, Cabbage Gum (*Eucalyptus amplifolia* subsp. *amplifolia)* and Grey Box with occasional Thin-leaved Stringybark.
Mid storey	Patchy and variable (<1 per cent to 50 per cent cover in plot/transects sampled). Moderate in most areas but with occasional very dense patches of Native Blackthorn, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Flax-leaved Paperbark (*Melaleuca linariifolia*), Swamp Oak (*Casuarina glauca)* or Acacia species to ten metres tall and up to 49 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses especially Weeping Grass along with Threeawn Speargrass, Early Spring Grass (*Eriochloa pseudoacrotricha*), *Oplismenus aemulus;* and Slender Rat's Tail Grass (*Sporobolus creber*); locally dense patches of sedges such as Slender Flat-sedge (*Cyperus gracilis*), *Cyperus polystachyos and* occasional very dense patches of Native Blackthorn shrubs; moderate to high cover and species richness of herbs such as Indian Weed*, Plectranthus parviflorus*, Native Wandering Jew, Forest Nightshade, Indian Pennywort (*Centella asiatica*) and Blue Trumpet; locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp*. trigonos*; and moderate cover and species richness of scramblers such as Amulla, Slender Tick-trefoil (*Desmodium varians*) and *Glycine* species. Native vines such as Headache Vine (*Clematis glycinoides*) are locally abundant. There are occasional patches of leaf litter and bare earth. Drainage lines through this vegetation zone feature high species richness and cover/abundance of native aquatic herbs and ferns such as *Marsilea mutica, Alternanthera denticulate, Eleocharis cylindrostachys, Triglochin microtuberosa* and *Myriophyllum variifolium*,

Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including frequent severe infestations. Exotic plants present include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana, Green Cestrum (*Cestrum parqui*), Blackberry and especially African Olive; pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as Panic Veldtgrass; widespread wind or bird spread herbs such as Fireweed, Madeira Winter Cherry (*Solanum pseudocapsicum*) and Dandelion; opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne; and localised very severe 'vine thickets' of scramblers such as Wandering Jew (*Tradescantia fluminensis*) and climbers such as Moth Vine, Madeira Vine (*Anredera cordifolia*) and Bridal Creeper *(Asparagus asparagoides)*.
Medium condition forest with intact mid and over storey but severe infestation with exotic vines and scramblers.	
Good condition forest with characteristic mid storey of *Melaleuca* species and Swamp Oak.	

Table 21 Poor condition Forest Red Gum - Rough-barked Apple grassy woodland

Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Plant community type (OEH, 2015c	HN526- Forest Red Gum - Rough-barked Apple grassy woodland on floodplains, Sydney Basin (Forest Red Gum - Rough-barked Apple grassy woodland).
Equivalent Map Units	Closest match is Cumberland River-flat Forest (FoW p33) (Tozer et al 2010) and Alluvial Woodland and Riparian forest (NPWS 2002a) though poor condition patches are generally not mapped.
Area	18.4 hectares
Survey effort	Plot/transects 14, 27, 34.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with minimal over storey cover (0 per cent in two of three plots sampled). Species richness, mid storey and native ground forb and shrub cover attributes were at or below benchmark values for this plant community type in the majority of plot/transects sampled. Native grass cover was consistently at or well above benchmark values. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived Swamp Oak or Paperbark low closed woodland or native Blackthorn shrub land. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees and little fallen woody debris (zero in one plot and below benchmark in all plots sampled). There is frequently high exotic plant cover (6-80 per cent in plot/transects sampled) mainly consisting of grasses and herbs.
Conservation significance	Comprises a local occurrence of River-flat Eucalypt Forest which is listed as an EEC under the TSC Act.
Landscape position	On alluvial soils on banks and terraces of drainage lines throughout the site, including Badgerys Creek, Oaky Creek and their tributaries.
Structure	The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived Swamp Oak or Paperbark low closed woodland or native Blackthorn shrub land.
Over storey	Generally absent. Occasional isolated Forest Red Gum, Cabbage Gum or Grey Box.
Mid storey	Patchy and variable. Low cover overall but with occasional very dense patches of Native Blackthorn, Prickly-leaved Tea Tree, Flax-leaved Paperbark and especially Swamp Oak to ten metres tall and up to 29 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses especially Weeping Grass along with Threeawn Speargrass, *Oplismenus aemulus* and Slender Rat's Tail Grass; locally dense patches of sedges such as Slender Flat-sedge and *Cyperus polystachyos*; occasional very dense patches of Native Blackthorn shrubs; low to moderate cover and moderate species richness of herbs such as Kidney Weed, Native Wandering Jew, Indian Pennywort and Lesser Joyweed (*Alternanthera denticulata*); locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp. *trigonos*; and moderate cover and species richness of scramblers such as Amulla, Slender Tick-trefoil (*Desmodium varians*) and *Glycine* species. There are frequent patches of bare earth associated with livestock. Drainage lines and flooded depressions through this vegetation zone feature moderate species richness and cover/abundance of native aquatic herbs and ferns such as *Marsilea mutica, Alternanthera denticulate, Eleocharis cylindrostachys, Triglochin microtuberosa* and *Myriophyllum variifolium*,

Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana, Green Cestrum and Blackberry; localised dense patches of the exotic sedge Sharp Rush (*Juncus acutus* subsp. *acutus*); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as Panic Veldtgrass; widespread wind or bird spread herbs such as Common Sowthistle (*Sonchus oleraceus*), Fireweed, Madeira Winter Cherry and Dandelion; and opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne.
Derived Swamp Oak scrub.	
Derived native grassland with moisture-loving herbs and sedges adjacent to a good condition patch of this vegetation type.	

Table 22 Good condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest

Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest	
Plant community type (OEH, 2015c	HN512 - Broad-leaved Ironbark – Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin (Broad-leaved Ironbark - *Melaleuca decora* grassy open forest).
Equivalent map units	Castlereagh Shale-Gravel Transition Forest (DSF p502) (Tozer et al 2010); Shale Gravel Transition Forest (NPWS 2002a).
Area	8.3 hectares
Survey effort	Plot/transect 1.
Condition (DECC, 2008)	Moderate/good – high. Near-intact, remnant or regrowth native vegetation. Species richness and most native vegetation cover attributes were at benchmark values for this plant community type. All canopy species were observed regenerating. There were no hollow-bearing trees and there was small quantities of fallen woody debris. This vegetation zone contains very little exotic plant cover compared to most of the airport site and included 0 per cent along the transect sampled. Some exotic plants were observed at low cover/abundances in the surrounding plot.
Conservation significance	Comprises a local occurrence of Cumberland Plain Woodland which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of the related community Shale-Gravel Transition Forest which is listed as a separate EEC under the TSC Act.
Landscape position	Occurs on free draining, gravelly clay or sandy clay soils derived from alluvium on mid and upper slopes in the north east of the airport site.
Structure	Open forest with a variable, moderate to dense, structurally complex mid storey and a sparse shrub/grass understorey.
Over storey	Continuous, around 15-25 metres tall and around 25 per cent cover. Features a mixed canopy of Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Forest Red Gum with occasional Thin-leaved Stringybark.
Mid storey	Variable and structurally complex, including mature *Melaleuca decora* to 10 metres tall and up to 40 per cent cover throughout; occasional very dense patches of Native Blackthorn, Black Wattle or Parramatta Wattle to five metres tall and 50 per cent cover and a range of other small trees such as Dwarf Cherry (*Exocarpos strictus*) and Wedge-leaf Hop-bush (*Dodonaea viscosa* subsp. *cuneata*).
Groundcover	Dense and dominated by grasses and grass like plants such as Threeawn Speargrass, Purple Wiregrass (*Aristida ramosa*), Wiry Panic (*Entolasia stricta*), Kangaroo Grass, Wallaby Grass (*Austrodanthonia racemosa*), Slender Chloris (*Chloris divaricata* var. *divaricata*), *Lomandra filiformis* subsp. *filiformis* and Many-flowered Mat-rush. Other understorey species include occasional: localised dense patches of *Melaleuca nodosa* and occasional other shrubs such as shrubs such as Rough Guinea Flower (*Hibbertia aspera*), Prickly Currant Bush (*Coprosma quadrifida*) and Sticky Cassinia (*Cassinia uncata*); herbs such as Pomax (*Pomax umbellata*), Variable Stinkweed (*Opercularia varia*), Slender Wire Lily (*Laxmannia gracilis*) and *Caesia parviflora* var. *vittata*; and scramblers such as *Glycine* species. There are occasional patches of leaf litter, gravel and bare earth.
Exotic species	There was no exotic species recorded along the transect sampled. This plant community type has generally very low exotic plant cover. Exotic plant species recorded include African Love Grass and wind-borne environmental weeds such as Dandelion and Fleabane.

Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest	
A patch of this vegetation zone in the northeast of the airport site, showing the characteristic dense mid storey of *Melaleuca decora* and gravelly soil.	

Table 23 Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest

Poor condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest on clay/gravel	
Plant community type (OEH, 2015c	HN512 - Broad-leaved Ironbark – Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin (Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay/gravel).
Equivalent map units	Castlereagh Shale-Gravel Transition Forest (DSF p502) (Tozer et al 2010) and Shale Gravel Transition Forest (NPWS 2002a) though poor condition patches are generally not mapped.
Area	2.3 hectares
Survey effort	Plot/transect 43
Condition (DECC, 2008)	Moderate/good –poor. Sub-mature regrowth native vegetation. No overstorey other than isolated trees. Species richness and most other native vegetation cover attributes were close to benchmark values for this plant community type. All canopy species were observed regenerating. There were no hollow-bearing trees and very little fallen woody debris.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines (DEWHA, 2010d). Comprises a local occurrence of the related community Shale-Gravel Transition Forest which is listed as an EEC under the TSC Act.
Landscape position	Occurs on free draining, gravelly clay or sandy clay soils derived from alluvium on mid and upper slopes in the north east of the airport site.
Structure	Derived scrub, shrubland or grassland.
Over storey	Generally absent. Occasional isolated Broad-leaved Ironbark or Grey Box.
Mid storey	Patchy and variable. Moderate cover overall but with occasional very dense patches of *Melaleuca nodosa, Melaleuca decora* or Native Blackthorn to five metres tall.
Groundcover	Areas of derived grassland feature a dense cover of grasses and grass like plants such as Threeawn Speargrass, Wiry Panic, Kangaroo Grass, Weeping Grass, Two-colour Panic and *Lomandra filiformis* subsp. *filiformis*. Areas of derived scrub or shrubland feature a diverse patchy mix of sub mature mid storey species such as Wedge-leaf Hop-bush and *Melaleuca nodosa,* shrubs such as Rough Guinea Flower and Peach Heath, herbs such as Pomax and Hairy Stinkweed; and scramblers such as *Glycine* species. There are occasional substantial patches of leaf litter, gravel and bare earth.
Exotic species	There is moderate to high exotic plant cover throughout, including African Love Grass, Fleabane, Paddys Lucerne, Kikuyu and a diverse mix of assorted garden escapees.
A patch of derived *Melaleuca* scrub.	

Table 24 Good condition artificial freshwater wetland on floodplain

Good condition artificial freshwater wetland on floodplain (HN630)	
Plant community type (OEH, 2015c	HN630 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin (Freshwater wetland).
Equivalent map unit	Closest match is Coastal Freshwater lagoon (FrW p313) though both natural and artificial examples have not been mapped because patches are too small to model (Tozer et al 2010). NPWS (2002) does not map or describe freshwater wetlands.
Area	35.4 hectares
Survey effort	Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9,10,11.
Condition (DECC, 2008)	Moderate/good. Near-intact, remnant native vegetation where this plant community type occurs throughout the majority of the airport site. Structure and species composition has probably been affected by changes to the drainage of the airport site, including creation of near-permanently inundated sedgelands upstream of culverts. These changes fall within the natural range of variation of the community.
Conservation significance	Not listed under the EPBC Act. Does not comprise an occurrence of the TEC 'Freshwater wetlands on coastal floodplains' listed under the TSC Act because artificial wetlands created on previously dry land are not regarded as part of this community (DECC, 2008).
Landscape position	Occurs on near-permanently inundated soils derived from alluvium on lower flats, depressions and drainage lines throughout the airport site. Vegetation structure appears to vary with inundation frequency and depth and also proximity to native woodland or forest.
Structure	Sedgeland or wet herbfield with a variable, moderate to dense understorey of shrubs, grasses, sedges, rushes and herbs. Artificial water bodies without native wetland vegetation have not been included in this vegetation zone. Large water bodies have been identified and included in 'Cleared land and cropland'. A number of smaller water bodies also fall within the mapped area of 'Exotic grassland'.
Over storey	Generally absent. Occasional isolated Cabbage Gum, *Melaleuca decora,* Flax-leaved Paperbark or Swamp Oak.
Mid storey	Generally absent. Occasional patches of *Melaleuca* species or Tantoon (*Leptospermum polygalifolium*) to two metres tall and up to 70 per cent cover.
Groundcover	Dense, structurally complex and variable. The most widespread form is a rushland, of species such as Common Reed (*Phragmites australis*), Cumbungi (*Typha orientalis*), Spike Rush and *Schoenoplectus validus*. Other wetland species include: moisture loving grasses such as Water Couch (*Zoysia macrantha* and Cooch; floating aquatic ferns such as Nardoo (*Marsilea mutica)* and *Azolla* species; emergent aquatic herbs such as Wooly Frogmouth (*Phylidrum lanuginosum), Persicaria* species and *Ludwigia peploides* subs. *montevidensis*; submerged aquatic herbs such as *Triglochin microtuberosum* and *Myriophyllum* species; and moisture loving herbs of wetland margins such as *Centella asiatica* and Swamp Goodenia (*Goodenia paniculata*).
Exotic species	There is generally low to moderate exotic plant cover. There is low to moderate cover of exotic moisture loving herbs such as *Ludwigia peruviana* throughout and occasional localised dense patches of the exotic sedge Sharp Rush. They are frequently fringed by African Love Grass or pasture grasses because the majority of these freshwater wetlands are surrounded by exotic grassland in cleared agricultural land. There is a localised severe infestation of Alligator Weed (*Alternanthera philoxeroides*) in the north western portion of the airport site associated with a dammed section of Oaky Creek.

Good condition artificial freshwater wetland on floodplain (HN630)	
An artificial freshwater wetland with native emergent rushes, fringing sedges and floating aquatic ferns surrounded by derived native grassland and exotic pasture grasses.	
An artificial freshwater wetland with native emergent rushes and sedges, water-loving grasses and herbs and floating aquatic ferns surrounded by native riparian forest.	

Table 25 Exotic grassland

Exotic grassland	
Plant community type (OEH, 2015c	No equivalent plant community type.
Area	956.8 hectares
Survey effort	Plot/transects 3 and 4.
Condition (DECC, 2008)	Cleared. Very low native over storey and no mid storey cover. Less than 50 per cent of the ground cover present is native and native cover is frequently less than 10 per cent.
Conservation significance	Exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensive areas are associated with lower slopes and alluvial flats adjoining Badgerys Creek in the east of the airport site and gently undulating terrain through the central portion of the airport site.
Structure	Closed tussock grassland or closed stoloniferous (i.e. running along the ground) grassland. Some areas of exotic garden vegetation, artificial water bodies, gravel tracks, houses and farm infrastructure have been included in the mapped extent of this vegetation zone.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic grasses as described below. A patchy and variable cover of native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as Common Fringe-sedge; and scramblers such as *Glycine* species. There are occasional extensive areas of bare earth associated with grazing, top soil removal or dumped fill.
Exotic species	Moderate to very high exotic plant cover dominated by pasture grasses such as Kikuyu, *Setaria parviflora* and Carpet Grass (*Axonopus fissifolius).* There are also extensive areas dominated by noxious or environmental weeds such as African Love Grass, Khaki Weed (*Alternanthera pungens*), Blackberry (*Rubus fruticosus* species aggregate) or Noogoora Burr (*Xanthium occidentale)* and infestations of environmental weeds such as Dandelion, Rhodes Grass (*Chloris gayana*), *Solanum sysimbrifolium*, Stinkgrass (*Eragrostis cilianensis*) and Lamb's Tongues (*Plantago lanceolata*) throughout.
Heavily grazed exotic grassland.	

Exotic grassland	
Ungrazed exotic grassland.	

Table 26 Cleared land and cropland

Cleared land and cropland	
Plant community type (OEH, 2015c	No equivalent plant community type.
Area	348.2 hectares
Survey effort	General observations.
Condition (DECC, 2008)	Cleared. No native over storey or mid storey. Less than 50 per cent of the ground cover present is native and/or >90 per cent of the ground cover is bare earth or hard stand.
Conservation significance	Cleared land or exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensively cleared areas are associated with small rural residential lots in the suburb of Badgerys Creek in the east of the airport site, a quarry in the central north of the site and cropland on gently undulating terrain through the central portion of the airport site.
Structure	No natural structural equivalent. This vegetation zone includes planted or fallow cropland, exotic garden vegetation, artificial water bodies, bitumen roads and tracks, a quarry, houses and farm infrastructure.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic crops or weeds as described below. Patchy and variable cover of opportunistic native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as *Juncus usitasis* and scramblers such as *Glycine* species. There are extensive areas of infrastructure or bare earth associated with quarrying, race tracks, fallow cropland, top soil removal or dumped fill.
Exotic species	There is patchy and variable exotic plant cover dominated by flower, grain or vegetable crops. There are also extensive areas dominated by noxious or environmental weeds such as African Olive, Blackberry or Inkweed (*Phytolacca octandra)* and minor infestations of environmental weeds such as African Love Grass, *Bidens* species, Rhodes Grass, *Solanum sysimbrifolium* and Lamb's Tongues throughout.
Extensive green houses comprising cleared land, distinct from the surrounding exotic grassland.	

Cleared land and cropland	
Ploughed cropland at the location of previous records of *Pultenaea parviflora* (Biosis 1999; SMEC 2014) (see Section 4.5.2). Part of an extensive commercial farm in the centre of the site.	

4.2.3 Noxious and environmental weeds

The Australian Weeds Strategy (AWS) provides a framework to establish consistent guidelines for all parties, identifying priorities for weed management across the nation with the aim of minimising the impact of weeds on Australia's environmental, economic and social assets (AWS 2015). The AWS includes the identification of ‘weeds of national significance’ (WoNS) which are recognised as Australia’s worst invasive plants. These weeds cause negative impacts to many of Australia’s natural and productive landscapes. A total of nine WoNs were observed at the airport site (Table 27).

Eight of the WoNS recorded at the airport site are also listed as noxious weeds under the NW Act in the Liverpool Local Government Area control area surrounding the airport site. A further seven listed noxious weed species were recorded at the airport site (DPI 2015b). The Noxious Weeds Act Control Category and control requirements for these species are included in Table 27. Noxious weeds are placed into one of five categories, with control requirements of Class 1 weeds the most onerous (is total eradication) and no control requirements for Class 5 weeds, although Class 5 weeds are notifiable and have restrictions on their sale and movement. These control requirements are not a legal requirement on Commonwealth land, however have been included as a guide to the comparative seriousness of each weed species.

As stated in Section 4.2.1 the airport site is likely to contain additional exotic plant species to those revealed by the field surveys because survey effort was not focussed on domestic gardens and other areas that were dominated by exotic plants. The airport site may therefore contain additional WoNS and noxious weeds. Those species identified in Table 27 should be considered a guide to the most serious and widespread of the weeds at the airport site.

Table 27 Noxious weeds and WoNS recorded at the airport site

Scientific Name	Common Name	WoNS (AWS 2015)	NW Act Control Category (DPI 2015b)	Control Requirements (DPI 2015b)
Alternanthera philoxeroides	Alligator Weed	Yes	3	The plant must be fully and continuously suppressed and destroyed.
Anredeira cordifolia	Madeira Vine	Yes		
Asparagus asparagoides	Bridal Creeper	Yes	4	The plant must not be sold, propagated or knowingly distributed.
Bryophyllum species	Mother of Millions	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
Cestrum parqui	Green Cestrum	No	3	The plant must be fully and continuously suppressed and destroyed.
Cortaderia selloana	Pampas Grass	No	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.
Lantana camara	Lantana	Yes	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold, propagated or knowingly distributed.
Ligustrum lucidum	Small-leaved Privet-	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Ligustrum sinense	Broad-leaved Privet	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Lycium feroccissimum	African Boxthorn	Yes	4	The plant must not be sold, propagated or knowingly distributed.
Olea europa subsp. *cuspidata*	African Olive	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.

Scientific Name	Common Name	WoNS (AWS 2015)	NW Act Control Category (DPI 2015b)	Control Requirements (DPI 2015b)
Opuntia stricta	Common Prickly Pear	Yes	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
Ricinus communis	Castor Oil Plant	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Rubus fruticosus species aggregate	Blackberry	Yes	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed. This is an All of NSW declaration.
Salvinia molesta	Salvinia	Yes	2	Regionally Prohibited Weed. The plant must be eradicated from the land and that land must be kept free of the plant.
Senecio madagascariensis	Fireweed	Yes	4	The plant must not be sold, propagated or knowingly distributed.

Blackberry infestation in an area of exotic grassland.

Scientific Name	Common Name	WoNS (AWS 2015)	NW Act Control Category (DPI 2015b)	Control Requirements (DPI 2015b)

African Olive, African Boxthorn and exotic grasses and herbs in remnant woodland in a road corridor.

The distribution and abundance of WoNS and noxious weeds are linked to disturbance. Particularly severe or extensive infestations include:

- Madeira Vine, Bridal Creeper, Lantana, privet species and African Olive in the riparian corridor of Badgerys Creek.
- African Olive and privet species in the riparian corridors of small drainage lines in the west of the airport site.
- Alligator Weed in dammed sections of Oaky Creek and the adjoining floodplain in the north of the airport site.
- African Boxthorn, African Olive, Common Prickly Pear and Blackberry on the margins of commercial farms in the centre of the airport site and on rural residential lots in the suburb of Badgerys Creek.

There are patchy, generally minor infestations of wind and vehicle-spread environmental weeds throughout the airport site. These widespread weeds include African Love Grass and herbs such as Dandelion, Fleabane, Cobblers Pegs and the WoNs Fireweed.

4.2.4 Groundwater dependent ecosystems

The Atlas of Groundwater Dependent Ecosystems (GDEs) (BOM 2015c) maps known groundwater dependent ecosystems and ecosystems that potentially use groundwater. It shows ecosystems that interact with the subsurface expression of groundwater (including vegetation ecosystems) or the surface expression of groundwater (such as rivers and wetlands). In addition, the Atlas shows the likelihood that landscapes are accessing water in addition to rainfall, such as soil water, surface water or groundwater.

No watercourses in or immediately adjoining the airport site are mapped as GDEs. Thompsons Creek and South Creek located in the catchment downstream from the airport site and the Nepean River to the west are mapped as ecosystems reliant on the surface expression of groundwater.

Most large patches of native vegetation (including riparian vegetation) at the airport site are mapped as having a high potential for groundwater interaction (i.e. they are likely to be GDEs that are reliant on subsurface groundwater) (BOM 2015c). Some smaller patches of native vegetation are mapped as having a low or moderate potential for groundwater interaction. Native vegetation along Badgerys Creek is mapped as being highly likely to be an inflow dependent ecosystem (i.e. likely to be accessing water in addition to rainfall, such as soil water surface water or groundwater). Most other patches of native vegetation at the airport site are also mapped as being likely to be inflow dependent (BOM 2015c).

As part of the NSW Office of Water's risk assessment guidelines for GDEs, the probability of vegetation types in coastal NSW being GDEs was assessed by Kuginis et al (2012). According to Kuginis et al (2012) all native vegetation types present at the airport site are likely to be GDEs. Given the above mapping by BOM (2015c) and identification of GDEs by Kuginis et al (2012), it is assumed native vegetation at the airport site is groundwater dependent, at least to some degree.

4.3 Terrestrial fauna species and habitats

4.3.1 Fauna species

A high diversity of fauna species was recorded at the airport site during the recent surveys and the surveys by Biosis Research (1997) and SMEC (2014). A total of 173 fauna species were recorded during the recent survey, including 127 bird species, 10 bat species, 10 terrestrial or arboreal mammal species, 10 frog species, 10 reptile species, four snail species, and two fish species. As many as 10 other microchiropteran bat species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. A further 20 fauna species, including 10 bird species, seven mammal species, two reptile species and one frog species were recorded by Biosis Research (1997) and/or SMEC (2014). The full list of species recorded is presented in Appendix C.

One threatened fauna species listed under the EPBC Act was recorded at the airport site. The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded during the recent surveys and the surveys for the 1999 EIS (PPK 1999). A further 10 threatened fauna species listed under the TSC Act (but not under the EPBC Act) have been recorded at the airport site during current and previous surveys. These are discussed in more detail in Section 4.5.3. Locations of threatened fauna recorded at the airport site are shown on Figure 6.

A number of introduced fauna species were recorded. These included seven bird species, six mammal species (including the Red Fox (*Vulpes vulpes*), Goat (*Capra hircus*) and Rabbit (*Oryctolagus cuniculus*), one fish species (Mosquitofish (*Gambusia holbrooki*)), and two snail species.

4.3.2 Fauna habitats

Five broad fauna habitat types were recorded within the airport site:

- grassland and cropped areas;
- native woodland;
- riparian forest;
- dams; and
- buildings and other structures.

These are described in Table 28 to Table 32 below.

Table 28 Fauna habitats of grassland and cropped areas

Grassland and cropped areas		
Description	The majority of the airport site contains grassland within fenced grazing land. These areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture. Exotic grassland and cleared land contain few habitat resources of relevance to most native species due to low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species. Occasional paddock trees and shrubs (e.g Native Blackthorn or African Olive) also occur in these areas. Regrowth trees and shrubs would provide some foraging resources for native woodland birds. Most of the species recorded in grassland areas would use these areas as an adjunct to the higher quality, more extensive areas of suitable habitat at and adjoining the airport site. Some small fauna species such as lizards may rely on grassland habitat for their survival.	
Typical fauna species recorded	Bird species commonly recorded in this habitat type include the Magpie-lark (*Grallina cyanoleuca*), Australian Magpie (*Cracticus tibicen*), Australian Raven (*Corvus coronoides*), White-winged Chough (*Corcorax melanorhamphos*), Australian Pipit (*Anthus novaeseelandiae*) and Welcome Swallow (*Hirundo neoxema*). Use of fertiliser in some paddocks led to large number of birds such as the Straw-necked Ibis (*Threskiornis spinicollis*) foraging in fields. Where grass was long, cryptic species such as the Brown Quail (*Coturnix ypsilophora*) were sometimes observed. A range of raptors were recorded hunting over the grassland areas. These included the Black-shouldered Kite (*Elanus axillaris*), Brown Falcon (*Falco berigora*), Wedge-tailed Eagle (*Aquila audax*) and the Little Eagle (*Hieraaetus morphnoides*). Double-barred Finches (*Taeniopygia bichenovii*), Yellow-rumped Thornbills (*Acanthiza chrysorrhoa*) and Superb Fairy-wrens (*Malurus superbus*) were observed where shrubs and paddock trees were present. Grassland and cropped areas provide foraging habitat for larger herbivorous species, including the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*). These mammals were recorded only in small numbers. Bats typical of open agricultural land such as the White-striped Freetail Bat (*Tadarida australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*) were recorded. Grassland areas also provides habitat for a range of reptile species, including snakes and small lizards. Small grass skinks (*Lampropholis* spp.) were observed, as was a Red-bellied Black-snake (*Pseudechis porphyriacus*). Spotted Grass Frogs (*Limnodynastes tasmaniensis*) were heard calling from small soaks in grassland areas and an Eastern Dwarf Tree Frog (*Litoria fallax*) was recorded in thick grass.	
Threatened fauna species recorded	Little Eagle (*Hieraaetus morphnoides*) (TSC Act)	Forages for rabbits and other mammals in grassland.
Migratory fauna species recorded	Cattle Egret (*Ardea ibis*)	Foraging in fields in association with cattle. Roosting in paddock trees.
	White-throated Needletail (*Hirundapus caudacutus*)	Foraging for insects above grassland areas.
Introduced species recorded	European Rabbit (*Oryctolagus cuniculus*) Brown Hare (*Lepus europaeus*) Red Fox (*Vulpes vulpes*) House Mouse (*Mus musculus*)	

Grassland and cropped areas

Cropped land.

Exotic grassland.

Table 29 Fauna habitats of native woodland

Native Woodland	
Description	Native woodland at the airport site provides moderate quality fauna habitats. Habitat resources include: mature canopy trees (i.e. trees between 20 to 80% of their life expectancy) and associated nectar, fruits and leaves as well as foraging substrate; a range of fruiting and flowering small trees and shrubs; and connectivity with wetland and aquatic habitat. Woodland and forest at the airport site forms some more extensive patches particularly where it is connected by riparian corridors (see Figure 3) however the majority is fragmented and subject to edge effects. There are roads, residences, agriculture and industry throughout the airport site and associated noise and light disturbance and barriers to fauna movement. Grazing and the presence of exotic pest fauna would further reduce the value of habitats. The airport site and broader airport site contain only moderate quantities of pre-European occupation age trees and associated habitat resources such as tree hollows and stags. These trees include hollows with a range of sizes, orientations and landscape positions and both living and dead trees. *Eucalyptus* species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and Native Blackthorn would help provide year-round foraging resources for a range of native birds, bats and mammals. Much of the shrub and ground layer vegetation and habitat features of the woodland and forest in the airport site have been removed and 'cleaned up' for grazing. Woodland at the airport site generally contains low quantities of woody debris and leaf litter, although some patches have higher quantities of these resources. Fallen timber and leaf litter provides shelter habitat for small reptiles, snakes and small mammals. A number of termite mounds were observed within the airport site.
Typical fauna species recorded	Nectarivorous species including the Eastern Spinebill (*Acanthorhynchus tenuirostris*) and White-plumed Honeyeater (*Lichenostomus penicillatus*) were recorded foraging in woodland areas. Insectivorous species recorded included the Rufous Whistler (*Pachycephala rufiventris*), Golden Whistler (*Pachycephala pectoralis*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Eastern Yellow Robin (*Eopsaltria australis*) and Grey Shrike-thrush (*Colluricincla harmonica*). In some woodland patches Bell Miners (*Manorina melanophrys*) were dominant. Small and gregarious flocking bird species such as Silvereye (*Zosterops lateralis*), Red-browed Finches (*Neochmia temporalis*), Double-barred Finches (*Taeniopygia bichenovii*), White-browed Scrubwren (*Sericornis frontalis*) and Grey Fantail (*Rhipidura albiscapa*) were recorded foraging in the shrubby midstorey where this was present. Hollow-bearing trees provide nesting habitat for species such as the Galah (*Eolophus roseicapilla*), Eastern Rosella (*Platycercus eximius*) and Common Brush-tailed Possum (*Trichosurus vulpecula*). Microbat species recorded included species typical of open woodland and/or agricultural areas, and some species that require large tracts of continuous vegetation. The East Coast Freetail Bat (*Mormopterus (Micronomus) norfolkensis*) was the most common microchiropteran bat species recorded at the airport site. Other species included the Chocolate Wattled Bat (*Chalinolobus morio*) and Eastern Freetail Bat (*Mormopterus ridei*). The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), which does require larger tracts, was possibly recorded during recent surveys and recorded previously by Biosis Research (1999). This species may use the Badgerys Creek corridor and large adjacent woodland patches for foraging and breeding. Elegant Snake-eyed Skinks (*Cryptobepharus pulcher*) were regularly observed basking on logs and timber, and Dark-flecked Garden Sunskinks (*Lampropholis delicata*) were regularly observed in the leaf litter. The Cumberland Plain Land Snail (*Meridolum corneovirens*) and Common Southern Carnivorous Snail (*Austrorhytida capillacea*) were recorded where deep litter occurred at the base of trees. Termite mounds showed some evidence of disturbance, most likely from Short-beaked Echidnas (*Tachyglossus aculeatus*).

Native Woodland		
Threatened fauna species recorded	Grey-headed Flying-fox (*Pteropus poliocephalus*) EPBC Act/TSC Act	Would forage throughout woodland patches. No breeding habitat present.
	East Coast Freetail Bat (*Mormopterus norfolkensis*) - TSC Act	Would forage throughout woodland patches. May breed in hollow-bearing trees.
	Little Lorikeet (*Glossopsitta pusilla*) - TSC Act	Would forage throughout woodland patches. Unlikely to breed in the area.
	Scarlet Robin (*Petroica boodang*) - TSC Act	Would forage throughout woodland patches. Unlikely to breed in the area.
	Varied Sittella (*Daphoenositta chrysoptera*) - TSC Act	Would forage throughout woodland patches. May breed in the area.
	Cumberland Plain Land Snail (*Meridolum corneovirens*) - TSC Act	Occurs in leaf litter in woodland patches.
Migratory fauna species recorded	Rufous Fantail (*Rhipidura rufifrons*)	Would forage throughout woodland patches. Unlikely to breed in the area.
Introduced species recorded	Garden Snail (*Cantareus aspersa*) Asian Tramp Snail (*Bradybaena similaris*)	

Shale-Gravel Transition Forest.

Cumberland Plain Woodland.

Table 30 Fauna habitats of riparian forest

Riparian forest	
Description	There is a relatively extensive network of drainage lines and waterbodies across the airport site. Most drainage lines feature moderate geomorphorphic condition, generally contain good instream and riparian vegetation but moderate to severe weed infestation and some evidence of degradation by cattle such as grazing, bank erosion, increased turbidity and probably also nutrient enrichment from waste. The main creek is Badgerys Creek which runs from the south-west along the southern and eastern boundaries of the airport site. Much of Badgerys Creek is vegetated. Creek banks are generally steep and are often dominated by weeds. Some patches of emergent aquatic vegetation (eg *Typha*) are present along the creek. Riparian forest is a closed woodland or forest of eucalypts with Swamp Oak (*Casuarina glauca*) present along the margins of the creeks. This species also occurs on the associated flats. A range of paperbarks (*Melaleuca* spp.) are also present. Understorey vegetation is similar to the adjacent native woodland along with additional moisture loving species such rushes and sedges. Large, hollow-bearing trees tend to occur in higher densities along the riparian corridor than in other woodland patches. *Eucalyptus* and other species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and paperbarks would help provide year-round foraging resources for a range of native birds, bats and mammals. Much of the shrub and ground layer vegetation and habitat features of the riparian areas in the airport site have been removed and 'cleaned up' for grazing. Low quantities of woody debris and leaf litter are present, although some patches have higher quantities of these resources. Fallen timber and leaf litter provides shelter habitat for small reptiles, snakes and small mammals. Dense weed infestations are present along the creek banks which may also reduce habitat quality for some species. Drainage lines provide habitat for native fish and aquatic invertebrates and breeding habitat for a number of stream breeding frogs. These drainage lines are not suitable habitat for any of the threatened frogs with the potential to occur in the locality, which are generally associated with clear, rocky streams located on sandstone substrates higher in the catchment.
Typical fauna species recorded	A higher diversity of bird species tended to occur along the Badgerys Creek riparian corridor compared to woodland patches. Species recorded included the Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*), and Black Bittern (*Ixobrychus flavicollis*), listed as vulnerable species under the TSC Act. The migratory Rufous Whistler (*Rhipidura rufifrons*) was observed at a number of locations, including along Badgerys Creek. Other species included the Scarlet Honeyeater (*Myzomela sanguinolenta*), Weebill (*Smicrornis brevirostris*), Olive-backed Oriole (*Oriolus sagittatus*), Fan-tailed Cuckoo (*Cacomantis flabelliformis*), Eastern Shrike-tit (*Falcunculus frontatus*), Azure Kingfisher (*Ceyx azureus*) and Buff-rumped Thornbill (*Acanthiza reguloides*). Some of these species also occurred in woodland patches away from riparian corridors. The Swamp Wallaby (*Wallabia bicolor*) was recorded along the riparian corridor. A small colony of microbats was observed under the bridge over Badgerys Creek on Badgerys Creek Road. Microbats recorded included the East Coast Freetail Bat (*Mormopterus norfolkensis*) and the Large-footed Myotis (*Myotis macropus*) (probable record). This latter species would forage along the creek and nearby dams. Eastern Snake-necked Turtles (*Chelodina longicolllis*) were observed on occasion in the creeks. Also recorded were Eastern Water Skinks (*Egernia quoyii*) and Australian Water Dragons (*Intellagama lesueurii*). The Striped Marsh Frog (*Limnodynastes peroni*) was the most common frog heard calling along the creeks. Native fish such as gudgeons were observed, as well as introduced species such as the Mosquitofish (*Gambusia holbrooki*).

Riparian forest		
Threatened fauna species recorded	Grey-headed Flying-fox (*Pteropus poliocephalus*) EPBC Act/TSC Act	Would forage throughout riparian forest. No breeding habitat present.
	East Coast Freetail Bat (*Mormopterus norfolkensis*) - TSC Act	Would forage throughout riparian forest. May breed in hollow-bearing trees.
	Large-footed Myotis (*Myotis macropus*) – TSC Act	Would forage along creeklines. May roost in hollow-bearing trees.
	Little Lorikeet (*Glossopsitta pusilla*) - TSC Act	Would forage throughout riparian forest. Unlikely to breed in the area.
	Scarlet Robin (*Petroica boodang*) - TSC Act	Would forage throughout riparian forest. Unlikely to breed in the area.
	Varied Sittella (*Daphoenositta chrysoptera*) - TSC Act	Would forage throughout riparian forest. May breed in the area.
	Black Bittern (*Ixobrychus flavicollis*) – TSC Act	Would forage and may breed within the riparian forest.
	Cumberland Plain Land Snail (*Meridolum corneovirens*) - TSC Act	Occurs in leaf litter along the outer margins of the riparian forest, where it intergrades with Cumberland Plain Woodland.
Migratory fauna species recorded	Rufous Fantail (*Rhipidura rufifrons*)	Would forage throughout riparian forest. Unlikely to breed in the area.
Introduced species recorded	Garden Snail (*Cantareus aspersa*) Asian Tramp Snail (*Bradybaena similaris*)	


Riparian forest in poorer condition along Badgerys Creek.


Riparian forest in good condition adjacent to Badgerys Creek.

Table 31 Fauna habitats of dams

Dams		
Description	There are a number of dams and flooded depressions in the airport site with varying growth of native wetland and aquatic plants, including some water bodies with extensive reed beds. These range in habitat value for native fauna depending on their size, presence of emergent or aquatic vegetation, and level of use by cattle and associated disturbance. Many dams contained a variety of aquatic vegetation, including *Typha orientalis*, *Eleocharis cylindrostachys*, and *Eleocharis sphacelata* and have been mapped as a native freshwater wetland vegetation zone (see Table 24).	
Typical fauna species recorded	A moderate diversity and abundance of native waterfowl, waders and other wetland birds were observed in these water bodies. Three migratory waterbirds, the Cattle Egret (*Ardea ibis*), Eastern Great Egret (*Ardea modesta*) and Lathams Snipe (*Gallinago hardwickii*) were recorded. The White-bellied Sea-eagle (*Haliaeetus leucogaster*) was observed on a number of occasions roosting near or flying over a number of dams. A range of ducks and grebes was observed, including various common species and three threatened Blue-billed Ducks (*Oxyura australis*). Large flocks of ibis (*Threskiornis* spp.), herons (*Ardea* spp. and *Egretta* spp.), and cormorants (*Phalacrocorax* spp.) were observed. Coots, moorhens and swamphens were common. Occasional Black-winged Stilts (*Himantopus himantopus*), spoonbills (*Platalea* spp.) and Black-fronted Dotterels (*Elseyornis melanops*) were observed. Australian Reed Warblers (*Acrocephalus australis*) and Golden-headed Cisticolas (*Cisticola exilis*) were recorded at dams with dense stands of reeds. A range of frog species was recorded during targeted nocturnal surveys. These included Peron's Tree Frog (*Litoria peronii*), Verreaux's Tree Frog (*Litoria verreauxii*), Eastern Dwarf Tree Frog (*Litoria fallax*), Broad-palmed Frog (*Litoria latopalmata*), Striped Marsh Frog (*Lymnodynastes peronii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), and Common Eastern Froglet (*Crinia signifera*). Also heard calling nearby in damp grassy areas were the Smooth Toadlet (*Uperoleia laevigata*), Wrinkled Toadlet (*Uperoleia rugosa*) and Bibron's Toadlet (*Pseudophryne bibroni*). Potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) is present at many dams however none were recorded during targeted surveys. Eastern Snake-necked Turtles (*Chelodinia longicolllis*) were observed in a number of dams and moving between dams. Red-bellied Black-Snakes (*Pseudechis porphyriacus*) were observed near dams and this species is likely to hunt for frogs in these areas. Long-finned Eels (*Anguilla rhinehardtii*) and Mosquitofish (*Gambusia holbrooki*) were also observed in a number of dams.	
Threatened fauna species recorded	Blue-billed Duck (*Oxyura australis*) – TSC Act	Would forage in dams on occasion when birds are present in the locality. Highly unlikely to breed in the area.
Migratory fauna species recorded	Latham's Snipe (*Gallinago hardwickii*)	Would forage and may breed around margins of dams.
	Cattle Egret (*Ardea ibis*)	Would forage around margins of dams.
	Eastern Great Egret (*Ardea alba*)	Would forage around margins of dams.
Introduced species recorded	Red Fox (*Vulpes vulpes*) Mosquitofish (*Gambusia holbrooki*)	

Dams

Typical farm dam in open paddock.

Larger farm dam adjacent to riparian forest.

Table 32 Fauna habitats of buildings and other structures

Buildings and other structures		
Description	A number of sheds and buildings are present at the airport site. These provide roosting habitat for birds and microbats. Sheds and buildings are also likely to provide shelter for rodents and snakes. Roosting microbats were observed under the bridge over Badgerys Creek on Badgerys Creek Road. Anabats were placed at this location and large numbers of calls probably attributed to the Large-footed Myotis were recorded.	
Typical fauna species recorded	Birds observed roosting in buildings and under bridges included Welcome Swallows (*Hirundo neoxena*) and Fairy Martins (*Petrochelidon ariel*). A Barn Owl (*Tyto javanica*) was heard one night, and may also roost in old buildings and sheds at the airport site. A number of bat species, small mammals and snakes may also utilise old buildings at the site. Note however that many houses and sheds are currently being demolished at the airport site, reducing the incidence of this habitat feature. The Large-footed Myotis (*Myotis macropus*) listed as vulnerable under the TSC Act was tentatively (Probable) identified from the call analysis under the bridge over Badgerys Creek on Badgerys Creek Road.	
Threatened fauna species recorded	Large-footed Myotis (*Myotis macropus*) – TSC Act	Possible colony recorded under a bridge over Badgerys Creek. Likely to forage over open water and may also roost in tree hollows.
Introduced species recorded	House Mouse (*Mus musculus*)	

Roosting bats and swallow nests under Badgerys Creek Road bridge.

4.3.3 Connectivity

Wildlife corridors are vital for the maintenance of ecological processes, including the movement of animals and the continuation of viable populations. Corridors can consist of a sequence of stepping stones across the landscape (discontinuous areas of habitat such as paddock trees, wetlands and roadside vegetation), continuous lineal strips of vegetation and habitat (such as riparian strips, ridge lines etc.), or they may be parts of an extensive patch of vegetation (DEC 2004b).

Connectivity of vegetation at the airport site with vegetation outside the airport site is limited (see Figure 7). As is the case within the site, most vegetation in the locality occurs as small patches, with long linear patches of vegetation tending to occur along creek lines. The Badgerys Creek corridor remains generally vegetated to the north of the site, albeit with some gaps in vegetation cover. It then links to the South Creek and Cosgrove Creek vegetated corridors. The

Western Sydney Urban Bushland Biodiversity Survey (NPWS 1997) identified a number of riparian corridors as targets for conservation within the Liverpool LGA, such as South Creek and Kemps Creek, but did not specifically include the Badgerys Creek corridor. More recent work by EcoLogical Australia (2012) mapped corridors along riparian areas and linked core stands of vegetation that exceeded a minimum size threshold. In this study, most native vegetation in the airport site was mapped as 'regional core'. These lands were considered significant to achieving local conservation management goals and were recommended for protection. All regional core vegetation in the Liverpool LGA was mapped as providing regional connectivity. This includes the Badgerys Creek Corridor.

Most patches of native vegetation at the airport site were mapped by Ecological Australia (2012) as being linked, and thus having a patch size of greater than 100 hectares. There is only limited connectivity however with other patches of vegetation outside the airport site. Large expanses of cleared land occur along the northern edge of Elizabeth Drive and Adam's Road. Small patches of vegetation to the south and west provide 'stepping stones' to other patches of vegetation outside the airport site.

Connectivity for fauna species is thus mainly along the Badgerys Creek riparian corridor or between closely linked patches within the airport site. Species with only limited mobility, such as the Cumberland Plain Land Snail, have minimal opportunities for dispersal. The Cumberland Plain Land Snail would generally be restricted to isolated patches of vegetation in which the local population occurs, with no opportunity for movement between patches that are separated by grassland or cleared land. Small woodland birds would tend to move along the riparian corridors or along roadside vegetation to access other areas of habitat. More mobile fauna, such as Grey-headed Flying-foxes and larger birds would move easily between patches of vegetation at the airport site and other areas of habitat in the locality.

Habitat connectivity through and outside the airport site would be further reduced by development in coming years. The Western Sydney Priority Growth Area plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands (DoP 2010). The Northern Road upgrade and realignment would comprise a barrier to fauna movement along the western boundary of the airport site. Likely future road and rail links to the airport site would further fragment and isolate habitat (see Section 7). The Badgerys Creek riparian corridor is likely to continue to function as an important fauna movement corridor.

4.4 Aquatic habitats and species

4.4.1 Overview of on site and downstream aquatic environments

The airport site is located in the upper reaches of the catchments of Badgerys, South and Oaky/Cosgrove Creeks, which flow northward from the site and drain to the Hawkesbury River, and Duncans Creek which flows westward and drains into the Nepean River. Badgerys and South Creeks converge approximately 4 kilometres downstream of the airport site, at the edge of the Twin Creeks Golf and Country Club. Cosgroves Creek subsequently converges with South Creek north of the Country Club.

Approximately 70 per cent of the total length of the mapped watercourses on the airport site are first and second order watercourses (GHD 2016b). Badgerys Creek has the highest stream order on the site, being fourth order for most of its length along the eastern boundary of the airport site. Downstream of the airport site, Badgerys and Cosgrove Creeks are 4th order watercourses, Oaky Creek is a 3rd order watercourse and Duncans Creek is a 5th order watercourse. The Strahler stream order of mapped watercourses on the airport site and downstream are displayed in Figure 4-12 of the Surface Water Hydrology and Geomorpholoy Report. There are also numerous farm dams constructed along watercourses, accounting for 16 per cent of the mapped watercourse length on the airport site.

The creeklines and tributaries on the airport site traverse cleared agricultural land and support a modified riparian corridor of native River-flat Eucalypt Forest of medium-high to low condition. The creek channels support native macrophytes and dense patches of declared noxious weeds occur at some locations.

Downstream of the airport site, Badgerys, Oakey, Cosgroves and Duncans Creeks also pass through predominantly cleared agricultural land. Remnant native vegetation within the downstream riparian corridors where present is composed of medium-poor to low condition River-flat Eucalypt Forest which extends up to ~20m from creek banks. As within the airport site, the vegetation has been heavily modified following many decades of agricultural activity and development. Dense patches of native and exotic aquatic vegetation are present throughout the creek channels.

Both through and downstream of the airport site, Badgerys, Cosgroves and Duncans Creeks display evidence of past and ongoing bed degradation. This is evidenced through the presence of active headcuts and over-steepened eroding banks. As a result, despite often having a generally well-vegetated riparian zone, these watercourses are considered to be in moderate geomorphic condition (GHD 2016b). Tributaries of Badgerys and Cosgroves Creeks across the airport site are also considered to be in largely moderate geomorphic condition as a result of past clearing, the construction of online dams and ongoing agricultural activities (GHD 2016b).

As a result of past clearing, the construction of online dams and ongoing agricultural activities, Badgerys, Oaky, Cosgroves and Duncans Creeks and their tributaries display evidence of past and ongoing bed degradation. As a result, despite having a generally well-vegetated riparian zone in some areas, these watercourses are considered to be in moderate geomorphic condition both through and downstream of the airport site (GHD 2016b).

Badgerys, Oaky, Cosgroves and Duncans Creeks are highly modified and in poor condition as a result of historical and current land use and disturbance. All of the affected reaches are small and ephemeral and largely intermittent. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats. Fish habitat is minimal at most sites and the habitats present are not suitable for threatened fish or invertebrate species (dragonflies) known or predicted to occur in the wider locality.

4.4.2 Aquatic habitats

The following aquatic survey site descriptions (see Table 33 to Table 47) are based on site visits that were undertaken at the airport site and at upstream and downstream locations in March and May 2015. All sites were accessed close to road crossings or other public access points except for the dam sites which required access to leased properties (

Figure 3e). Site descriptions and habitat dimensions are based on the New South Wales AUSRIVAS habitat assessment sheets.

Table 33 BCUS – Badgerys Creek upstream

BCUS – Badgerys Creek upstream	
Landscape position and stream type	Site BCUS is located in a broad valley dominated by agriculture on the flood plain. At this location Badgerys Creek is mapped as a third order stream (GHD 2016b).
Description	The symmetric channel form had vertical sides approximately 3m high and the channel was inundated with dense stands of the macrophyte *Typha orientalis*, which was restricting flow in this narrow (~4m wide) channel and covering all visible open channels. Flows are intermittent at this site and the dominant habitat at the time of sampling was soft substrate pools and substantial macrophyte habitat. Water extraction pumps were noted at the site. The average depth in the sampled habitat was 0.3m with a mean wetted width of 4m. Silt and clay dominated the pools (90 per cent) suggesting the reach is subject to extended periods of low / no surface flows.
Key fish habitat	Badgerys Creek is mapped as Key Fish Habitat by DPI (2007). Based on the lack of woody debris but presence of aquatic vegetation it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	Macroinvertebrate sampling was restricted to edge habitat at each end of the bridge culverts, because this was the only open habitat available. There was no suitable habitat to permit the use of fyke nets. Bait traps were set around the ends of the bridge culverts.
Catchment landuse	Catchment land use is predominately agricultural so the site is subject to nutrient enrichment and has a moderate erosion potential through land clearing and a poor riparian buffer zone. The riparian zone is dominated by native and pastoral grasses with very little canopy cover. There were some individual stands of Eucalyptus spp. disconnected from the river channel on the right hand side otherwise trees were largely absent and therefore there was no natural shading in the channel.
Macrophytes in the channel at BCUS both upstream and downstream of the bridge.	
	

Table 34 BCMC – Badgerys Creek mid-catchment

BCMC – Badgerys Creek mid-catchment	
Landscape position and stream type	Site BCMC represents the downstream condition on Badgerys Creek. At this location Badgerys Creek is mapped as a fourth order stream (GHD 2016b).
Description	The creek channel was asymmetrical with vegetated shallow point bars on either bank. The banks were compounded with some toe deposition, which were also vegetated throughout the reach. The average channel width was 2m with an average depth at the sampling point of 0.1m. The available habitat at BCMC included several isolated pools in the upper section of the site where the surface flows ceased and farther downstream there was a moderate amount of soft substrate runs present. The substrate in the edge / pools was 100 per cent silt and clay and was also covered entirely by a layer of detritus. Large woody debris was present in the reach, but not at abundant levels (~10 per cent) which would provide adequate fish habitat. Compositionally, the riparian zone was dominated by grasses and shrubs, while at the sampling point itself there was adequate canopy from *Casuarina* spp. which thinned out with distance downstream. Erosion potential was minimal at this site because of the extent of the grass cover, which may buffer the surrounding perimeter from fertilizer-based nutrient runoff from the intensive agricultural practices adjacent to the stream.
Key fish habitat	Badgerys Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of aquatic vegetation it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	One macroinvertebrate sample was collected from the edge (of a pool). The water depth was too shallow for both the fyke net and the bait traps (maximum depth approximately 15-20 cm). As a consequence, fish sampling was not completed at this site.
Catchment landuse	Agriculture. Native vegetation in the riparian corridor.
Isolated pools at BCMC, where macroinvertebrate sampling was completed.	
	

Table 35 BCDS – Badgerys Creek downstream

BCDS – Badgerys Creek downstream	
Landscape position and stream type	Site BCDS is the downstream location on Badgerys Creek. At this location Badgerys Creek is mapped in as a fourth order stream (GHD 2016b).
Description	Access was unimpeded to BCDS, which was accessed via a road bridge crossing. Existing habitat included a large pool immediately downstream of the bridge and no evidence of existing or semi-permanent riffle habitat. The pools and the edge habitat that characterised this site were lined with a canopy of mainly Casuarina spp. (approximately 50 per cent cover) and an extensive understory dominated by native and exotic shrubs. On the water's surface in the larger pools (Plate 4-3) there was an extensive blanket of duckweed (Wolffia spp.) suggesting low flows and some nutrient enrichment is a feature of this reach. The substrate throughout the reach was dominated by silts and clay in the edge and pool habitat (90 per cent and 50 per cent respectively) and the pools contained approximately 30 per cent cobble. The composition of the substrate further emphasises the low flow characteristics at this site. Furthermore, there was a thick detrital layer covering both habitat types which has the potential to lower dissolved oxygen concentrations substantially, which would lower the probability of this site providing adequate habitat for the fish species which were documented in the data base search. Because of the elevated electrical conductivity at this site, electrofishing was not undertaken at this site. There were no natural barriers to fish passage although during the summer months connectivity maybe compromised through periods of drying. There is a farm dam within 1 kilometre upstream of BCDS, which would alter the hydrology during runoff events.
Key fish habitat	Badgerys Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of woody debris it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	Macroinvertebrates, fish and water quality.
Catchment landuse	BCDS is located within a broad valley surrounded by agricultural and rural/residential land uses, suggesting that existing disturbances to the site are dominated by the influence of nutrient enrichment following rainfall / runoff events.
Fyke net location at BCDS.	

Table 36 SCUS – South Creek upstream

SCUS – South Creek upstream	
Landscape position and stream type	Site SCUS is the upstream location on South Creek. At this location South Creek is a sixth order stream.
Description	Access to SCUS was via the Elizabeth Drive Bridge. Four habitat types were documented at SCUS which were: macrophytes; soft-substrate pool; soft substrate run and large woody debris. The substrate in the edge and pool habitats were mainly comprised of silt and clay (75 per cent and 90 per cent respectively), although sand (15 per cent) and gravel (10 per cent) also formed significant components of the edge habitat. The channel shape was irregular but a broad description would be that it was asymmetrical with meander bends and some areas of erosional undercuts with the occasional dispositional point bar. The mean channel width was 8m and the mean edge and pool depths were 0.3m and 0.7m respectively. The bank morphology was also irregular and difficult to describe because of the extent of the vegetation cover on both sides; bank height was approximately 3m. Grasses and trees <10m dominated the riparian zone, but there were extensive thickets of *Bolboschoenus* spp. throughout the reach.
Key fish habitat	South Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of woody debris and aquatic vegetation it is considered to be Type 1 (highly sensitive) key fish habitat.
Survey effort	Water quality, macroinvertebrates and fish sampling. Fyke netting was conducted downstream of the bridge and bait traps were also used. The pool directly upstream of the bridge was completely covered by a floating macrophyte (*Salvinia*), preventing macroinvertebrate sampling in that reach, however appropriate habitat for both an edge and a pool bed macroinvertebrate sample was present both under the bridge and downstream of it.
Catchment landuse	The potential risk of diffuse runoff from the surrounding area is reduced by the extent of coverage and width of the riparian zone despite the zone itself having some elevated areas of erosion. The bridge is causing an obvious change in the hydraulics by channelling flow through an unnatural chute resulting in some channelization. This however would not impose a permanent barrier to fish movement. Several small farm dams were present in the majority of all upstream water courses, which may not block fish passage directly, but do impact the natural hydrology of the catchment.
Floating macrophyte in pool upstream of SCUS (top) and fyke net set location (bottom).	
	

Table 37 SCDS – South Creek downstream

SCDS – South Creek downstream	
Landscape position and stream type	Site SCDS is the downstream location on South Creek. At this location South Creek is a fifth order stream.
Description	Large sections of macrophytes provided suitable habitat for a macroinvertebrate edge sample to be collected, however, the large channel at this site was too deep for a pool sample to be collected safely and no riffle habitat was present. Substrate at the site was 100 per cent silt with mode stream width 3m, the edge habitat depth was 1m with a bank height of 1.5m. Although only flowing slightly, water was turbid and an oil slick was observed in backwaters. The substrate was made up of clay and silt and some large woody debris was found along the banks of the site. Shading was restricted to the edges of the creek, and most of the riparian vegetation was made up of a mix of ground cover and introduced shrubs with some canopy cover from *Casuarina cunninghamiana*. The site was littered with car tyres, plastic sheeting and metal.
Key fish habitat	South Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of woody debris and aquatic vegetation it is considered to be Type 1 (highly sensitive) key fish habitat.
Survey effort	Water quality, macroinvertebrates and fish sampling.
Catchment landuse	SCDS is located adjacent to the fairway of a golf course.
Looking downstream (top) and upstream (bottom) at SCDS.	
	

Table 38 SCREC – South Creek recovery

SCREC – South Creek recovery	
Landscape position and stream type	Site SCREC is the recovery location on South Creek. At this location South Creek is a fifth order stream.
Description	SCREC was the only site in the March 2015 programme that had riffle habitat, which enabled all three macroinvertebrate sample types (edge, pool and riffle) to be collected. The site was polluted by rubbish. There were no visible impediments to fish passage at this site. The riparian zone was dominated by *Casuarina* spp., which provided shading upstream of the bridge. The width of the riparian zone narrowed with distance downstream and was gradually replaced with pastoral grasses as the agricultural land use intensified. There was also an increase in the dominance of weeds with this change in vegetation type. The Creek substrate was variable at this site with the riffle and pool habitats under the bridge dominated by cobbles. The edge habitat substrate was almost entirely composed of silt and clay (90 per cent). The mode stream width at SCREC was 3m with a bank height of 2m, while the habitat depths varied from 0.15m in the riffle habitat to 0.7 m in the pool habitat.
Key fish habitat	South Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of woody debris and aquatic vegetation it is considered to be Type 1 (highly sensitive) key fish habitat.
Survey effort	The large pool underneath the bridge provided suitable habitat for fyke netting, while bait trapping was done farther upstream from the bridge.
Catchment landuse	Agriculture and housing.
Fyke location in pool below bridge (top), riffle habitat (bottom) at SCREC.	
	

Table 39 DCUS – Duncans Creek Upstream

DCUS – Duncans Creek Upstream	
Landscape position and stream type	DCUS is located in the upper reaches of Duncans Creek. At this location Duncans Creek is mapped in GHD 2016b as a fifth order stream.
	DCUS is located in the upper reaches of Duncans Creek in a section of the catchment that was not impounded. There were, however, dams upstream on the tributaries and intermittent drainage lines which likely influence the natural hydrology of the creek at this point. Potential habitat was largely overgrown at the time of the survey meaning that there had been little flow at this site for some time. Furthermore, the existing surface water appeared to be coming from the overflow of a dam upstream that had occurred recently (most likely during the April rain event).
Key fish habitat	Duncans Creek is mapped as Key Fish Habitat by DPI (2007). It is considered to be Type 3 (moderately sensitive) key fish habitat.
Survey effort	Water quality only. Surface water was sparse at the time of our site visit meaning that there were no macroinvertebrate or fish samples collected.
Catchment landuse	Low-density grazing and native vegetation.
Facing upstream.	
Facing downstream showing grassy creek bed.	
The farm directly upstream of site DCUS.	

Table 40 DCDS – Duncans Creek Downstream

DCDS – Duncans Creek Upstream	
Landscape position and stream type	DCUS is located where Duncans Creek crosses Greendale Road, about 1 kilometre to the west of the airport site. At this location Duncan's Creek is mapped as a fifth order stream (GHD 2016b).
Description	The mode stream width was 3m with a bank height of 5m, while the depth of the pool was approximately 0.2m. Large sections of the creek bed both upstream and downstream of the bridge have been colonised by grasses (native and introduced pasture grasses) indicating low flows through this section of creek, which is likely to be an impact from the high number of small farm dams in the upstream catchment area which is also restricting fish passage.
Key fish habitat	Duncans Creek is mapped as Key Fish Habitat by DPI (2007). It is considered to be Type 3 (minimally sensitive) key fish habitat.
Survey effort	Water quality only. Surface water was sparse at the time of our site visit meaning that there were no macroinvertebrate or fish samples collected.
Catchment landuse	Low-density grazing and native vegetation.
Looking downstream at culvert.	
Looking upstream.	

Table 41 OCUS – Oaky Creek upstream

OCUS – Oaky Creek upstream	
Landscape position and stream type	OCUS is located upstream of a dam on Oaky Creek. At this location Oaky Creek is mapped as a third order stream (GHD 2016b).
Description	OCUS is located upstream of a dam on Oaky Creek, but was not influenced by the impoundment. This reach consisted of a long narrow pool downstream of a road culvert (Longley's Road) and a macrophyte filled pool upstream of the culvert. The riparian zone itself was occupied by three vegetation types: grasses, shrubs and small trees (70 per cent, 20 per cent and 10 per cent respectively). There was no flow at the time of sampling, but it was evident that the April rainfall event had generated flow through the creek. The site was characterised by vertical banks ~0.5 m in height that were well vegetated. The mode stream width was 1.5m while the depth in the edge habitat was 0.25m. Most of the reach was shaded by *Casuarina* spp. and *Callistemon* spp. with some intrusions of weedy shrubs (*Lantana camara*, *Rubus* spp.). *Typha* spp. was growing in a thick stand upstream of the culvert. The right bank of the narrow pool was lined with exposed roots whereas the right side was mainly made up of undercut banks and trailing vegetation. The reach was too narrow to collect a poolbed sample for macroinvertebrates, but an edge sample was taken with the substrate dominated by silt and clay (>65 per cent).
Key fish habitat	Oaky Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of limited aquatic vegetation and woody debris it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	Water quality, macroinvertebrate and fish sampling. A fyke net and bait traps were deployed at the site.
Catchment landuse	The surrounding land use was intensive agricultural practices which were widespread in the vicinity of the site. There were sections along the riparian zone which had moderate levels of unnatural erosion – likely imposed through the direct and indirect effects of historical land clearing.
Looking upstream in shaded pool downstream of culvert.	
Macrophytes pushed over by flow in culvert upstream of site.	

Table 42 OCDS – Oaky Creek downstream

OCDS – Oaky Creek downstream	
Landscape position and stream type	OCDS is located at a bridge along Elizabeth Drive consisting of two box culverts, which is located amongst agricultural land. At this location Oaky Creek is mapped as a third order stream (GHD 2016b).
Description	OCDS was characterised by a pool in the culvert underneath the bridge while a large pool downstream of the bridge, which appeared to have good habitat, was inaccessible due to the presence of a large fence; which imposes a barrier to larger species. It would be advisable that should this site be sampled again, access be obtained to the pool for a better representation of the creek conditions than the pool within the culvert. Apart from the possible impedance from the fence spanning the width of the stream, there were no additional barriers to fish passage at this site. Pools were connected by surface flows throughout the reach. Riparian vegetation was composed of large trees, *Casuarina* spp. and *Eucalyptus* spp., with dense shrubs and ground cover, while downstream of the bridge was dominated by pasture grasses and introduced shrubs and vines. The substrate under the bridge was concrete, while the largest wetted area with the remaining substrate was classified as silt and clay (100 per cent). The mode stream width was 3.5m with a bank height of 1.5m, while the edge habitat depth was 0.15m.
Key fish habitat	Oaky Creek is mapped as Key Fish Habitat by DPI (2007). Based on the lack of aquatic vegetation and woody debris it is considered to be Type 3 (minimally sensitive) key fish habitat.
Survey effort	Water quality, macroinvertebrate and fish sampling. An edge macroinvertebrate sample was collected at the end of the culverts but there was no suitable pool or riffle habitat for additional samples to be collected. There was no suitable site within the creek for the use of fyke nets, so only bait traps were used at this site.
Catchment landuse	Agriculture.
Culvert underneath bridge.	
Blocked access to large pool downstream of bridge at OCDS.	

Table 43 CCUS – Cosgrove Creek upstream

CCUS – Cosgrove Creek upstream	
Landscape position and stream type	The CCUS site is located alongside Adams Road, outside the airport site. At this location Cosgrove Creek is mapped as a fourth order stream (GHD 2016b).
Description	The upstream Cosgrove Creek site consisted of a large pool upstream of the bridge, which contained a mosaic of aquatic habitats, including extensive submerged macrophyte cover throughout. Smaller pools were also present underneath the bridge culverts. The riparian zone was good quality with tiered habitat with *Casuarina* spp. dominant, while at ground level rushes lined the creek banks overhanging the channel. The mode stream width at CCUS was 3m with a bank height of 0.5m, while the edge habitat depth was 0.4m. Fish passage was impeded at this site with some pools at the bridge being disconnected due to the low levels of flow at this time.
Key fish habitat	Cosgrove Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of aquatic vegetation it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	A macroinvertebrate edge sample was collected in the pool upstream of the bridge, but this pool was not deep enough to collect a pool sample and there was no riffle habitat at the site. There was no section of the creek channel large enough to set the fyke net and the high EC level precluded electrofishing, resulting in the sole use of bait traps for fish sampling at this site.
Catchment landuse	The site is located within a broad valley which is predominantly cleared for agricultural activities.
Pool upstream of bridge.	
Pool underneath the bridge.	

Table 44 CCDS – Cosgrove Creek downstream

CCDS – Cosgrove Creek downstream	
Landscape position and stream type	The CCDS site is located about 3 kilometres north of the airport site. At this location Cosgrove Creek is mapped as a fourth order stream (GHD 2016b).
Description	Aquatic habitat at the downstream Cosgrove Creek site was restricted to isolated pools, with the largest of these immediately upstream of the road crossing. This discontinuity resulting from low flows is creating a barrier to fish passage. This is the only site sampled in March 2015 where rubbish was absent. Habitat resources included floating macrophytes and algae, overhanging grasses and shrubs. Habitat substrate was entirely silt while mode stream width was 1.5m with a bank height of 0.5m and an edge habitat depth of 0.5m. The riparian canopy was provided by *Casuarina* spp. with occasional tea trees also present. Ground cover was thick with low growing forbs and vines present.
Key fish habitat	Cosgrove Creek is mapped as Key Fish Habitat by DPI (2007). Based on the presence of aquatic vegetation it is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	Overhanging grasses and shrubs provided habitat for a macroinvertebrate edge sample. However, the pool was not deep enough for a pool sample to be collected and no riffle habitat was present. EC at this site was on the upper limit for electrofishing, but, as no other sites had been fished using this method, bait traps were used to standardise the methods across all sites. There was no section of creek with a large enough area to set the fyke net.
Catchment landuse	CCDS is located upstream of a concreted creek crossing amongst a small vegetated channel through the golf course.
Pool upstream of road crossing.	
Looking downstream past the road crossing.	

Table 45 TCUS – Thompson Creek upstream

TCUS – Thompson Creek upstream	
Landscape position and stream type	TCUS is located at The Northern Road, about 3 kilometres south of the airport site. It is a third order stream.
Landscape position and stream type	TCUS was easily accessed from the side of The Northern Road Bridge. The site is dominated by pool habitat, with minimal flow between pools. Fish passage was restricted at this site due to some small drop offs downstream off the bridge which may restrict the upstream movement of some species. These appear to have been created by high flows through this reach which may have been exacerbated due to the construction of the bridge causing some minor channelization. The mode stream width was 2.5m with a bank height of 1m, while the habitat depth varied from 0.15m in the edge habitat to 0.7m in the pool habitat. The immediate riparian zone was dominated by grasses and weeds, with *Casuarina* spp. and *Eucalyptus* spp. providing shading throughout the reach. The riparian zone in the lower section of the reach was thick with shrubs, rushes and weeds. There was considerable area on the left bank which was un-vegetated with some slumping exposing tree roots present downstream of the bridge. The stream banks within the reach were composed of hard clays and the substrate also consisted of high proportions of a mixture of clay and silt suggesting significant erosion from the stream bank.
Key fish habitat	Thompsons Creek is mapped as Key Fish Habitat by DPI (2007). It is considered to be Type 2 (moderately sensitive) key fish habitat.
Survey effort	Edge and pool macroinvertebrate samples were collected, but no riffle habitat was present to sample. EC levels were too high for electrofishing, and the creek had too many snags to allow the fyke net to be set, resulting in the sole use of bait traps at this site.
Catchment landuse	The area is predominantly used as a rural residential zone and is one of the most heavily populated site areas.
Downstream of bridge.	
Upstream of bridge.	

Table 46 OCDAM – Oaky Creek Dam

OCDAM – Oaky Creek Dam	
Landscape position and stream type	The dam is approximately 12 m wide and 40 m long, with the majority of shallow areas covered in emergent macrophytes (*Juncus* spp. & *Typha orientalis*). The riparian zone consisted mainly of pasture in the paddocks on the downstream side, while on the upstream side of the dam, *Casuarina* spp. were present, providing some shade. There were discontinuous stands of un-identified shrubs the area. There was rubbish such as car and tractor parts submerged in the water, and a number of Wood Ducks were observed on the water's surface. This site is located downstream of OCUS. Some large wood debris was present within the dam, which provided habitat structure. Several horses were seen nearby and evidence that they had been accessing the dam recently was seen. The substrate within the dam was made up of silt (100 per cent) with a layer of detritus with mean depth approximately 1.1m.
Survey effort	A fyke net and bait traps were set at this site. An edge and a pool-bed sample were collected for macroinvertebrates.
Catchment landuse	Rural residential and agricultural land.
Upstream showing dense emergent macrophyte growth (*Triglochin* spp.) and a car tyre in the water.	
Open water in deep section of dam.	

Table 47 OSDAM – On Site Dam

OSDAM – On Site Dam	
Landscape position and stream type	This site is located mostly within the Stage 1 construction impact zone. The dam is not located on a creek line, but on a minor drainage line within a cattle paddock. There were no trees in the paddock, creating an environment with no shade. The dam bank was grassed along one side, while the grass on the opposite bank was discontinuous with patches of mud with evidence of stock access, likely the cause of the turbid nature of the water. Submerged habitat was uncommon in the dam, with only some small sections of submerged macrophytes present. The dam was approximately 20 m long, 15 m wide and 1m deep. The paddocks surrounding the dame did not have any cattle in them at the time of sampling. The substrate of the dam was made up of silt and clay (>90 per cent). The field on one side of the dam had recently been ploughed which may also be contributing sediment through runoff during periods of rain.
Survey effort	A pool bed and edge sample were taken, fyke nets and bait traps were set.
Catchment landuse	Rural residential and agricultural land.
Expanse of water at OSDAM.	
Bank with submerged grass.	

4.4.3 Fish habitat

The results of the fish habitat assessment indicate that 71 per cent of sites are classified as Class 3 (minimal fish habitat), 22 per cent as Class 2 (moderate habitat) and 7 per cent as Class 4 (unlikely habitat) (Table 48), as per the waterway class definitions in DPI (2013) (refer to Section 3.3.4). Those within the airport site are all Class 3 (minimal fish habitat). All survey sites at creeks are mapped as key fish habitat by DPI (2007). Those on the airport site are Type 2 (moderately sensitive) key fish habitat (Table 48). Isolated farm dams are not key fish habitat. Farm dams located along creeks at the airport site (such as OCDAM) may be considered Type 3 minimally sensitive key fish habitat.

Sites on Oaky Creek (OCDS) and Badgerys Creek (BCDS) immediately downstream of the airport site, on Cosgrove Creek (CCDS) prior to its confluence with South Creek 5 kilometres downstream of the airport site and along Duncans Creek (DCDS) 1.6 kilometres downstream of the airport, also comprise Class 3 minimal key fish habitat/Type 2 moderately sensitive habitat.

Sites sampled along South Creek downstream of its confluence with Badgerys Creek (SCDS) and after its confluence with Cosgrove Creek (SCREC) are Class 2 moderate fish habitat/Type 1 highly sensitive fish (Table 48). These sites are located 4.5 kilometres and 8 kilometres (respectively) downstream of the airport site.

The majority of sites on and up- and downstream of the airport site are intermittent with some indication of semi-permanent pools existing throughout the reaches surveyed, which may provide refuge during periods of stress for some fish species. The intermittent nature of these systems suggests that they are unlikely to be suitable habitat for listed threatened species recorded in the database search.

Table 48 Fish habitat survey results

Site	Location	Waterway Class (DPI 2013)	Key Fish Habitat type (DPI 2013)
BCUS	Badgerys Creek upstream	3 (minimal key fish habitat)	2 (moderately sensitive)
BCMC	Badgerys Creek mid-catchment	3 (minimal key fish habitat)	2 (moderately sensitive)
BCDS	Badgerys Creek downstream	3 (minimal key fish habitat)	2 (moderately sensitive)
SCUS	South Creek upstream	2 (moderate key fish habitat)	1 (highly sensitive)
SCDS	South Creek downstream	2 (moderate key fish habitat)	1 (highly sensitive)
SCREC	South Creek Recovery	2 (moderate key fish habitat)	1 (highly sensitive)
OCUS	Oaky Creek upstream	3 (minimal key fish habitat)	2 (moderately sensitive)
OCDS	Oaky Creek downstream	3 (minimal key fish habitat)	2 (moderately sensitive)
CCUS	Cosgrove Creek upstream	3 (minimal key fish habitat)	2 (moderately sensitive)
CCDS	Cosgrove Creek downstream	3 (minimal key fish habitat)	2 (moderately sensitive)
TCUS	Thompson Creek upstream	3 (minimal key fish habitat)	2 (moderately sensitive)
DCDS	Duncans Creek downstream	3 (minimal key fish habitat)	3 (minimally sensitive)
DCUS	Duncans Creek upstream	4 (unlikely key fish habitat)	3 (minimally sensitive)
OCDAM	Oaky Creek Dam	3 (minimal key fish habitat)	3 (minimally sensitive)
OSDAM	On Site Dam	3 (minimal key fish habitat)	Not key fish habitat

4.4.4 Water quality

The *Airports (Environment Protection) Regulations 1997* (AEPR) regulate water pollution at airports and contain a schedule of acceptable limits. The requirements of these regulations are listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC guidelines) which are considered in this assessment. Guideline levels for specific water quality parameters are shown in Table 44.

The ANZECC guidelines outline default trigger values for physical and chemical stressors and toxicants for several water system groups. These trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types. For the sites monitored in this project, the trigger values for south-eastern Australian lowland river ecosystems are most applicable.

Comparison of the AEPR to the ANZECC guidelines shows that the contaminants selected and the trigger values are broadly comparable. However there are a number of parameters for which the AEPR is significantly more stringent. For these parameters the compliance with the AEPR will ensure that ANZECC guidelines will also be met, however pollution from past and present land uses may make it difficult to comply with the AEPR. In particular the very stringent limit for ammonia in the AEPR (<0.02 mg/L) will be difficult to meet and it is possible that baseline water quality prior to development already exceeds this limit. The AEPR contain provisions which allow an airport lessee company to apply to the Minister for a local standard where the standard set out in the Schedule to the regulations is not appropriate. This may be required for the proposed airport. Currently, water quality monitoring is occurring at the proposed airport site with a view to developing site specific standards (see GHD 2016c).

In-situ water quality parameters

The results of the in-situ water quality parameters are shown in Table 49.

Table 49 In-situ water quality measurements

Site	Date	Time	Temp. °C	EC µS/cm	DO % sat.	DO mg/L	pH	Turb. NTU	Alk. mg/L
ANZECC & ARMCANZ Guidelines[1]			No guideline	125-2,200	85-110		6.5-8.5	6-50	
Airport Guidelines[2]			An increase of 2ºC above the seasonal mean temperature	>1000 mg/L or an increase of >5% [3]	80% of the average level for a normal 24 h period or <6.0 mg/L[4]		6.5-9.0	A reduction of 10% clarity in the euphotic zone from the seasonal mean	
BCUS	14/3/15	11:05	19.2	2278	21.3	2.78	7.51	12.0	230
BCMC	13/3/15	14:05	20.0	2219	36.0	3.28	7.30	7.71	110
BCDS	13/3/15	16:40	20.4	3164	8.6	0.75	7.48	13.0	275
SCUS	13/3/15	15:15	21.5	1631	20.1	1.75	7.38	9.44	175
SCDS	16/3/15	16:30	22.4	1929	68.2	5.86	7.65	58.2	120
SCREC	15/3/15	15:15	21.9	1542	50.1	4.29	7.61	24.9	125
OCUS	28/5/15	12:00	13.85	1703	81.1	2.10	7.34	26.9	210
OCDS	15/3/15	17:45	19.8	4301	55.4	4.99	7.19	38.1	150
CCUS	15/3/15	16:50	20.4	6524	73.6	6.50	7.28	4.25	350
CCDS	16/3/15	16:00	19.1	1120	42.0	1.55	7.28	10.4	145
TCUS	13/3/15	10:55	20.1	1365	52.3	4.64	7.50	56.8	100
DCDS	16/3/15	10:15	17.9	876	52.5	4.96	7.55	89.2	95
DCUS	28/5/15	-	-	-	-	-	-	-	-
OCDAM	28/5/15	14:00	19.58	796	57.4	5.27	7.22	27.2	135
OSDAM	28/5/15	17:00	17.98	848	41.2	3.89	8.92	73.9	140

Notes:

1) Trigger values for South- East Australia based on 95% ecosystem protection for slightly to moderately disturbed (SMD) waterways

2) *Airports (Environment Protection) Regulations 1997* (AEPR) trigger values

3) It is unclear in the Airport Guidelines if the increase of >5% in the Electrical Conductivity unit is with respect to a single sample or if it means above the baseline measured over a defined period of time

4) Lower Dissolved Oxygen limit

Highlighted cells indicate exceedance of the ANZECC & ARMCANZ (2000) guidelines

The guidelines are not relevant for OCDAM and OSDAM sites as these are dam sites

Temp. °C = Temperature in degrees celcius; EC µS/cm = Electrical Conductivity Unit; DO = Dissolved Oxygen; Turb. NTU = Turbidity Nephelometric Turbidity Units; Alk. = Alkalinity; mg/L = milligrams per litre; guidelines not relevant for OCDAM and OSDAM as these sites are within dammed sites; yellow highlight indicate exceedance of the ANZECC & ARMCANZ (2000) guidelines.

Electrical conductivity (EC) was high at all survey sites with one site recording in excess of 6000 µS/cm. It is not known what factors contributed to this, but they could include the influence of local geology, heavy groundwater input during periods of low flow, salinity issues due to agricultural practices, or a combination of these factors. These high salinities are outside the known tolerance range for some sensitive macroinvertebrate species (Hart 1991).

Dissolved oxygen levels were generally low, with only one site recording a value greater than 80 per cent saturation. While caution is advised when interpreting spot dissolved oxygen levels taken at different times of the day, it is likely that the low dissolved oxygen levels are due to a combination of low flow conditions and nutrient enrichment. Water pH varied little between sites and was close to base. Turbidity levels were, somewhat surprisingly, not particularly high, with only three sites recording values above 50 NTU. Alkalinity levels were indicative of moderately to very hard waters. Sites with high alkalinity were also those with elevated EC, so some of the high EC at those sites relates to elevated calcium and carbonate ion levels.

Analytical water quality parameters

The detailed water quality results collected in March and May are provided in Appendix C.

Results show that the majority of the BTEX and Total Petroleum Hydrocarbons (TPH) analysed were below the detectable limits at all survey sites. Dissolved and Total metals were also for the most part, below the detectable limits for each parameter. The exceptions were zinc, nickel and copper. While these metals do occur naturally, high levels of each can indicate specific catchment related impacts such as industry, fertilizers and run off from roads.

Iron varied considerably between water bodies with the highest concentrations occurring in Oaky Creek, regardless of habitat or water body type. This may indicate localised differences in geochemistry and/or a higher groundwater / surface water ratio at these sites. Other toxicants such as fumigants, mercury and halogenated aliphatic and aromatic components were also all below detection limits, as were the Trihalomethanes and Polynuclear Aromatic Hydrocarbons.

All sites were classified as having moderately high to extremely high electrical conductivity levels. The major cation in the system is sodium which ranged from 92 mg/l at OCDAM to 846 mg/L at CCUS. These high sodium levels may be natural, but given the surrounding land-use there may also be a significant contribution from road salts and fertilisers.

The high nutrient concentrations throughout the project area suggest an agricultural land use signature. All of the total nitrogen (TN) and total phosphorus (TP) concentrations exceeded ANZECC and AEPR guidelines. Nitrates exceeded the ANZECC guideline values at four of the 14 sites (28%). Badgerys Creek (mid catchment) had very high TN and Nitrate values which can be indicative of animal waste and / or fertilisers. High level total organic carbon (TOC) values were also recorded at BCMC which is consistent with the high levels of organic deposits in the isolated pools at this site.

In terms of the aquatic environment, the existing habitat within the airport site is considered to be a series of highly modified and largely intermittent water courses. On the whole the survey sites are subject to the impacts of surface water run off which, based on the water quality data at hand, appears to be dominated by agricultural – based impacts including high nutrients and salts. However, part of the water quality signature across the survey sites (i.e. low DO and high EC) may be due partly to low flows in the broader area which seems to be the dominant feature at the time of the surveys. However, the low dissolved oxygen may also reflect the high detrital content and die back of the extensive stands of macrophytes surveyed in the study area.

4.4.5 Aquatic flora

Macrophytes that were observed during both survey events comprised species belonging to emergent, floating and submerged vegetation types. The majority of macrophytes observed at all sites were native (see Table 50. Two declared noxious weeds were recorded during surveys. Salvinia (*Salvinia molesta*) was found in a dense mat at BCDS upstream of the road crossing (ie within the airport site), and was observed in small clumps downstream. Water Hyacinth (*Eichhornia crassipes)* was seen in small clumps at SCDS (not within the airport site), but was not widespread. Both of these weeds are known to grow and disperse quickly under favourable conditions and are also recognised as weeds of national significance (WONS). Where exotic or declared species were found, they tended to dominate the waterway, such as Para Grass (*Urochloa mutica*) found at DCDS, SCDS and TCUS.

There is no marine vegetation as listed under the FM Act at the airport site.

Table 50 Macrophyte species recorded in the study area

Scientific name	Common name	Status
Azolla sp.	Ferny Azolla	Native
Bolboschoenus fluviatilis	Marsh Clubrush	Native
Cyperus difformis	Dirty Dora	Native
Eichhornia crassipes	Water Hyacinth	Declared noxious weed
Juncus usitatus	Common Rush	Native
Persicaria decipiens	Smartweed	Native
Potamogeton crispus	Curly Pondweed	Native
Salvinia molesta	Salvinia	Declared noxious weed
Schoenaplectus validis	Clubrush	Native
Triglochin sp.	Water Ribbons	Native
Typha sp.	Cumbungii	Native
Urochloa mutica	Para Grass	Exotic
Wolffia sp.	Duckweed	Native

4.4.6 Aquatic fauna

Fish

A total of eight fish species were recorded during fish surveys (Table 51). These included five native species and three exotic species. Of the native fish species collected, the Firetail Gudgeon (*Hypseleotris galii*) was the most widespread and was recorded on site and in downstream sampling sites. Long-finned Eels (*Anguilla reinhardtii*) were collected and released from fyke nets at several downstream sites (BCDS and SCDS). Eels, most likely the Long-finned Eel, were also observed at dams at the airport site during the terrestrial fauna surveys.

Exotic species where present at almost all sites and accounted for the majority of the individuals caught. Large numbers of Eastern Gambusia (*Gambusia holbrooki*) were caught throughout the surveys but particularly at dam sites. Also caught were Common Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*). Eastern Gambusia and Common Carp are both listed as Class 3 noxious fish under the FM Act, which restricts their sale and possession. A control plan for carp has been published for NSW (I&I NSW). The main objective of this plan is to prevent the introduction of carp into areas that are carp-free, and is not particularly relevant to the airport site. Predation by Eastern Gambusia is listed as a key threatening process under the TSC Act (see Section 8.1).

The presence and abundance of exotic species is not surprising considering the degraded nature of most of the sampling locations and the significant hydrological impacts from the large number of farm dams. There are populations of both Firetail Gudgeons and Western Carp Gudgeons (*Hypseleotris klunzingerii*) in the study area which showed relatively high abundances, considering the high level of competition by the exotic species. These native species have been found to prefer low flows and the high levels of aquatic vegetation found at the locations on the airport site (Gomon 2011; Lintermans 2007).

No threatened fish species listed under the EPBC Act and for the FM Act identified in the database searches as potentially occurring in the locality were collected during the surveys. No suitable habitat for these species was observed at the survey sites on the airport site or in areas up or downstream of the site, which is in agreement with the findings of SMEC (2014).

Table 51 Fish species caught at each survey site

Scientific Name	Common Name	BCDS	SCUS	SCDS	SCREC	OCUS	OCDS	CCUS	CCDS	TCUS	DCDS	DCUS	OCDAM	OSDAM
Anguilla reinhardtii	Long Finned Eel	2												
Carassius auratus	Goldfish*		1											
Cyprinus carpio	Common Carp*			1										
Gambusia holbrooki	Gambusia*	80	134	188	55	89		20	47	12	30		290	3220
Hypseleotris galii	Firetail Gudgeon			21	4	14	12				1		19	
Hypseleotris klunzingerii	Western Carp Gudgeon			10	8	17							41	
Hypseleotris sp.	Gudgeon Species (unidentified)					5							30	
Retropinna semoni	Australian Smelt				1									

Note: * denotes introduced species.

The fish communities at the airport site, and up and downstream of the airport site, are also indicative of a disturbed habitat. Low surface flows and poor water quality are likely to have caused reductions in native fish populations over the years and the increase in farm dams and the impacts they play on water shed hydrology are also likely part of the broader picture in the project area. The intermittent nature of these creeks are likely to be natural inhibitors to rare or endangered species populating the area but this has likely been exacerbated by land clearing and the flow-on effects of erosion, deteriorating water quality and population increases in exotic fish species, creating competition for resources which potentially did not exist previously. An assessment of fish habitat found it to be moderate or minimal at most sites, with a dominance of exotic species at all sites.

Aquatic macroinvertebrates

A total of 1075 individual macroinvertebrates were identified in the March and May 2015 surveys on the airport site and up and downstream. The macroinvertebrate communities were dominated by Dipterans (true flies) (31%), Acarina (water mites) (25%) and Odonata (Dragonflies) (10%) (see Table 52). The remaining components of the community comprised low numbers of taxa belonging to 12 other taxonomic groups with low to moderate SIGNAL scores indicating that the communities were generally made up of groups that have a high tolerance to moderate to severe pollution (Plate 1).

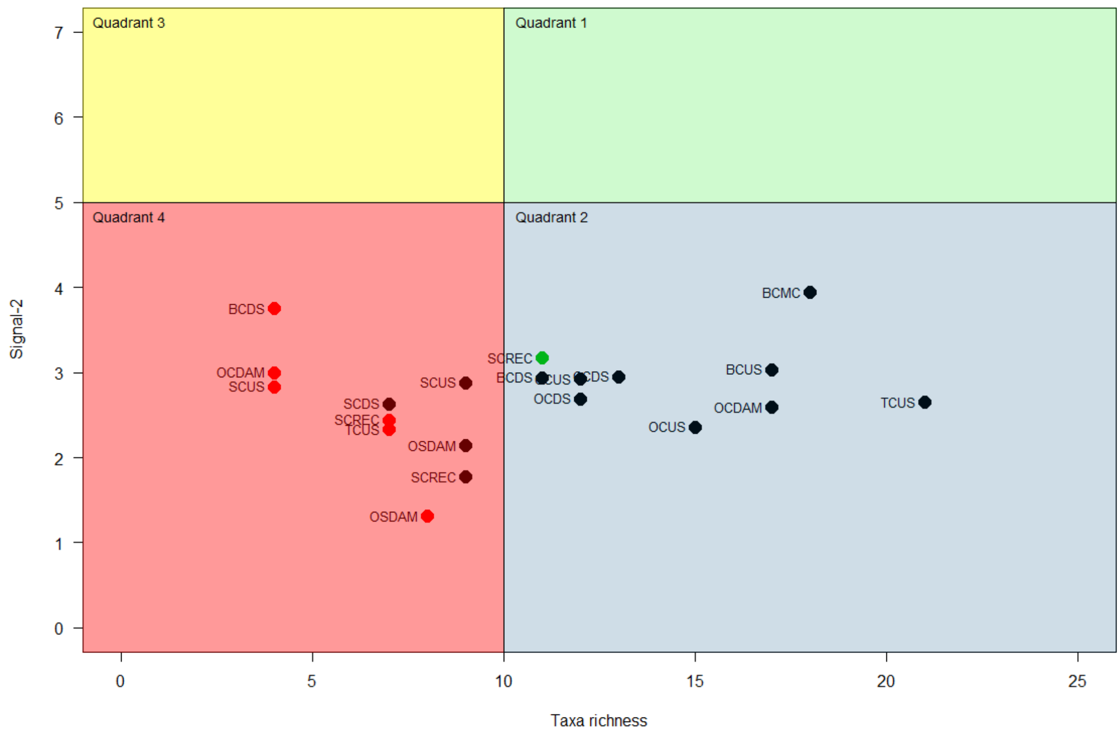
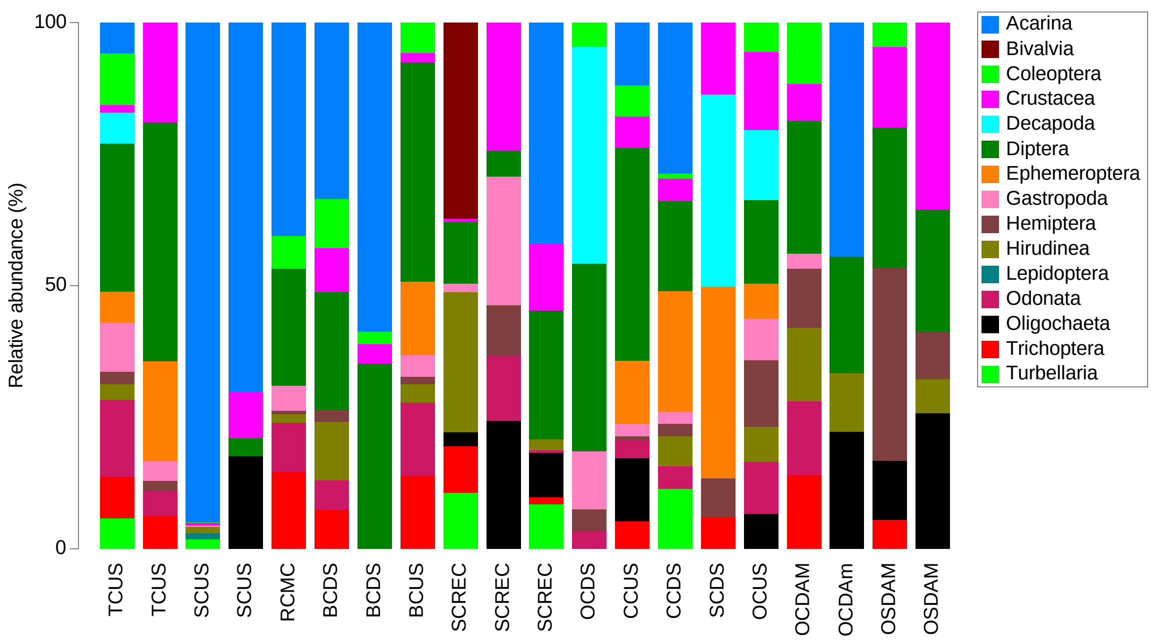


Plate 1 SIGNAL/Richness biplot

Note: Colours of the data points indicate habitat type: green = riffle; red=pool; black =edge

Table 52 Relative abundance of the major taxonomic groups of macroinvertebrates collected from the March 2015 survey



The tolerance to poor water quality, or inversely the absence of taxa sensitive to poor water quality is reflected in the poor representation of EPT taxa, which ranged from 3 at BSUS to 0 at 7 of the sites surveyed (see Table 53) and the significantly impaired to extremely impaired AUSRIVAS rating for all sites (see Table 54). The analysis of SIGNAL 2 scores against the total number of families collected at all survey sites show very low SIGNAL 2 scores (Range 1.31 – 3.75). This indicates that these sites at some stage have been subject to or are consistently exposed to severe pollution, according to the SIGNAL 2 interpretation method of Chessman (2003).

The SIGNAL / Richness biplot (see Table 53 and Figure 5) shows that all of the samples collected belong to either Quadrant 2 or Quadrant 4, which indicates high salinity or nutrient levels – these may be natural. The majority of the edge samples fall into Quadrant 2, as well as the only riffle sample collected. The remaining samples fall into Quadrant 4, which indicates urban, industrial or agricultural pollution, or may indicate the downstream effects of dams or other impoundments, which is consistent with the water quality results. This quadrant contains all of the pool samples, but also three of the edge samples (SCDS, SCUS and SCREC).

Odonata (Dragonflies and Damselflies) made up approximately 10 per cent of the total number of individuals collected. The majority of these individuals were immature nymphs meaning that the taxonomy of these groups could not be determined to species or genus level. However, no individuals belonging to either of the families from which the endangered dragonfly species belong (*Archaeophya adamsi*: Gompomacromiidae; *Austrocorrdulia leonardi*: Austrocorduliidae) were recorded. As such, this broad resolution to family level for the majority of the samples has not influenced the ability of the field assessment to detect these threatened taxa had they been present.

Table 53 Univariate index summary for all survey sites

Site	SIGNAL 2	Taxa Richness	EPT Richness	Habitat
TCUS	2.65	21	2	Edge
TCUS	2.33	7	2	Pool
SCUS	2.88	9	0	Edge
SCUS	2.83	4	0	Pool
BCMC	3.94	18	1	Edge
BCDS	2.94	11	1	Edge
BCDS	3.75	4	0	Pool
BCUS	3.03	17	3	Edge
SCREC	3.17	11	2	Riffle
SCREC	1.77	9	0	Edge
SCREC	2.44	7	1	Pool
OCDS	2.69	12	0	Edge
CCUS	2.92	12	2	Edge
CCDS	2.95	13	1	Edge
SCDS	2.63	7	2	Edge
OCUS	2.36	15	1	Edge
OCDAM	2.59	17	1	Edge
OCDAM	3.00	4	0	Pool
OSDAM	2.14	9	1	Edge
OSDAM	1.31	8	0	Pool

Table 54 AUSRIVAS scores for the macroinvertebrate survey

Site	O/E AUSRIVAS ratio		AUSRIVAS Band		SIGNAL 2 score	
	Edge	Riffle	Edge	Riffle	Edge	Riffle
BCUS	0.56	NA	B	NA	3.03	NA
BCMC	0.62	NA	B	NA	3.94	NA
BCDS	0.48	NA	B	NA	2.94	NA
SCUS	0.15	NA	C	NA	2.88	NA
SCDS	0.30	NA	C	NA	2.63	NA
SCREC	0.28	0.25	C	D	3.17	1.77
OCUS[1]	NA	NA	NA	NA	NA	NA
OCDS	0.52	NA	B	NA	2.69	NA
CCUS	0.59	NA	B	NA	2.92	NA
CCDS	0.48	NA	B	NA	2.95	NA
TCUS	0.69	NA	B	NA	2.65	NA
DCDS[2]	NA	NA	NA	NA	NA	NA
DCUS	0.54	NA	B	NA	2.36	NA
OCDAM	0.35	NA	C	NA	2.59	NA
OSDAM	0.44	NA	C	NA	2.14	NA

Note: 1 Not sampled due to very low surface water volume (see photographs in Section 4.3.7).

2 Not sampled due to unsafe access

The generally poor water quality is a likely factor affecting the poor state of health of the macroinvertebrate communities which is reflected in the low SIGNAL scores, but not necessarily in the number of families. A bi plot was used as an interpretation tool and is in agreement with the interpretation that the aquatic sampling sites are all subject to one or another form of agricultural, urban or industrial pollution, or the macroinvertebrate communities reflect high nutrient and or EC values (which may be natural). Poor water quality has not resulted in an overall loss of taxa, just a loss of the more pollution-sensitive taxa (and replacement by pollution-tolerant taxa). This is more likely to result in a moderate degree of degradation of the macroinvertebrate community.

4.5 Conservation significance

4.5.1 Threatened ecological communities

Larger and better condition patches of Grey Box - Forest Red Gum grassy woodland on flats, Grey Box - Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest at the airport site comprise occurrences of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (Cumberland Plain Woodland). Cumberland Plain Woodland is listed as a critically endangered ecological community (CEEC) under the EPBC Act. EPBC Act Cumberland Plain Woodland CEEC was identified according to the criteria in the listing advice for the community, specifically: woodland that is part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species; is associated with shale-influenced soils; and contains >50% perennial native plants in the groundcover (TSSC 2008).

Patches of woodland at the airport site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 5. There are 104.9 hectares of EPBC Act Cumberland Plain Woodland as defined under the EPBC Act at the airport site. Patches of EPBC Act Cumberland Plain Woodland at the airport site include many 'larger patches (>5ha) which are inherently valuable due to their rarity' as defined in the listing advice for the community (TSSC 2008) (see Figure 5). There are only very occasional 'patches that have large mature trees (ie trees between 20 to 80% of their life expectancy) or trees with hollows (habitat) that are very scarce on the Cumberland Plain' (TSSC 2008). Derived native grassland and other moderate/good – poor condition vegetation at the airport site does not meet the condition criteria for a local occurrence of EPBC Act Cumberland Plain Woodland as defined in the listing advice for the community (TSSC 2008) and associated guidelines (DEWHA 2010d). This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA 2010d). Patches with native tree cover greater than 10% but that are isolated from other native vegetation and are less than 0.5 hectares in area have also been excluded in accordance with the guidelines (DEWHA 2010d).

All of the native woodland and forest vegetation at the airport site, including derived native grasslands, comprise local occurrences of TECs listed under the TSC Act (see Figure 5) as follows:

- Both good and poor condition patches of Grey Box - Forest Red Gum grassy woodland on flats and Grey Box - Forest Red Gum grassy woodland on hills comprise the CEEC 'Cumberland Plain Woodland in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest comprise the EEC 'Shale-Gravel Transition Forest in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Forest Red Gum - Rough-barked Apple grassy woodland comprise the EEC 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions'.

Patches of good condition artificial freshwater wetlands on floodplains at the airport site feature predominantly native plant species but are associated with dams and flooded depressions that have been formed by the construction of barriers across small drainage lines. They are clearly not natural geomorphic features. They do not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains' because artificial wetlands created on previously dry land for purposes such as sewerage treatment, stormwater management and farm production are not regarded as part of this community (DECC 2008e).

Exotic grassland, cropland and cleared land at the airport site occupy former habitat for the TECs described above but are dominated by exotic plants or bare earth. They could not regenerate into functional ecological communities, even with assisted natural regeneration and do not comprise part of the occurrences of these TECs.

No threatened ecological communities listed under the FM Act occur at the airport site or in adjoining or downstream areas.

4.5.2 Threatened flora species and populations

Threatened species recorded or likely to occur

Four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road by SMEC (2014) and these records were verified by GHD during the current field surveys (Figure 5D). *Pultenaea parviflora* is listed as a vulnerable species under the EPBC Act and an endangered species under the TSC Act. This is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location in 1999 (Biosis 1999; SMEC 2014). The former locations of the 64 specimens currently contain cleared, ploughed cropland or severely weed infested road edges. Past management actions by previous tenants, which appear to have resulted in a decline of the former population, include clearing of native vegetation, ploughing, planting with exotic crops, harvesting of exotic crops, grading of Longleys Road, construction of road batters and table drains and slashing of the road corridor. This past management has resulted in transformation of the former area of occupied habitat for *P. parviflora* into bare earth and exotic grassland. These areas do not comprise occupied or potential habitat for this species (see photo in Table 26).

Seed and cutting collections were made from this population by the Royal Botanic Gardens Trust on a number of occasions in 1990 and 1991, with the aim of testing propagation methods for the species and also ultimately replanting the species at the airport as part of landscaping works (RBGS 1992).

Endangered populations recorded

A total of 142 stems of *Marsdenia viridiflora* subsp. *viridiflora* have been recorded at the airport site, with the majority recorded in Grey Box - Forest Red Gum grassy woodland on flats adjacent to Longleys Road (84 stems) and Anton Lane (52 stems) in the centre of the airport site (see Figure 5). These comprise part of the endangered *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas listed under the TSC Act. No other threatened flora species or populations listed under the TSC Act have been recorded at the airport site.

Threatened species or populations with a moderate likelihood of occurrence

No other threatened flora species listed under the EPBC Act have been recorded at the airport site. There is potential habitat for up to five threatened flora species listed under the EPBC Act: Spiked Rice-flower (*Pimelea spicata*); Downy Wattle (*Acacia pubescens*); White-flowered Wax Plant (*Cynanchum elegans*); Small-flowered Grevillea (*Grevillea parviflora* subsp. *parviflora*) and Austral Toadflax (*Thesium australe)*.

There is potential habitat at the airport site for at least two additional threatened plant species listed under the TSC Act: *Dillwynia tenuifolia* and *Grevillea juniperina* subsp*. juniperina*. *Dillwynia tenuifolia* is also listed as the Kemps Creek endangered population. The Kemps Creek endangered population is located around three kilometres to the east of the airport site in the area bound by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps

Creek (OEH 2015b). Any *Dillwynia tenuifolia* individuals or habitat at the airport site would not be part of this endangered population.

Threatened species not likely to occur

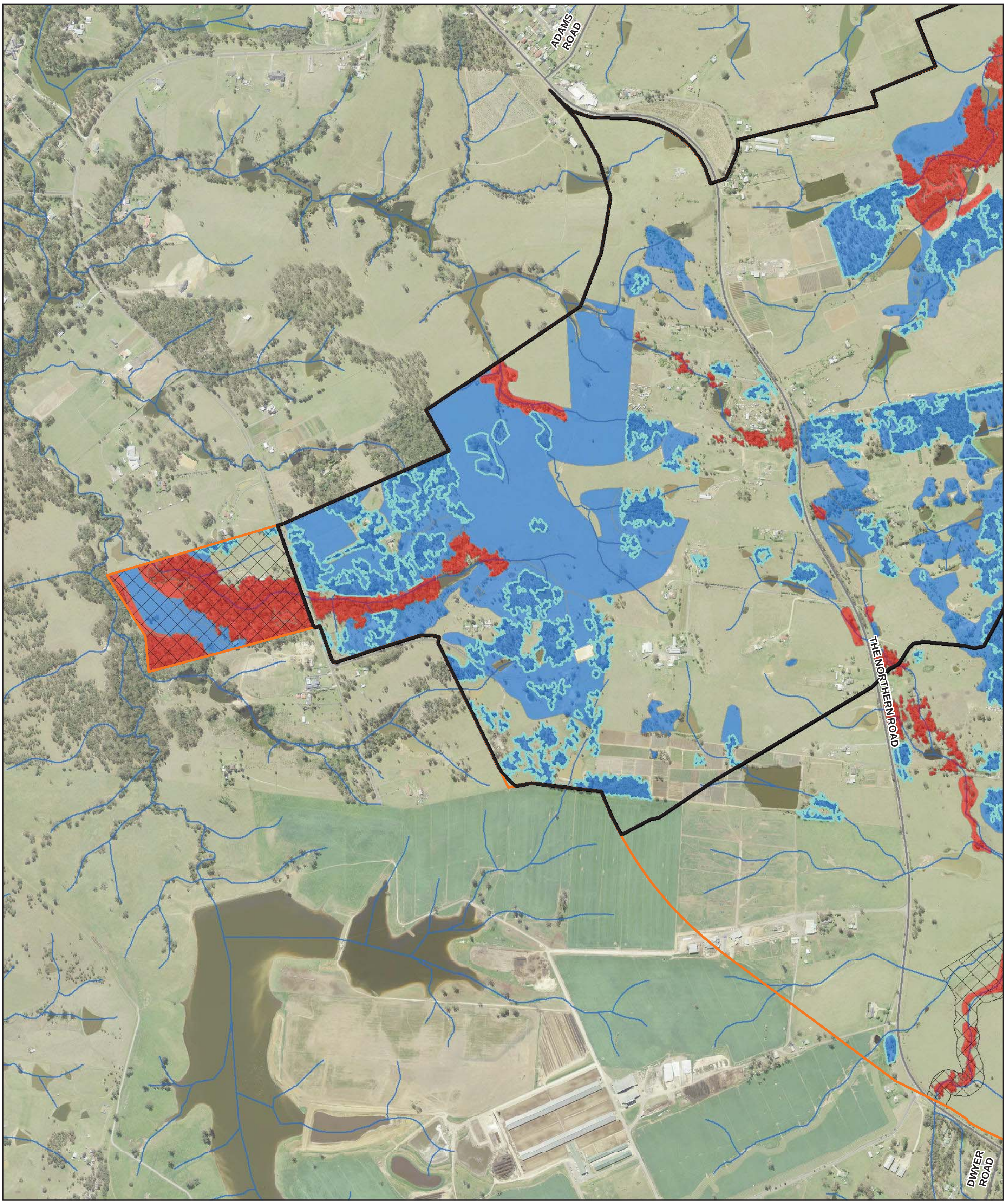
The remainder of the threatened flora species previously recorded or predicted to occur in the locality would not occur because the airport site is outside of their known distribution and/or does not contain suitable habitat (Appendix A). The airport site does not contain any sandstone outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any threatened plant species that have habitat requirements specific to these soil types. These threatened flora species would not occur at the airport site and would not be impacted by the airport.

A summary of flora species recorded or with a moderate likelihood of occurrence is provided in Table 55.

Table 55 Threatened flora recorded or that may occur at the airport site

Species	Common Name	EPBC Act Status	TSC Act Status	Likelihood of occurrence
Pultenaea parviflora		V	E	Present
Marsdenia viridiflora subsp. *viridiflora*			EP	Present
Cynanchum elegans	White-flowered Wax Plant	E	E	Possible
Pimelea spicata	Spiked Rice-flower	E	E	Possible
Acacia pubescens	Downy Wattle	E	V	Possible
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	Possible
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea		V	Possible
Thesium australe	Austral Toadflax	V	V	Possible
Dillwynia tenuifolia			V	Possible

Key: E – endangered; EP – endangered population; V - vulnerableFigure 5 Threatened flora and ecological communities



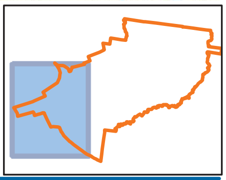
LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora subsp. viridiflora* (endangered population under the TSC Act)

TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Airport
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Threatened flora and ecological communities

Figure 5A

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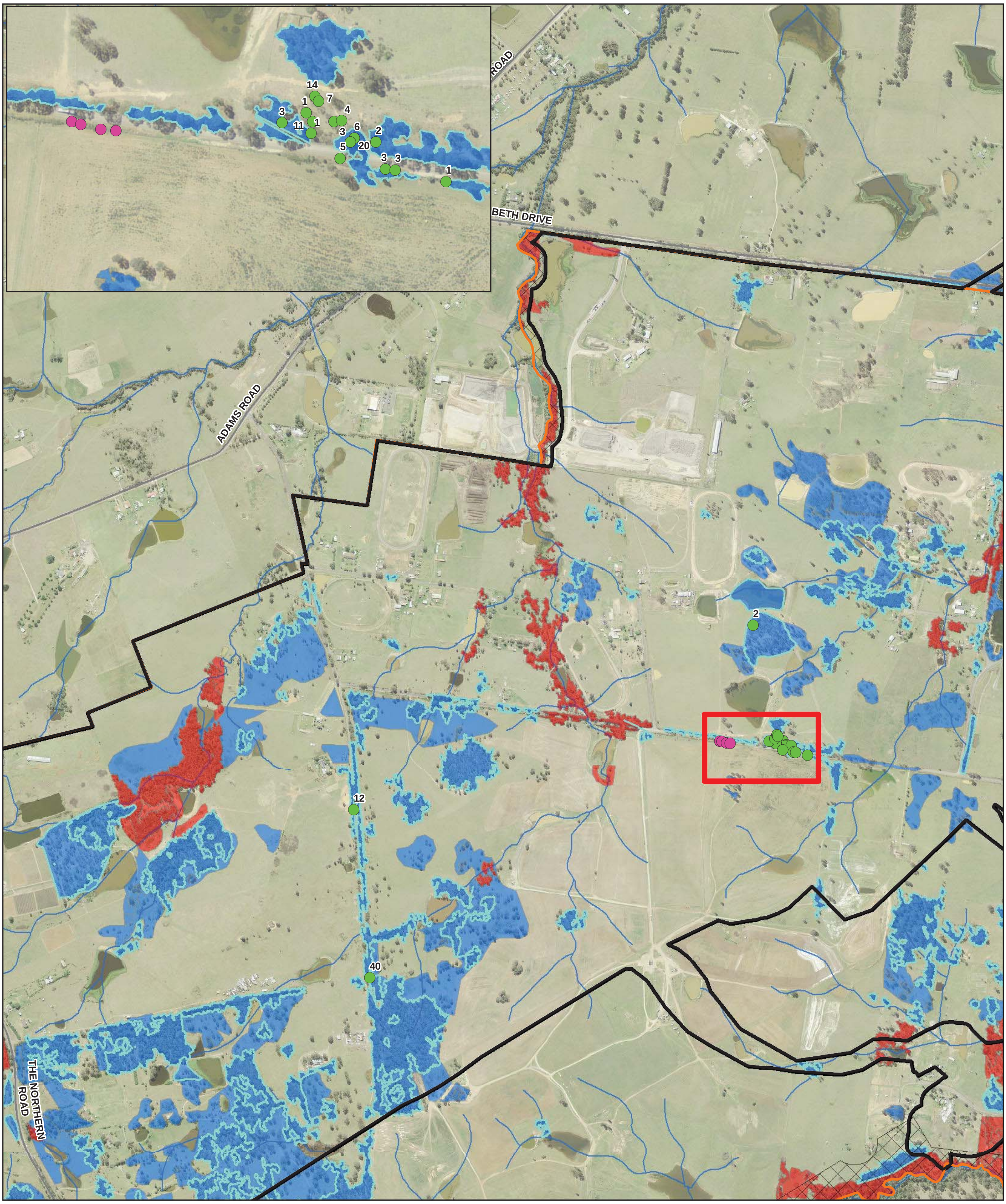
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

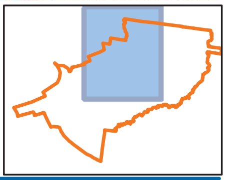


LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses
- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora subsp. viridiflora* (endangered population under the TSC Act)

TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)



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GHD

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Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
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Threatened flora and ecological communities

Figure 5B

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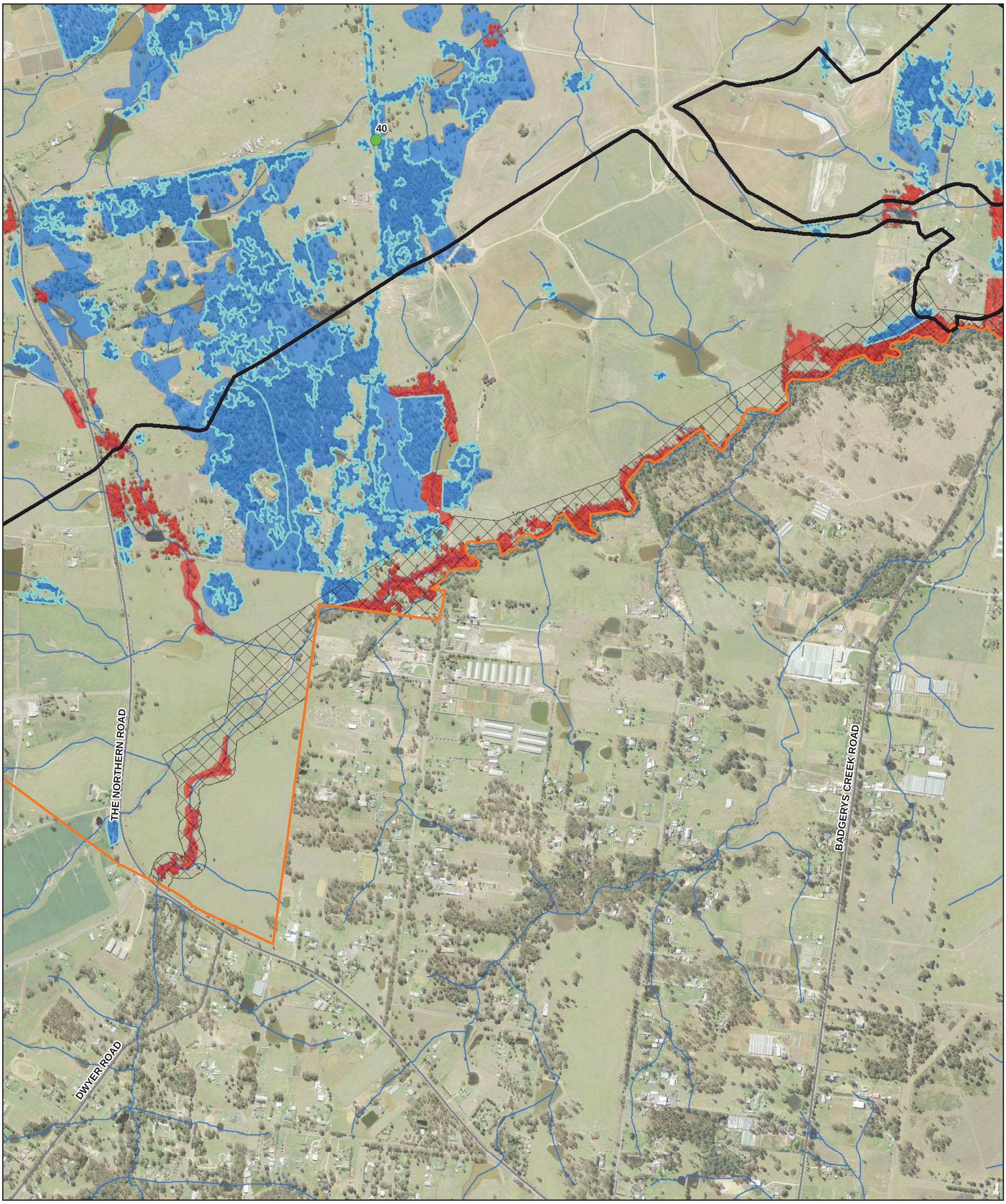
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

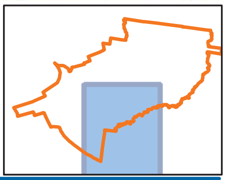


LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses
- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora subsp. viridiflora* (endangered population under the TSC Act)

TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Threatened flora and ecological communities Figure 5C

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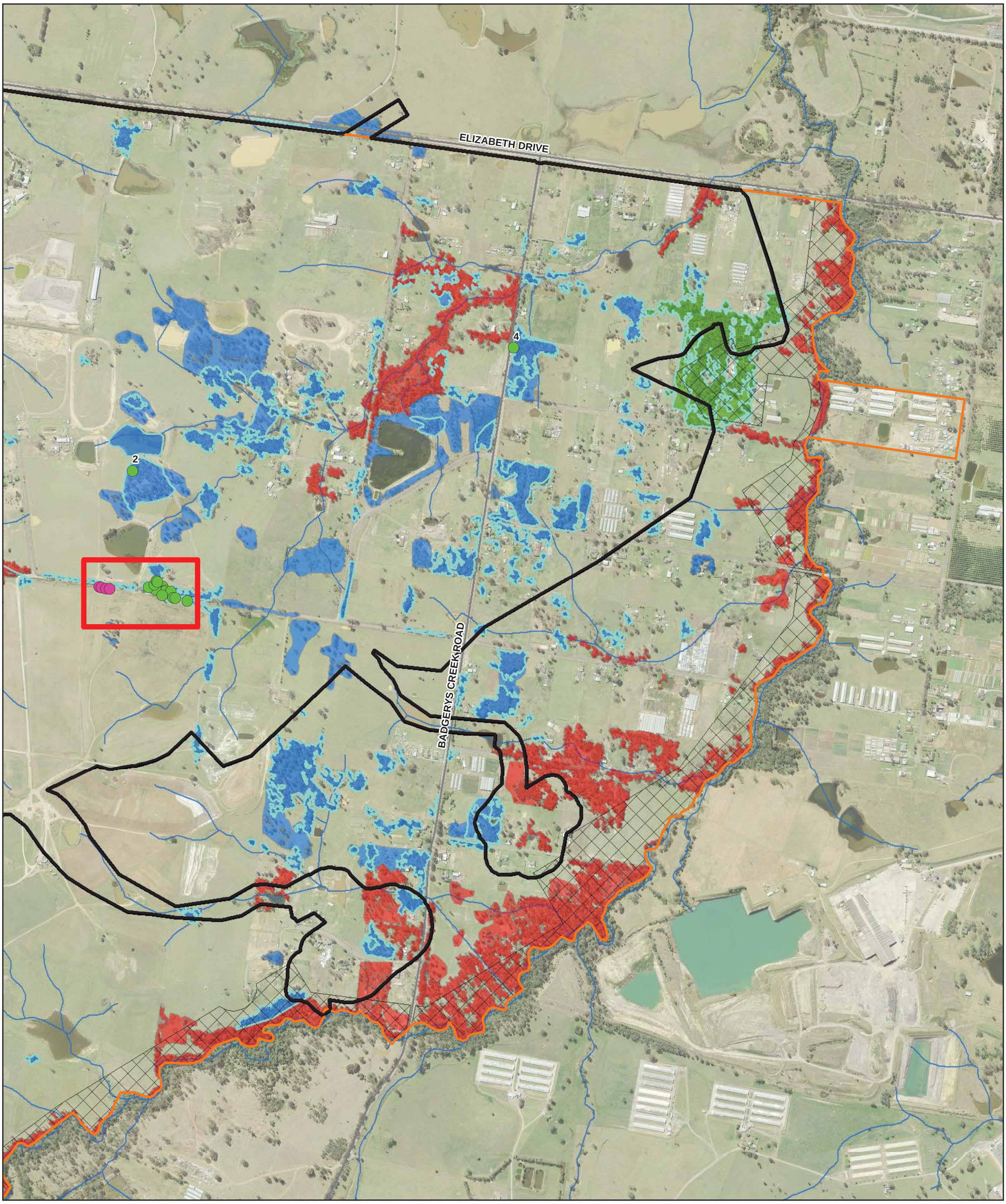
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

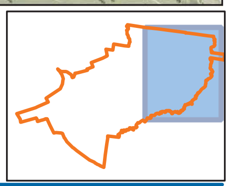


LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses
- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora subsp. viridiflora* (endangered population under the TSC Act)

TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)
- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)



Paper Size A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	19 Aug 2016

Threatened flora and ecological communities

Figure 5D

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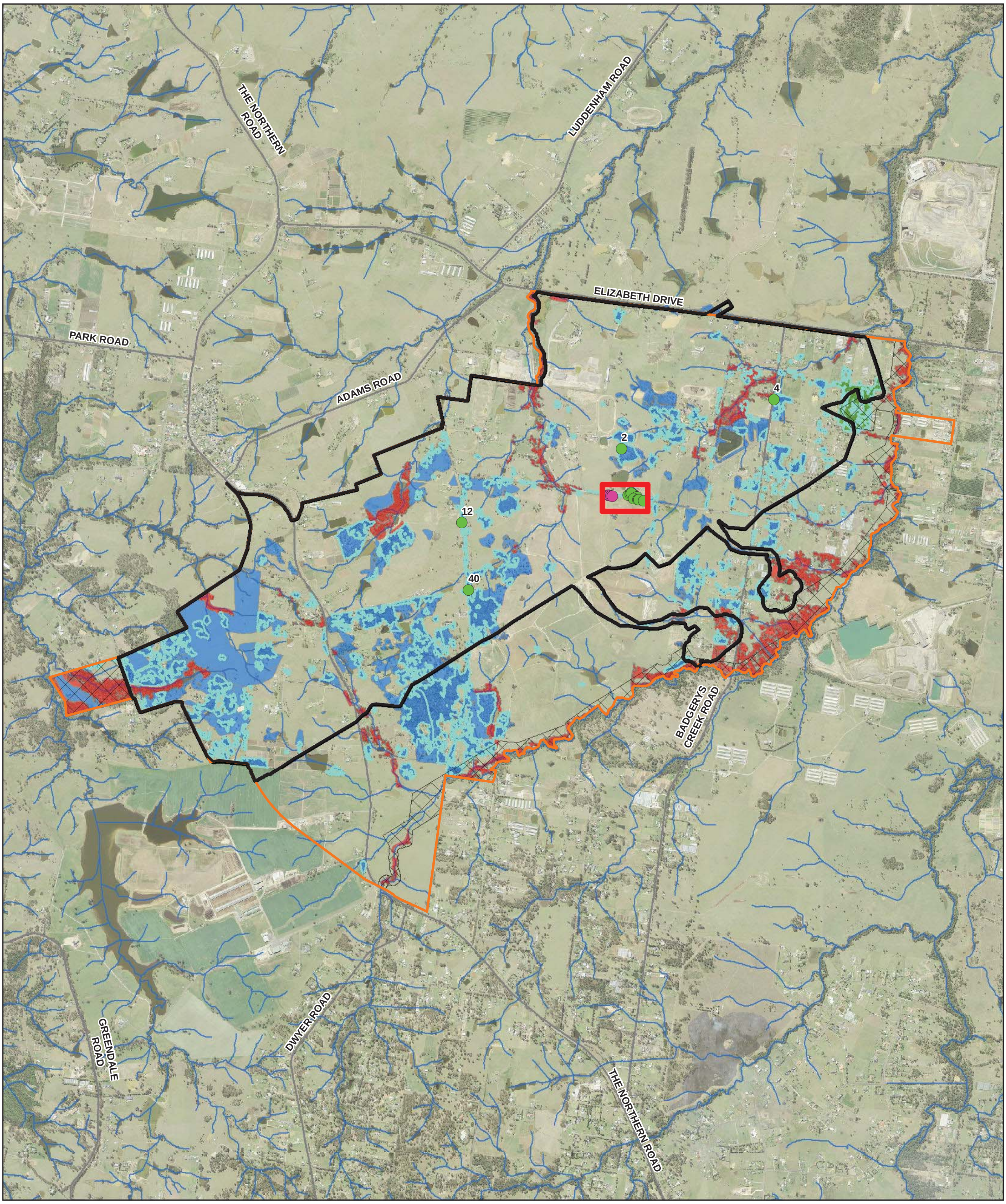
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora subsp. viridiflora* (endangered population under the TSC Act)

TSC Act

- Cumberland Plain Woodland (CEEC under the TSC Act)
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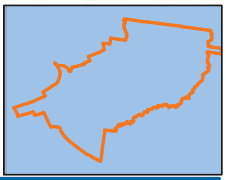

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
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Threatened flora and ecological communities

Figure 5E

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

4.5.3 Threatened fauna species

Threatened species recorded or likely to occur

One threatened fauna species listed under the EPBC Act was recorded at the airport site during the recent surveys: the Grey-headed Flying-fox (*Pteropus poliocephalus*). This species is listed as a vulnerable species under the EPBC Act and under the TSC Act. The Grey-headed Flying-fox was also recorded at the airport site during previous surveys for the 1999 EIS (PPK 1999). There are no Grey-headed Flying-fox camps located at the airport site, although there are at least seven known camps within 20 kilometres.

All native woodland and forest in the airport site provides foraging habitat for the Grey-headed Flying-fox. Dominant canopy species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus mollucana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Forest Red Gum and Grey Box are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) however none of these species are highly productive flowering species. Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering (0.67). This species flowers in late winter and spring, partly during the 'food bottleneck'. Grey Box has low productivity and reliability (0.35). It flowers in late summer and early autumn. Broad-leaved Ironbark has high productivity but is an unreliable flowerer (0.54) (Eby and Law 2008). This species flowers in summer and early autumn, providing forage habitat during the Grey-headed Flying-fox breeding period. Habitat at the airport site is thus somewhat productive during food bottlenecks, and may be habitat critical to the survival of the Grey-headed Flying-fox, as defined in the draft recovery plan (DECCW 2009).

The Swift Parrot (*Lathamus discolor*) may occur at the airport site on occasion during its winter migration, but was not detected during targeted surveys. This species is listed as a critically endangered species under the EPBC Act and an endangered species under the TSC Act.

There are eight local records of the Swift Parrot. There are scattered records of this species across the Cumberland Plain, but limited evidence of any concentration of records at any locations (OEH 2015a). In addition, there are very few records of the species in south-western Sydney. There are no records of the species in the area bounded by the M4 motorway, The Northern Road, the M7 and Camden Valley Way. Local records are from Mulgoa and Mulgoa Nature Reserve to the north-west, the Western Sydney Parklands at Cecil Hills to the east and Cobbitty to the south. These records are all located about 8-10 kilometres from the airport site. There are no previous records (last 30 years) from within the airport site or immediate surrounds. GHD obtained atlas records from both OEH and BirdLife Australia. A number of BirdLife atlas locations are situated within the airport site boundary. No records of the Swift Parrot were located at any of these sites. A broad-scale habitat map prepared for the Greater Southern Sydney Region (DECC 2007) identifies the largest area of habitat for the Swift Parrot within the Burragorang Valley (approximately 30 kilometres to the southwest of the airport site), with smaller patches around Glenmore, west of Liverpool, and around Wedderburn.

Targeted surveys were conducted for this species following confirmation of its arrival in Western Sydney since May 2015. Eucalypts had started to flower prior to the second survey in June. Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Grey Box (*Eucalyptus moluccana*) and Red Bloodwood (*Corymbia gummifera*) are important nectar sources in coastal parts of the non-breeding range. Commonly used lerp infested trees include Grey Box (*Eucalyptus microcarpa)*, Grey Box (*Eucalyptus moluccana)* and Blackbutt (*Eucalyptus pilularis)*. Forest Red Gum (*Eucalyptus tereticornis*) is also considered a food tree in coastal areas, including the Sydney Metro and Hawkesbury-Nepean areas (Saunders and Tzaros 2011). The occurrence of Swift Parrots at foraging sites has been linked with the abundance of lerp, nectar and non-aggressive competitors (Swift Parrot Recovery Team 2001).

Swift Parrots have been found to preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees (Saunders and Tzaros 2011). Dominant canopy species in the airport site include Grey Box (*Eucalyptus mollucana*) and Forest Red Gum (*Eucalyptus tereticornis*), which would provide nectar and lerp resources. Much of the airport site is vegetated with relatively young regrowth which reduces habitat quality, although patches containing large, old-growth trees are also present. A range of aggressive competitors such as the Noisy Miner (*Manorina melanocephala*) and the Bell Miner (*Manorina melanophrys*) are common at the airport site, potentially further reducing habitat suitability for the Swift Parrot.

The airport site would not provide core winter foraging resources for the Swift Parrot given the presence of mostly young regrowth and aggressive competitors, although it may provide shelter or supplementary foraging resources for migrating individuals, and the lack of evidence of any records at or near the site for the last 30 years.

Ten threatened fauna species listed under the TSC Act were positively recorded during recent and previous surveys:

- Cumberland Plain Land Snail (*Meridolum corneovirens*), listed as an endangered species.
  - Habitat for the Cumberland Plain Land Snail occurs in larger patches with remnant trees. Live snails and shells of this species were recorded at a variety of locations (see Figure 6) where moist, deep leaf litter was present. In general, this species was recorded at locations where it had previously been recorded for the 1999 EIS, as well as some additional locations. In some locations, including some where the species had previously been recorded, appropriate potential habitat with good leaf litter was present but no individuals were found. Locations that were searched but where no individuals were recorded are also mapped on Figure 6. Lack of evidence of the species at these locations may have been as a result of individuals burrowing deep into the soil and not being found, or previous local extinction of a population. This species was not detected where leaf litter was shallow, woodland patches were small and no remnant trees were present. It is likely that in isolated patches of regrowth woodland, the species has not been able to recolonise due to distance between patches and inhospitable habitat (ie cleared land). The native Common Southern Carnivorous Snail (*Austrorhytida capillacea*) was also found in woodland patches in deep leaf litter. The introduced Garden Snail (*Cantareus aspersa*) was recorded at a number of locations, generally in the open, or in grassy areas, and the Asian Tramp Snail (*Bradybaena similaris*) was recorded in a weedy area near Elizabeth Drive.
- Little Eagle (*Hieraaetus morphnoides*), listed as a vulnerable species.
  - The Little Eagle was observed on a number of occasions soaring above open grassland at the airport site. The Little Eagle would prey upon small to medium sized mammals such as rodents and rabbits that occur at the site. It is likely that the airport site forms part of the home range of a number of breeding pairs. The species may use tall trees to nest in, although no raptor nests were observed during surveys.
- Little Lorikeet (*Glossopsitta pusilla*), listed as a vulnerable species.
  - A pair of Little Lorikeets was observed flying over the western portion of the airport site. Individuals within a regional population of this nomadic species are likely to forage at the airport site when eucalypts are in flower. While hollow-bearing trees are present in some locations, the species is unlikely to breed at the airport site given the level of fragmentation.

- Scarlet Robin (*Petroica boodang*), listed as a vulnerable species.
  - One individual Scarlet Robin was recorded foraging with a mixed species group in River-flat Eucalypt Forest near Badgerys Creek and may also occur in larger patches of Cumberland Plain Woodland. The Scarlet Robin may breed and forage in larger woodland patches in the airport site, although it tends to breed in woodland on foothills and ridges, moving to lower more open habitats in winter (OEH 2015b).
- Varied Sittella (*Daphoenositta chrysoptera*), listed as a vulnerable species.
  - About three or so individuals were recorded foraging with a mixed species group in River-flat Eucalypt Forest near Badgerys Creek and this species may also occur in larger patches of Cumberland Plain Woodland. It is likely to breed and forage in larger woodland patches at the airport site.
- Black Bittern (*Ixobrychus flavicollis*), listed as a vulnerable species.
  - One individual was observed in the northern section of Badgerys Creek. This species may breed and forage in the riparian corridor and at dams with good cover at the airport site.
- Blue-billed Duck (*Oxyura australis*), listed as a vulnerable species.
  - Three individuals were observed on the large, deep constructed dam on Taylors Road. This species is unlikely to rely on habitats present at the airport site. It only rarely occurs in coastal areas as a vagrant generally during times of drought and breeding occurs in swamps in inland NSW.
- East Coast Freetail Bat (*Mormopterus norfolkensis*), listed as a vulnerable species.
  - The East Coast Freetail Bat was recorded at many locations, and was often the most common bat species recorded. It may roost and breed in hollow-bearing trees at the airport site. It would forage in woodland and open areas at the airport site.
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), listed as a vulnerable species.
  - The Eastern False Pipistrelle was recorded during the surveys for the 1999 EIS. Possible calls of the species were recorded during recent surveys. The Eastern False Pipistrelle prefers large tracts of vegetation, and would mainly occur along the Badgerys Creek riparian corridor and nearby large patches of vegetation.
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), listed as a vulnerable species.
  - This species was recorded during the surveys for the 1999 EIS. Possible calls of the species were recorded during recent surveys. No breeding habitat for this species is present at the airport site, although it may roost under bridges and in buildings. This species forages in cleared and wooded areas, and could therefore forage throughout the airport site.

One additional microchiropteran bat species was probably recorded at the airport site during the surveys above based on call echolocation analysis:

- Large-footed Myotis (*Myotis macropus*), listed as a vulnerable species.
  - Probable calls of the Large-footed Myotis were recorded at a number of locations. Calls were considered to be most likely the Large-footed Myotis given habitat preferences and local records. However due to the lack of local reference calls and known overlap with *Nyctophilus* species, a definitive identification from analysis of echolocation call recordings could not be made. A small colony of bats were recorded roosting under the bridge over Badgerys Creek. A large number of calls probably attributable to the Large-footed Myotis were also recorded at this location.

– Farm dams and creeks would provide foraging habitat for this species. It may roost in tree hollows, under bridges and in old buildings at the airport site. A colony of bats (possibly this species) was recorded under the Badgerys Creek Road bridge over Badgerys Creek. A large number of probable calls of this species were recorded at this location.

Two additional threatened bat species were possibly recorded at the airport site during the recent surveys based on echolocation call analysis. Poor data quality and/or interspecific call similarities precluded definitive identification of these species:

- Greater Broad-nosed Bat (*Scoteanax rueppellii*), listed as a vulnerable species; and
- Eastern Cave Bat (*Vespadelus troughtoni*), listed as a vulnerable species. The calls of three different Vespadelus species are very similar, and could not be distinguished to confirm the presence of this species. The airport site is near the limit of this species' distribution. It is known to occur in the Blue Mountains area.

A number of other threatened fauna species listed under the TSC Act are likely to occur at the airport site, based on a combination of recent records in the locality and the presence of potential habitat (see Appendix A). The airport site contains extensive areas of habitat in moderate to good condition for each of these species and is likely to support viable local populations or would provide foraging habitat for transient species. Species likely to occur include:

- Small woodland birds: Potential foraging and breeding habitat for a range of woodland birds previously recorded in the locality is present at the airport site. These include the Flame Robin and Diamond Firetail (*Stagonopleura guttata*).
- Hollow-dependent birds: Potential foraging and breeding habitat for a range of woodland birds previously recorded in the locality is present at the airport site. These include the Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*) and Masked Owl (*Tyto novaehollandiae*).

Notwithstanding the generally moderate condition of fauna habitat at the airport site it has high conservation significance as a result of the presence of threatened species described above and the generally limited extent and quality of similar habitat in the Western Sydney region.

No threatened aquatic fauna species listed under the EPBC Act or the FM were recorded at the airport site or in upstream or downstream habitats and none are likely to occur given known distributions and the absence of suitable habitat (see below).

Threatened species with a low likelihood of occurrence

A number of species listed under the EPBC Act identified through the desktop review have a low likelihood of occurrence at the airport site based on low habitat suitability, lack of nearby records or lack of previous records (see Appendix A). In particular, two species identified in the *Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport* (DoE 2015f) as potentially being significantly impacted by the airport (the Large-eared Pied Bat and Green and Golden Bell Frog) have a low likelihood of occurrence at the airport site and are therefore unlikely to be significantly impacted by the proposed development. In addition, the Australian Painted Snipe, Australasian Bittern and the Koala were assessed as having a low likelihood of occurrence given the habitats present and lack of records or low numbers of records in the locality (see Appendix A). These species are discussed below.

In NSW, the Large-eared Pied Bat (*Chalinolobus dwyeri*) is widely distributed, but uncommon, in the sandstone areas of the Sydney Basin. Most records in the Sydney Basin occur in the Greater Blue Mountains area, including in the Blue Mountains and Wollemi National Parks (DECC 2007).

Habitat critical to the survival of the Large-eared Pied Bat noted in the Recovery Plan (DERM 2011) includes sandstone cliffs for roosting and proximate fertile wooded valley habitat for foraging (DECC 2007). This species is dependent on roosts, including sandstone caves and overhangs, used for diurnal and nocturnal shelter (when not feeding) and for rearing young (DERM 2011). It appears to forage in nearby fertile valleys and plains and along watercourses rather than sandstone landscapes and nearly all records are within several kilometres of cliff lines or rocky terrain (DERM 2011).

Large expanses of suitable habitat for this species are present in the Blue Mountains National Park to the west of the airport site and at Bents Basin State Conservation Area to the south-west. No breeding colonies are known from these areas. The closest record of a lactating female and/or indication of a maternity roost for the species has been recorded near Ulan in NSW a few hundred kilometres to the north of the airport site (Fly By Night 2005).

Predictive habitat modelling in the Greater Southern Sydney region highlighted vegetation remnants on the Cumberland Plain, including in the vicinity of the airport site, as moderate quality foraging habitat for the Large-eared Pied Bat (DECC 2007). However, it is noted that many remnants may not be used if the distance from suitable roosting habitat is too far, or if remnants have become too isolated as a result of clearing (DECC 2007), which is likely to be the case at the airport site. The Large-eared Pied Bat has been recorded in transitional forests at a few locations on the edge of the Cumberland Plain, including near Oakdale, Douglas Park and Bargo (DECC 2007). These records are near extensive tracts of vegetation in reserves and/or along larger watercourses and are over 30 kilometres from the airport site. More local records include at Bents Basin State Conservation Area to the south-west of the airport site where the Nepean River flows through extensively vegetated sandstone gorge country.

The Large-eared Pied Bat has not been recorded at the airport site during either the recent or previous surveys but could conceivably occur on occasion. The airport site is not considered to comprise habitat critical for the survival of the Large-eared Pied Bat given it does not contain sandstone cliffs required for roosting and is not located in close proximity to sandstone escarpment country. The small, scattered patches of remnant vegetation at the airport site and the extensive areas of cleared agricultural land and urban development between areas of known sandstone habitat, including Bents Basin State Conservation Area and the Blue Mountains National Park and the airport site, make it unlikely that a local population of this species would occur or be dependent on the site.

No Green and Golden Bell Frogs (*Litoria aurea*) were recorded during the recent targeted surveys carried out in March 2015, despite the presence of suitable habitat at the airport site. Similarly, none were recorded during the surveys conducted for the EIS in October 1998 (Lemckert 1999) and there are no other previous records of this species at the airport site (OEH 2015a). Numerous farm dams are present and many of these appear to provide good quality potential habitat, with a range of emergent flora species, including *Typha orientalis*, *Eleocharis cylindrostachys*, and *Eleocharis sphacelata*. Surrounding grassland would provide basking sites for frogs if present. Mosquitofish (*Gambusia holbrooki*) were observed at many of the dams, potentially reducing habitat quality for this species.

Targeted surveys for the Green and Golden Bell Frog were conducted at a reference site at Homebush Bay in unison with the surveys at the airport site. Targeted surveys had been conducted at the Homebush Bay reference site earlier in 2015 but concluded at the end of February. Green and Golden Bell Frogs had not been heard calling at Homebush Bay through March 2015 after a surge in activity with the stormy weather of January/February 2015. Through March there were a large number of juvenile Green and Golden Bell Frogs dispersing from a breeding event in early summer and tadpoles from a late January breeding event (O’Meara, J. Sydney Olympic Park Authority, pers. comm.). Several juvenile Green and Golden Bell Frogs and a mature adult were observed on two out of three nights that surveys were conducted at the reference site (Harrington, J. Sydney Olympic Park Authority, pers. comm.).

Large numbers of nine other species of frogs were recorded during the most recent surveys at the airport site, showing that frogs in general were active at this time and suggesting that if Green and Golden Bell Frogs were present, they would have been recorded. As described above and in Section 3.4.3, targeted surveys were conducted late in the 2014-15 breeding season and no frogs were calling at the reference site which may have reduced the chances of detecting the species. However given the observed Green and Golden Bell Frog activity at the reference site and the number of individuals of other frog species recorded at the airport site, it is likely that this relatively conspicuous species would have been detected if present. It is likely that the Green and Golden Bell Frog does not occur at the airport site. According to Lemckert (1999) this is a typical situation for this species, as it appears to have become extinct through most of its range, despite the presence of apparently excellent habitat. Many populations in western Sydney have become extinct over recent decades. According to White and Pyke (2008), formerly known populations at Liverpool, Merrylands, Milperra, and Mount Druitt, also in western Sydney, are extinct or probably extinct.

The Australian Painted Snipe (*Rostratula australis*) may occur on rare occasions at wetlands and nearby flooded grassland within the airport site. This species is most common in eastern Australia, although most records in NSW are from the Murray-Darling Basin (DoE 2015b). The Australian Painted Snipe inhabits many different types of shallow, brackish or freshwater terrestrial wetlands, especially temporary ones which have muddy margins and small, low-lying islands (Birdlife Australia 2015). There are no local records of this species, and none were recorded during surveys, however the species is cryptic and could potentially occur but not be detected.

The Australasian Bittern (*Botaurus poiciloptilus*) may also occur on rare occasions at wetlands within the airport site. The species' preferred habitat comprises wetlands with tall dense vegetation, particularly those dominated by sedges, rushes and reeds (DoE 2011). There are no local records of this species, and none were recorded during surveys, however the species is cryptic and could potentially occur but not be detected.

The Koala was also identified as having a low likelihood of occurrence at the airport site despite the presence of primary food tree species (DECC 2008c) (see Appendix A). There are few records of the Koala in the locality. It has been recorded to the west in the Blue Mountains National Park, and to the east in the Western Sydney Parklands area, however there is minimal connectivity between these areas and the airport site. No Koalas have been observed at the airport site, and no scats were recorded during targeted searches.

The vegetation at the airport site has been assessed to determine if it comprises 'habitat critical to the survival of the Koala' as defined in the referral guidelines for the species (DoE 2014). In accordance with the guidelines, an attribute score of five or over indicates habitat critical to the survival of the Koala. The assessment of Koala habitat in the airport site is summarised in Table 56. The outcome of this assessment (a total attribute score of 2) is that potential Koala habitat at the airport site is not habitat critical to the survival of the species.

Table 56 Assessment of Koala habitat in the airport site

Attribute	Score	Habitat appraisal	
Koala occurrence	+0	Desktop	EPBC PMST report identified the koala as 'known to occur' in the locality. There are no records of Koalas within 2 km of the airport site from the last 5 years (OEH 2015b). No evidence of the species was noted during previous surveys (Biosis 1999).
		On-ground	No Koala scats or Koalas were recorded during diurnal habitat searches or nocturnal spotlighting surveys.
Vegetation structure and composition	+2	Native vegetation at the airport site contains *Eucalyptus tereticornis* (a primary feed tree) or *Eucalyptus moluccana* (a secondary feed tree).	
Habitat connectivity	0	Native woodland at the airport site is patchy with minimal connectivity both within the airport site and the surrounding locality.	
Key existing threats	0	Three 80 km/hr roads are located at the airport site. Many domestic dogs were observed at the airport site and feral dogs are also likely to occur.	
Recovery value	0	Vegetation at the airport site is unlikely to be important for achieving recovery objectives given the lack of connectivity and presence of existing threats.	
Total	2	Decision: The total habitat score for the airport site is 2 and therefore the habitat present does constitute habitat critical to the survival of the Koala.	

Threatened species not likely to occur

The remainder of the terrestrial threatened fauna species previously recorded or predicted to occur in the locality would not occur due to a lack of suitable habitat, and/or a lack of local records (see Appendix A). These species would not occur at the airport site and would not be impacted by the airport.

The Giant Burrowing Frog (*Heleioporus australiacus*) was identified in the assessment process notice following determination of the airport as a controlled action, as potentially being significantly impacted by the airport (DoE 2015c). This species has a strong habitat association with sandstone geology, especially the Hawkesbury Sandstone plateaux surrounding Sydney, where it occurs on sandy soils supporting heath, woodland or open forest (Stauber 2006). It does not occur on the Shale and alluvium substrates of the Cumberland Plain and would not occur at the airport site. The conservation advice for the Giant Burrowing Frog does not include Cumberland Plain Woodland as a vegetation type in which the species occurs (DoE 2014d).

The Spotted-tailed Quoll (*Dasyurus maculatus*) is unlikely to occur at the airport site. There are no local records of this species and very few records on the Cumberland Plain. Most records of the species in the region are from the Blue Mountains National Park, Ku-ring-gai Chase National Park, Holsworthy army base and vegetated land near Oakdale which is connected to Nattai State Recreation Area and the Warragamba Special Area (OEH 2015a). The Spotted-tailed Quoll has a preference for mature wet forest habitats and requires large areas of relatively intact vegetation through which to forage. Females occupy home ranges of up to 650 hectares and males up to 2,560 hectares (DoE 2015b). No extensive areas of mature wet forest are present near the airport. There is limited connectivity between the airport and any large patches of vegetation.

Surveys for the Spotted-tailed Quoll included searches for habitat resources, scats and latrines over 18 days of surveys, spotlighting on nine nights and remote cameras at four locations for 4 weeks each. Given the few records for this species on the Cumberland Plain, the lack of large expanses of native vegetation in the local area connected to the airport site, the lack of suitable habitat at the airport site, and lack of evidence of the species during surveys, this species is unlikely to occur at the airport site.

There is no suitable aquatic habitat for EPBC Act-listed threatened fish predicted to occur in the broader catchment, such as the Macquarie Perch (*Macquaria australasica*) or the Australian Grayling (*Prototroctes maraena*), at the airport site or in habitats sampled downstream. Potential indirect impacts of the project on downstream water quality and flows would not be of a magnitude or extent to impact habitat for such species that may occur within the broader catchment at considerable distance downstream of the site.

Similarly, it is unlikely that the airport site or areas immediately downstream support habitat for threatened dragonflies listed under the FM Act that are known from the greater Sydney region and that have been predicted to occur in the broader catchment. Larvae of the Sydney Hawk Dragonfly (*Austrocorrdulia leonardii*) are found in small creeks with gravel or sandy bottoms, in narrow shaded riffle zones with moss and rich riparian vegetation. Riffle zone habitat is very limited at the airport site and in downstream areas and where present, does not occur with other required habitat features. Similarly, there is no suitable habitat for the Adams Emerald Dragonfly (*Archaeophya adamsi*) which is generally found in steams and small rivers amongst rocks and litter and in riffle areas. No larval specimens belonging to the families from which these species belong were recorded during the macroinvertebrate surveys at the site or in downstream or upstream habitats and given the absence of suitable habitat and lack of local records neither is considered likely to occur or be impacted by the project.

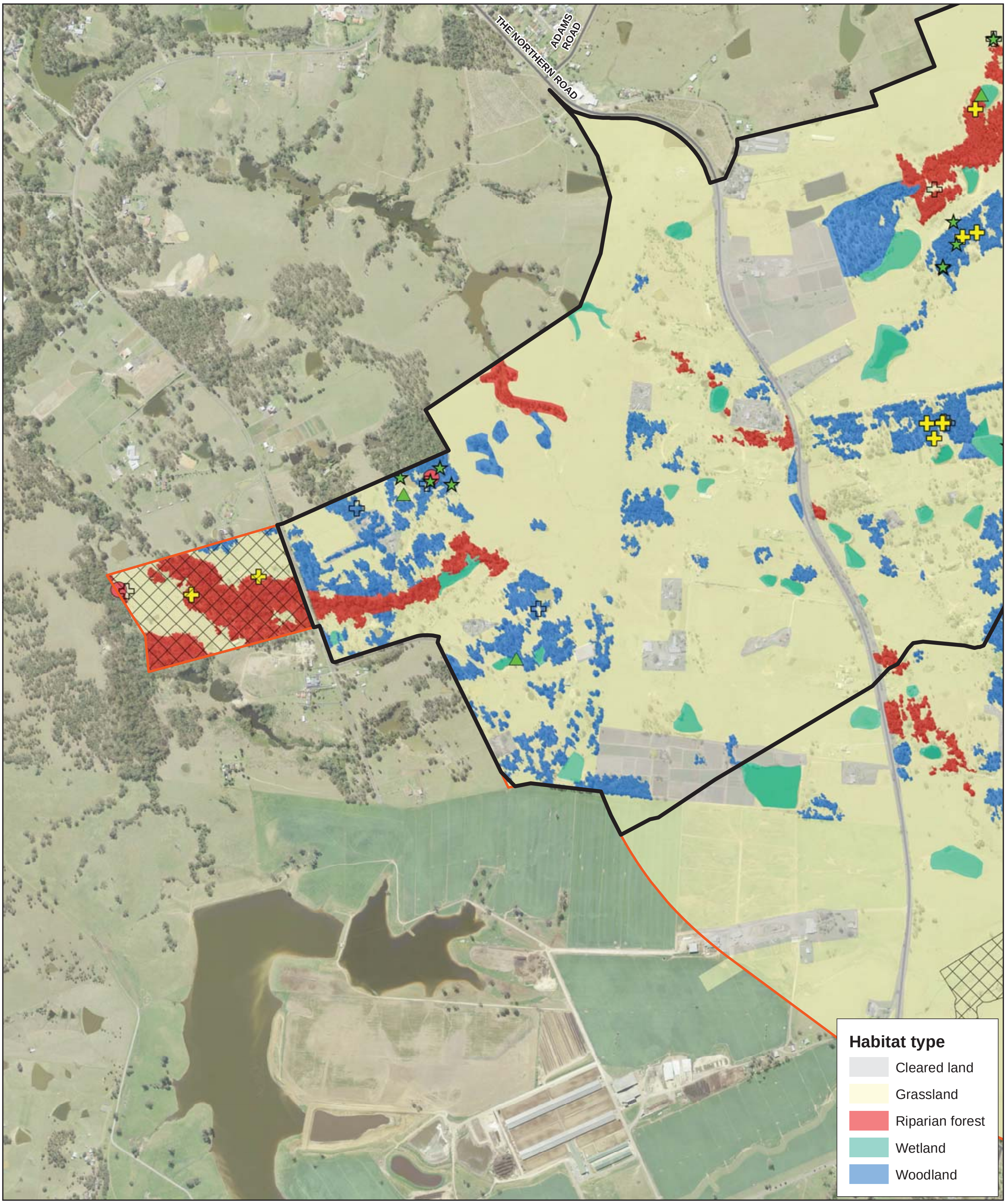
A summary of threatened fauna species recorded or that may occur at the airport site is provided in Table 57.

Table 57 Threatened fauna recorded or that may occur at the airport site

Species	Scientific name	EPBC Act Status	TSC Act Status	Likelihood of occurrence
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Present
Cumberland Plain Land Snail	Meridolum corneovirens		E	Present
Little Eagle	*Hieraaetus morphnoides*		V	Present
Little Lorikeet	*Glossopsitta pusilla*		V	Present
Scarlet Robin	*Petroica boodang*		V	Present
Varied Sittella	*Daphoenositta chrysoptera*		V	Present
Black Bittern	*Ixobrychus flavicollis*		V	Present
Blue-billed Duck	*Oxyura australis*		V	Present
East Coast Freetail Bat	Mormopterus norfolkensis		V	Present
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*		V	Present
Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*		V	Present
Large-footed Myotis	*Myotis macropus*		V	Probably recorded (anabat)
Greater Broad-nosed Bat	*Scoteanax rueppellii*		V	Possibly recorded (anabat)
Eastern Cave Bat	*Vespadelus troughtoni*		V	Possibly recorded (anabat)
Yellow-bellied Sheath-tail Bat	*Saccolaimus flaviventris*		V	Possible
Swift Parrot	*Lathamus discolor*	CE	E	Likely
Powerful Owl	*Ninox strenua*		V	Likely

Species	Scientific name	EPBC Act Status	TSC Act Status	Likelihood of occurrence
Masked Owl	*Tyto novaehollandiae*		V	Likely
Flame Robin	*Petroica phoenicea*		V	Likely
Hooded Robin	*Melanodryas cucullata*		V	Possible
Diamond Firetail	*Stagonopleura guttata*		V	Likely
Speckled Warbler	*Pyrrholaemus sagittatus*		V	Possible
Black-chinned Honeyeater	*Melithreptus gularis*		V	Possible
Gang-gang Cockatoo	*Callocephalon fimbriatum*		V	Possible
Glossy Black-cockatoo	*Calyptorhynchus lathami*		V	Possible
Barking Owl	*Ninox connivens*		V	Possible
Square-tailed Kite	*Lophoictinia isura*		V	Possible
Australian Painted Snipe	*Rostratula australis*	E	E	Possible
Australasian Bittern	*Botaurus poiciloptilus*	E	E	Possible
Freckled Duck	*Stictonetta naevosa*		V	Possible

Note: CE – critically endangered; E – endangered; V - vulnerable



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

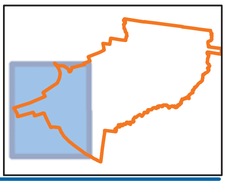
Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E) (absent)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)

Migratory species

- Cattle Egret
- Latham's Snipe
- Rufous Fantail

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act



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Grid: GDA 1994 MGA Zone 56

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Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
Date 18 Aug 2016

Threatened fauna and habitat features

Figure 6A

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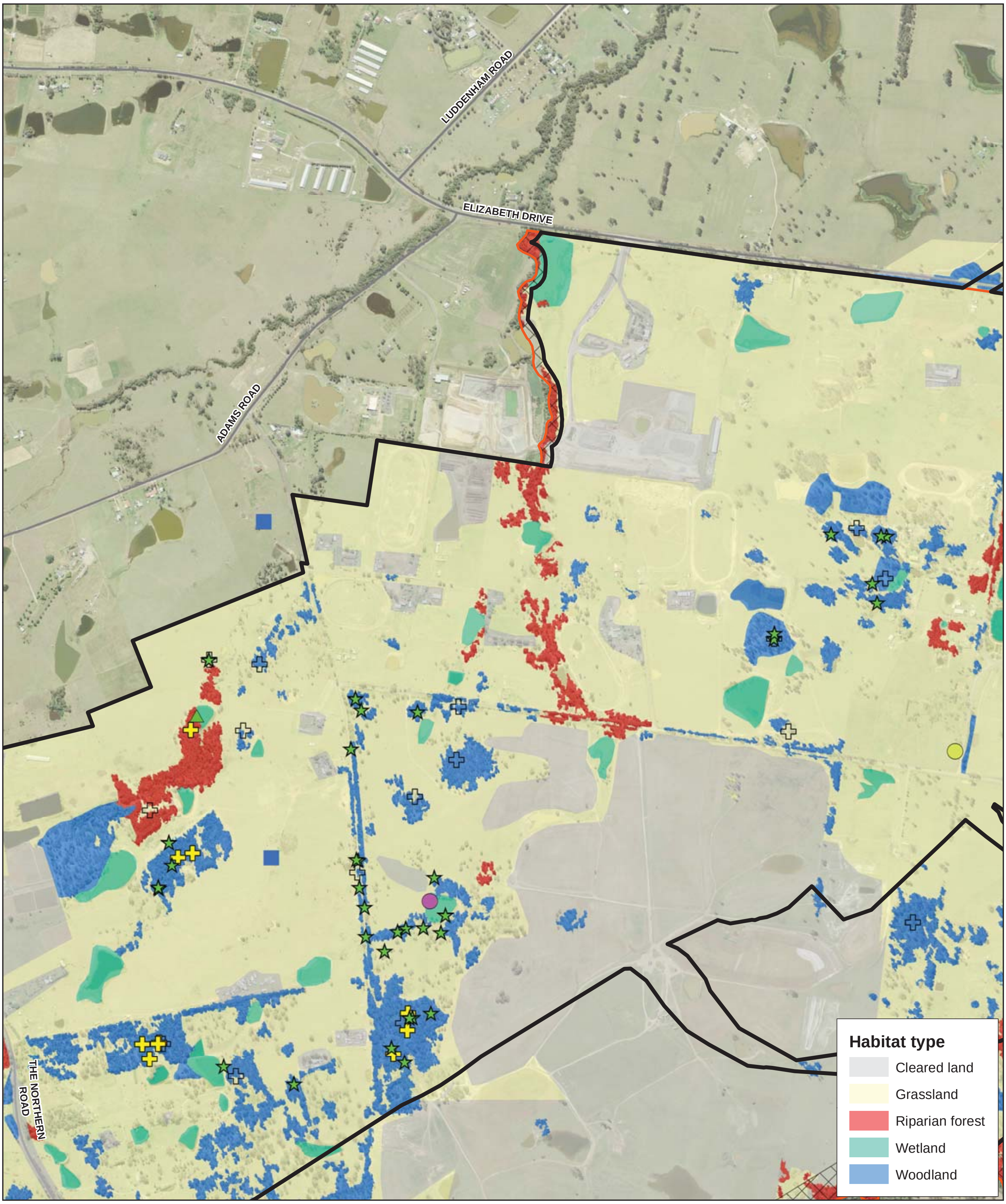
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

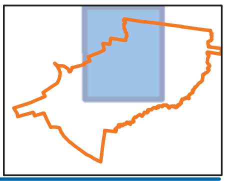
Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E) (absent)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)

Migratory species

- Cattle Egret
- Latham's Snipe
- Rufous Fantail

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act



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Grid: GDA 1994 MGA Zone 56

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Western Sydney Airport
Biodiversity Assessment

Job Number 21-24265
Revision A
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Threatened fauna and habitat features

Figure 6B

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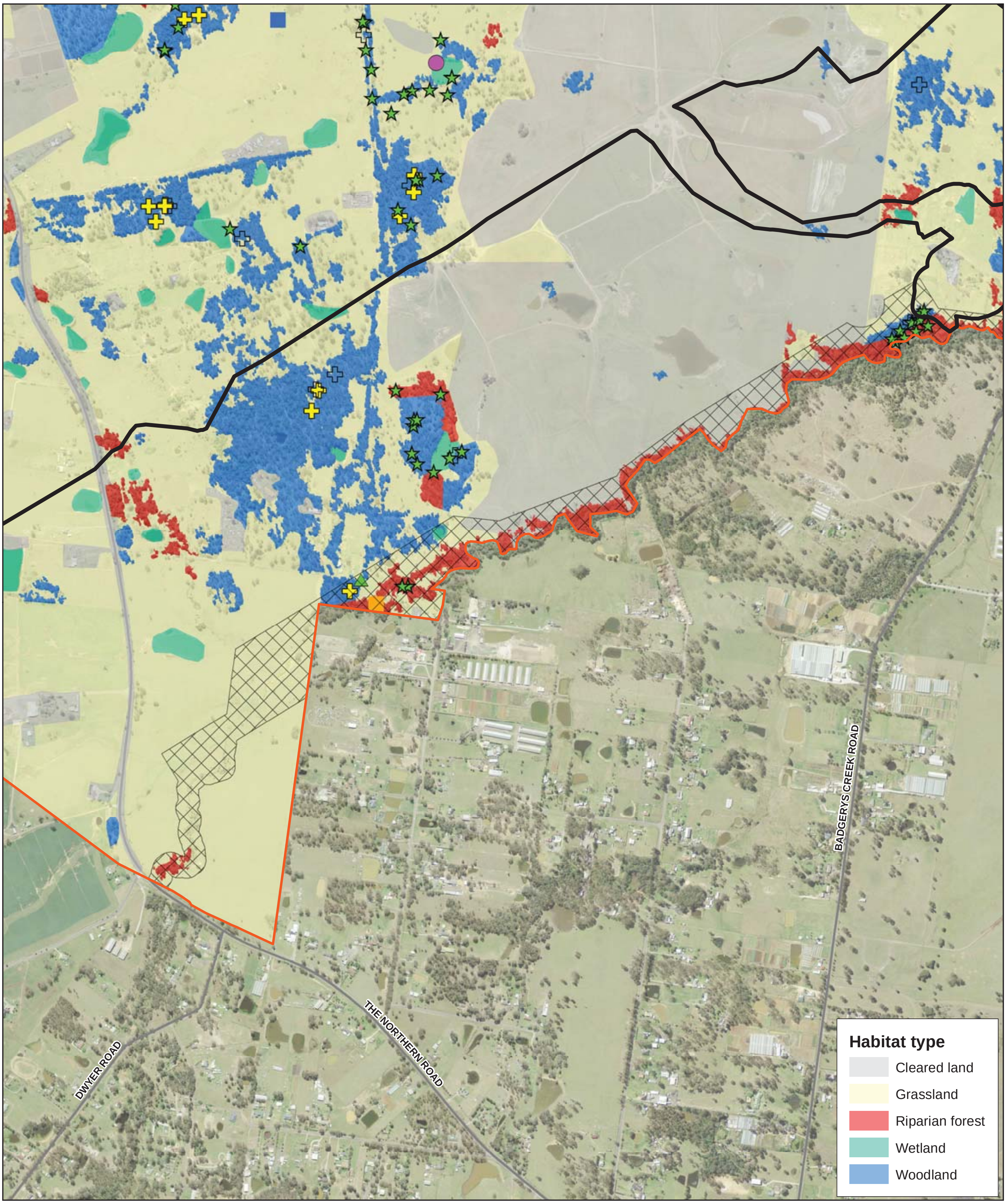

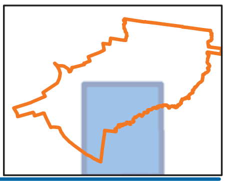

Legend

Airport site
Stage one construction impact zone
Environmental conservation
Roads
Habitat tree

Threatened species

Black Bittern (V)
Cumberland Plain Land Snail (E) (absent)
Cumberland Plain Land Snail (E) (present)
East Coast Freetail Bat (V)
Grey-headed Flying-fox (V/V)
Large-footed Myotis (V)
Little Eagle (V)
Scarlet Robin (V)
Varied Sittella (V)

Migratory species

Cattle Egret
Latham's Snipe
Rufous Fantail

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act

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Grid: GDA 1994 MGA Zone 56

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Western Sydney Airport
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Threatened fauna and habitat features

Figure 6C

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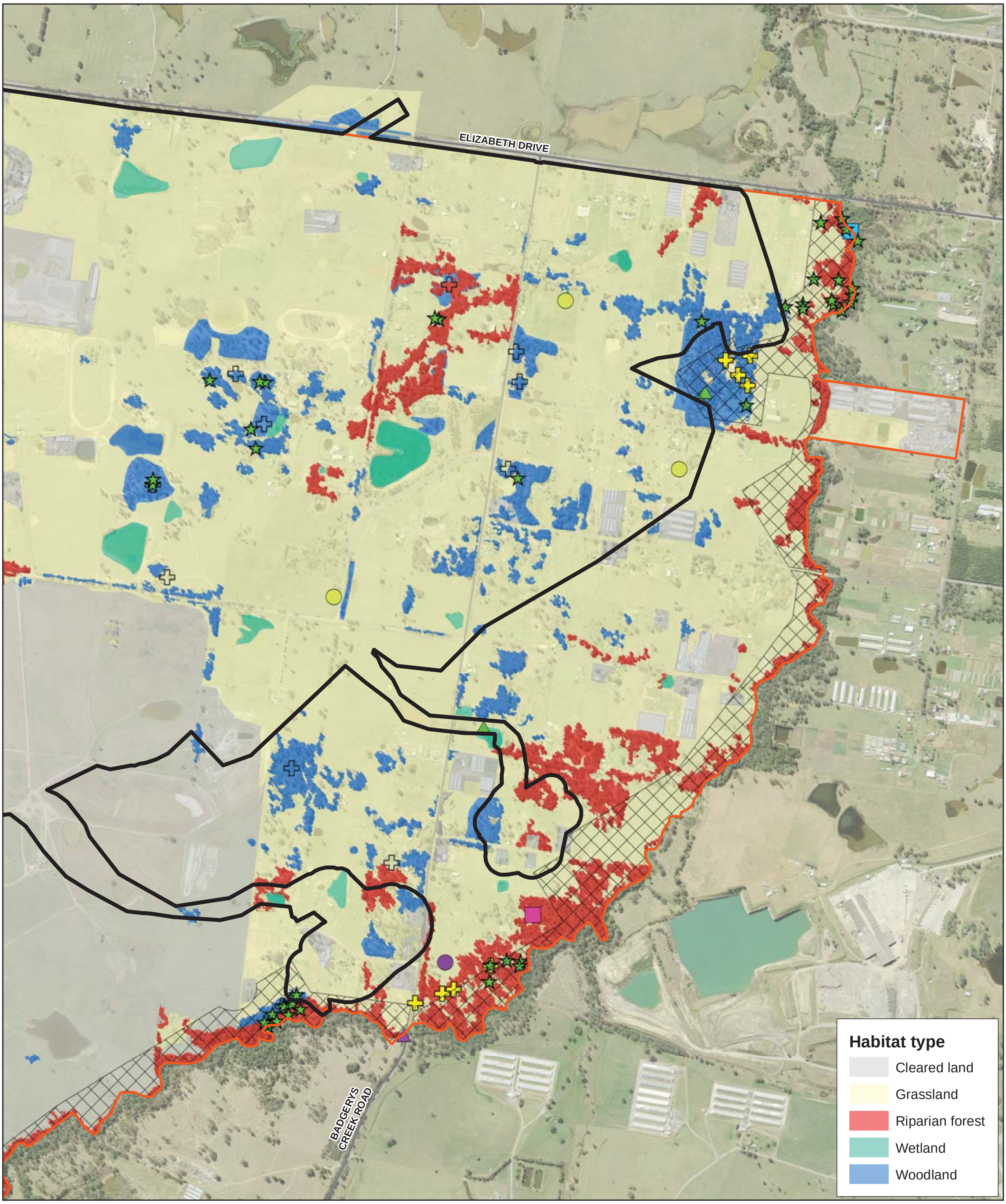
Data source: Please refer to 'Digital Data Sources' on the second page of the EIS



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

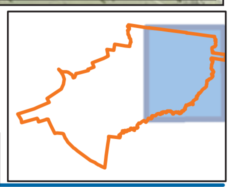
Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E) (absent)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)

Migratory species

- Cattle Egret
- Latham's Snipe
- Rufous Fantail

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Western Sydney Unit, Department of Infrastructure and Regional Development
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Threatened fauna and habitat features

Figure 6D

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EIS

4.5.4 Migratory species

Overview

Six migratory bird species listed under the EPBC Act have been positively recorded at the airport site.

Three migratory wetland species were recorded at the airport site. Cattle Egrets (*Ardea ibis*) were observed at a number of locations in paddocks and near dams and on several occasions flocks of about 30 individuals were recorded. Occasional individual Eastern Great Egrets (*Ardea alba*) were observed at dams and one Latham's Snipe (*Gallinago hardwickii*) was disturbed from exotic grassland adjacent to a dam. In addition, a flock of about 40 shorebirds was disturbed one night during frog surveys. These were not able to be identified, however are likely to be a type of sandpiper, based on the body shape in flight and the calls. Potential species include the Marsh Sandpiper (*Tringa stagnatilis*) and the Sharp-tailed Sandpiper (*Calidris acuminata*), which are known to occur on farm dams or the Common Greenshank (*Tringa nebularia*) previously recorded in the locality.

A flock of White-throated Needletails (*Hirundapus caudacutus*) was also recorded foraging high above the airport site. The Rainbow Bee-eater (*Merops ornatus*) was heard on a number of occasions in patchy woodland remnants in the vicinity of the Badgerys Creek riparian corridor. The Rufous Fantail (*Rhipidura rufifrons*) was observed in a number of woodland patches at the airport site.

The EPBC Act lists migratory species that are listed under international agreements, as well as families of birds (such as ducks, waders, eagles and hawks) that are also known to be migratory but are not listed under international agreements. A range of waterfowl and waders have been recorded at the airport site. Other seasonally migratory or nomadic species would also be likely to utilise habitats at the airport site on occasion.

An assessment of the importance of habitat at the airport site for these migratory birds has been prepared with reference to the *Draft significant impact guidelines* (DEWHA 2009b) and is provided below.

Migratory wetland species

Two migratory shorebird species were recorded at the airport site: one Latham's Snipe (*Gallinago hardwickii*)) and a flock of an unidentified sandpiper species (see Section 4.3.2). Potential species include the Marsh Sandpiper (*Tringa stagnatilis*) and the Sharp-tailed Sandpiper (*Calidris acuminata*). Note that the Great Egret and Cattle Egret are not considered within DEWHA (2009b), as they are not migratory shorebirds.

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species is whether or not a proposed action is likely to affect 'important habitat' (DEWHA 2009b). Important habitat is defined separately for 35 of the listed migratory shorebird species and Latham's Snipe (*Gallinago hardwickii*).

Important habitat for Latham's Snipe occurs at sites that have previously been identified as internationally important for the species, or sites that:

- support at least 18 individuals of the species; and
- are naturally occurring open freshwater wetlands with vegetation cover nearby (for example, tussock grasslands, sedges, lignum or reeds within 100 m of the wetland) (DEWHA 2009).

The airport site has not been previously identified as an internationally important site for Latham's Snipe. This species has been recorded five times previously in the locality. Only one Latham's Snipe was recorded at the airport site, but given the size of the airport site and other local records, it is possible that the airport site could support 18 or more individuals of the species. Wetlands at the airport site are artificial farm dams rather than naturally occurring freshwater wetlands and the airport site therefore does not meet the criteria for important habitat.

An area of 'important habitat' for the 35 migratory shorebird species identified in DEWHA (2009b) is defined as either:

- a site that is identified as internationally important; or
- a site that supports either:
  a) at least 0.1 per cent of the flyway population of a single species; or
  b) at least 2000 migratory shorebirds; or
  c) at least 15 shorebird species (DEWHA 2009b).

One unidentified migratory shorebird species was recorded at a farm dam in the airport site. The flock of about 40 individuals is highly unlikely to make up 0.1 per cent of the species' population. For example, the Australian population of the Common Greenshank (*Tringa nebularia*) is estimated to be about 60,000 (DoE 2015b). No other shorebird species were recorded at the airport site and there are no previous records of migratory wader species at the airport site. Given the low number of birds recorded and the low species diversity present, the airport site is unlikely to comprise important habitat for migratory shorebird species.

As no important habitat for migratory shorebirds is present at the airport site, the airport is unlikely to have a significant impact on any of these species. Consequently, assessments of significance for these species have not been prepared.

Other migratory species

Other migratory species recorded at the airport site were the Great Egret (*Ardea alba*); Cattle Egret (*Ardea ibis*); Rufous Fantail (*Rhipidura rufifrons*); and Rainbow Bee-eater (*Merops ornatus*). Important habitat for these migratory birds is defined in the significance criteria for listed migratory species (DoE 2013) as follows:

- Habitat utilised by a migratory species occasionally or periodically within the region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

The small migratory birds could forage and breed throughout the airport site. Other areas of potential habitat are present in the locality. The Cattle Egret would forage in paddocks. The airport site is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DEWHA 2009) because:

- The habitat for migratory species in the study area is equivalent to similar habitats present throughout the locality and region. There are many thousands of hectares of such habitat in the region, including extensive areas in National Parks. The study area would only ever support a small number of individuals of any migratory species and never an ecologically significant proportion of the population of any species.
- The study area does not contain any specific habitat resources that would be of critical importance to any migratory species at particular life-cycle stages. Shelter, foraging and breeding habitat within the study area is also available in many thousands of hectares of similar vegetation in the region.
- The habitat for migratory species in the study area is surrounded in all directions by equivalent habitat and is not the terminal patch of habitat near the limit of any species' range.

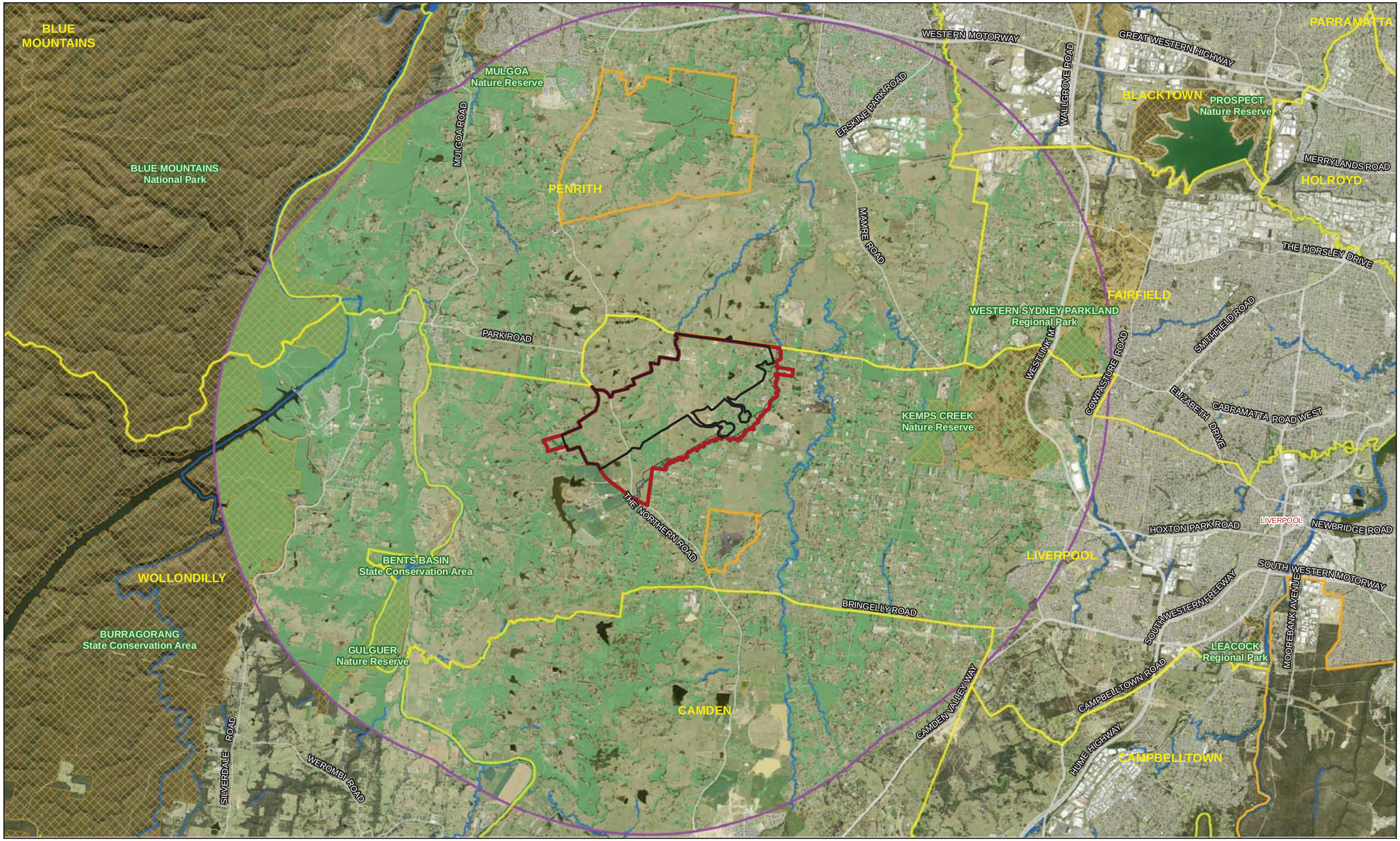
4.5.5 Greater Blue Mountains World Heritage Area

The Greater Blue Mountains Area which is listed as a declared World Heritage Property and a National Heritage Place under the EPBC Act is located around 8 kilometres to the west of the airport site. The Greater Blue Mountains World Heritage Area (GBMWHA) is separated from the airport site by extensive areas of residential and agricultural land, fragmented patches of native vegetation, roads and the Nepean River.

The GBMWHA consists of 1.03 million hectares of sandstone plateaux, escarpments and gorges dominated by temperate eucalypt forest. It is noted for the diversity of eucalypts associated with its wide range of habitats as well as significant numbers of rare or threatened species, including endemic and evolutionary relict species. A significant proportion of the Australian continent's biodiversity occurs in the area. (UNESCO 2015). The GBMWHA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas (DECC 2009b). A detailed discussion of the GBMWHA is provided in Section 8.2.5.

4.5.6 Other MNES

No other MNES of relevance to this report occur at or in the locality of the airport site.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Airport site
- Stage one construction impact zone
- The locality
- Defence land
- Native woodland and forest
- LGAs
- Highways
- Major roads
- Secondary and other roads
- Waterways
- Reserves

GHD

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Western Sydney Airport
Biodiversity Assessment

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Date	18 Aug 2016

Regional vegetation and habitat

Figure 7

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5. Construction impacts

5.1 Stage 1 development

5.1.1 Construction framework

Construction activities for the Stage 1 development are anticipated to occur in four major phases as follows:

- site preparation activities which includes some preparatory activities such as securing the construction impact zone, establishment of site services and construction facilities; and, Main Construction Works such as the clearing of vegetation and earthworks programme. The earthworks would include relocation of around 1.9 million cubic metres of topsoil and 22 million cubic metres of subsoil and rock to create a level site;
- aviation infrastructure activities, such as construction of the runway, taxiways, apron areas, internal road network, the terminal complex, air traffic control tower, freight, cargo and maintenance facilities and a fuel farm; and
- site commissioning activities at the completion of the aviation infrastructure activities, such as testing and commissioning of all facilities in readiness for the operation of the proposed airport.

For the purposes of this assessment, it is assumed that the Main Construction Works would largely proceed from the north-east to the south-west of the airport site to allow for the early relocation of existing infrastructure such as The Northern Road and the TransGrid 330 kilovolt (kV) transmission line. The relocation of existing utilities infrastructure would be subject to separate approval processes, but will likely be required to occur concurrently with other site preparation activities.

The Stage 1 construction impact zone would include the area of bulk earthworks in the northern half of the airport site, which would facilitate the development of the runway, terminal and aviation support facilities, as well as areas of disturbance outside the bulk earthworks boundary that would be used for ancillary infrastructure such as drainage controls, detention ponds, perimeter roads, security fencing and site services. No significant construction would occur outside the Stage 1 construction impact zone.

Clearance of vegetation would be restricted to the construction impact zone for the Stage 1 development, and remnant vegetation in the southern portion of the site would remain largely intact. The clearing would be undertaken before the construction of the majority of the southern perimeter fence, to allow mobile fauna to relocate off site.

For the purposes of the EIS modelling, site preparatory activities are indicatively scheduled from late-2016. Sectors of the site would be subject to progressive transition to the aviation infrastructure activities which would be completed over approximately five years to the mid-2020s. The hours of construction would generally be between 6.00 am and 6.00 pm, Monday to Saturday. However, some works are likely to occur outside these work hours.

The construction framework for the proposed airport has been developed, based on contemporary construction methodologies for similar scale projects, to provide a reasonable indication of the likely construction activities and the potential sequencing, methodology and equipment that may be used in the proposed development of the airport site. The final construction methodology and timing would be subject to refinement during detailed design. Further detail regarding the construction framework is provided in Chapter 6 of the EIS.

5.1.2 Removal of vegetation

This assessment assessed the Stage 1 construction impact zone as shown on Figure 2. The boundary of this area depicts the extent of vegetation clearing and grubbing, earthworks, permanent detention basins and the permanent infrastructure that would be constructed for Stage 1 of the proposed airport. Construction of the Stage 1 development would result in direct impacts within a 1153.8 hectare disturbance footprint, including 318.5 hectares of native vegetation as shown on Figure 4. The extent of clearing of vegetation and habitats within the Stage 1 construction impact zone is summarised in Table 58 below.

There may be minor additional earthworks or other disturbance associated with works such as drainage swales up and downstream of the proposed sediment basins. These features would be defined at the detailed design stage. Based on a general assessment of their likely size and location they would affect a small area (typically around 25 metres in cross section including construction access) and would coincide with existing drainage lines located in exotic grassland and crop land. Constructing these features would have a minor effect on the overall extent of vegetation removal.

Land clearance is listed as a Key Threatening Process (KTP) under the EPBC Act. Land clearance consists of the destruction of the above ground biomass of native vegetation and its substantial replacement by non-local species or by human artefacts. Substantial replacement by non-local species or human artefacts is defined as the achievement of more than 70% of the total cover by species or human artefacts that did not occur previously on the site (Threatened Species Scientific Committee 2001). The Stage 1 construction impact zone would be completely developed and converted to airport infrastructure or managed open space with minimal native vegetation cover. The removal of 318.5 hectares of native vegetation in the Stage 1 construction impact zone would comprise land clearance as defined under the EPBC Act and would constitute a notable increase in the operation of this KTP in the locality. The effect of the proposed airport on the operation of KTPs is assessed further in Section 8.1. The removal of native vegetation for construction of Stage 1 would be permanent and irreversible.

The net impact of the extent of vegetation removal for construction of Stage 1 of the proposed airport is mitigated by the generally poor quality of the disturbance area. Around 169.9 hectares of the 1153.8 hectare impact zone contains good condition native vegetation (including freshwater wetlands) with an intact natural structure. This vegetation frequently comprises small, fragmented patches with moderate weed infestation. There is a further 148.6 hectares of poor condition vegetation that comprises derived native grassland or scrub with moderate to severe weed infestation. The remaining 835.3 hectares of the Stage 1 construction impact zone contains exotic grassland, crop land or cleared land (see Figure 4).

Impacts would be further mitigated by the retention of around 117.1 hectares of land in the environmental conservation zone, including around 56.8 hectares of native vegetation and representative areas of each of the vegetation types at the airport site (see Figure 4). All or part of the 60.3 hectares of land within the conservation zone that does not currently contain native vegetation could be revegetated (see Section 9.2).

Table 58 Estimated area of vegetation removal in the Stage 1 construction impact zone

Vegetation Zone	TSC Act Status	EPBC Act Status	Area in Stage 1 construction impact zone (hectares)	Area in environmental conservation zone (hectares)
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	79.8	2.6
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC		112.5	4.3
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	22.9	
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC		27.6	
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		34.2	39.5
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		7.9	5.2
Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC	CEEC	4.4	3.5
Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC		0.6	1.2
Good condition artificial freshwater wetland on floodplain (HN630)			28.6	0.5
Total native vegetation			**318.5**	**56.8**
Exotic grassland			663.2	50.5
Cleared land or cropland			172.1	9.8
Total			**1153.8**	**117.1**

The Stage 1 development would include impacts on a local occurrence of Cumberland Plain Woodland, patches of which are commensurate with the EPBC Act-listed form of this TEC. There would also be impacts on a number of TECs listed under the TSC Act and on populations of threatened plants listed under the EPBC Act and/or TSC Act as shown on Figure 5. Impacts on this threatened biota are assessed in Section 8.

The majority of the earthworks footprint is disturbed, cleared land containing exotic pasture species or environmental weeds. These areas contain little native vegetation cover and have limited habitat value for native plants. Any vegetation clearing required in these areas would remove a small number of individuals of non-threatened native plants and noxious and environmental weeds.

The clearing of around 318.5 hectares of native vegetation would involve the removal of a large number of individuals and a moderately diverse range of non-threatened native plants. The Stage 1 earthworks footprint includes around 141.8 hectares of native woodland and forest vegetation in high condition that contains an over storey of mature trees. Mature trees have particular value within plant populations because they take longer to replace and are sources of pollen and seed. There are moderate areas of these vegetation types and plant species in the locality, including around 12,568 hectares of similar woodland and forest on shale or alluvial substrates within a 10 kilometre radius of the site (see Figure 7).

Under the land use plan in the revised draft Airport Plan, around 56.8 hectares of native vegetation would be retained in the environmental conservation zone at the airport site. This zone contains representative areas of each of the vegetation types at the airport site and would support many of the plant species in the impact area. The environmental conservation zone is placed along the south-eastern perimeter of the airport site to help maintain vegetation connectivity and to allow pollination, seed fall and other ecological processes that are necessary to maintain plant populations. Flora populations are also likely to persist within adjoining areas of alternative habitat beyond the airport site.

Plant species with a limited distribution in the locality would be most affected by vegetation clearing for the proposed airport. Notably the endangered population of *Marsdenia viridiflora* subsp. *viridiflora* at the airport site would be completely removed, which would comprise a significant impact at the local scale (see Section 8.3.1).

This reduction in the extent of native vegetation is less significant at the regional scale and is unlikely to threaten the persistence of any populations of native plants and vegetation communities. It is unlikely that an ecologically significant proportion of any regional plant populations would be located entirely within the airport site. At the regional scale flora populations would persist in habitat that is conserved in Kemps Creek Nature Reserve, Mulgoa Nature Reserve, existing and proposed Biobank sites at Mulgoa and in the Ropes and South Creek riparian corridors, the Western Sydney Regional Park and other offset sites linked to the North and South West Growth Centres. Notably there is a parcel of land with shale/gravel transition habitat located at Kemps Creek around three kilometres to the east of the site that is to be set aside as an offset for the South West Growth Centres. This site contains local populations of *Pultenaea parviflora* and other threatened plant species that may be affected by Main Construction Works of the proposed airport (OEH 2015a).

5.1.3 Removal of terrestrial and wetland fauna habitat

Construction of the Stage 1 development would result in the removal of fauna habitat and associated resources within a maximum disturbance footprint of around 1153.8 hectares as shown on Figure 6A to D. The extent of fauna habitat removal and associated features and resources within the Stage 1 construction impact zone is summarised in Table 59 below.

Table 59 Estimated area of fauna habitat in the Stage 1 construction impact zone, environmental conservation zone and locality

Habitat type	Area in Stage 1 construction impact zone (hectares)	Estimated extent in the locality (hectares)[1]	Percentage of the estimated extent in the locality)	Area in environmental conservation zone (hectares)[3]
Woodland	107.6	10,014	1.08%	7.3
Riparian forest	34.2	2555	1.34%	39.5
Sandstone woodland, forest and scrub		4825	0.00%	0.0
Total woodland and forest	**141.8**	**17,393**	**0.82%**	**46.8**
Wetlands[2]	28.6			0.5
Grassland[2]	811.2			60.1
Cleared land and cropland	172.1			9.8

Notes: 1) Based on GHD mapping within the airport site and on a composite of Tozer et al (2010) and NPWS (2002) mapping in the locality. 2) Grassland and wetland vegetation has not been mapped by Tozer et al (2010) or NPWS (2002). 3) Includes around 2.1 hectares of surface water management features (such as detention ponds) that fall within the environmental conservation zone. This area would require initial vegetation removal and earthworks and so has been included in the impact calculations. The disturbed area would be allowed to regenerate and will support native vegetation and provide fauna habitat resources in the longer term and so has also been included in the total area of the environmental conservation zone.

The airport site provides habitat for a range of fauna groups typical of the Cumberland Plain (see Section 4.3). Native fauna present include species of macropods, flying-foxes and bats, a wide variety of birds, reptiles including goannas, snakes and lizards, frogs and small fish. A discussion of specific impacts of habitat loss on threatened biota and migratory species is provided in Section 8. Fauna that would be most impacted include those that occur in grassland areas, artificial wetlands and dams and those that can use fragmented patches of woodland vegetation, as the site does not provide habitat for species that need extensive patches of vegetation. Key habitats that would be lost include those associated with grassland areas, farm dams, riparian habitat and woodland stands.

The majority of the proposal would result in the disturbance of exotic grassland or cropland and derived native grassland which provides only limited habitat values for fauna in isolation, but is valuable as it is part of the mosaic of habitat over a large area. The loss of these areas would remove foraging, breeding and shelter habitat for small grassland animals such as skinks, and would result in the loss of entire populations of these species. The loss of this habitat would remove foraging habitat for a wide range of species, including macropods, open-country microchiropteran bats, and bird species such as the Australian Magpie, Australian Raven, Magpie-lark, Straw-necked Ibis and Cattle Egret in particular.

A large number of artificial wetlands (farm dams), minor drainage lines and associated damp soaks would be removed. In total, 28.6 hectares of wetland habitat and 34.2 hectares of riparian habitat would be lost. This would result in the loss of local populations of frog species. Large areas of habitat for waterbirds, including migratory species, would be destroyed. Foraging habitat for a range of microchiropteran bat species, including in particular the Large-footed Myotis, would be removed.

Construction of Stage 1 would have permanent and irreversible impacts on fauna habitats present at the airport site. Construction would require the permanent removal of a maximum area of 141.8 hectares of woodland and forest habitat, consisting of vegetation, including young regrowth and more mature trees (ie trees between 20 to 80% of their life expectancy). This area comprises all native vegetation not including derived grassland. Clearing of this vegetation would permanently remove foraging and breeding resources for native fauna, particularly in forest and woodland habitats, which comprise a canopy of eucalypt trees of varying age classes. Eucalyptus and other native canopy species provide nectar resources as well as foraging substrate for a diverse range of arboreal species, such as birds and arboreal mammals, as well as bats.

Construction of the Stage 1 development would result in the loss of at least 50 hollow-bearing trees, which occur as scattered trees across the airport site. Note that this is an underestimate of the total numbers present, as not all patches of vegetation were able be visited, and some smaller or less obvious hollows may have been missed in stands that were surveyed. Hollow-bearing trees occur at low densities across the airport site due to the previous clearing of vegetation. Much of the woodland present is young regrowth, and often no hollow-bearing trees are present in woodland patches. Hollow-bearing trees are critical habitat components for many tree-dwelling fauna species at the airport site, including arboreal mammals, microchiropteran bats and woodland birds that rely on hollows for shelter and breeding habitat. Due to the long timeframe it takes for hollows to form in eucalypts (usually greater than 150 years) (Gibbons et al 2000), the loss of these hollows represents a long-term reduction in habitat resources for fauna.

Shrub layers and leaf litter would also be removed as a result of construction. This would result in the loss of habitat for small woodland birds that rely on these resources for foraging and breeding. In addition, loss of leaf litter would remove habitat for small reptiles and gastropods that rely on this feature for shelter, breeding and foraging.

Around 2.1 hectares of surface water management features such as detention ponds fall within the environmental conservation zone. This area would require initial vegetation removal and earthworks and so has been included in the impact calculations. Because it would be allowed to regenerate and will support native vegetation and provide fauna habitat resources in the longer term, it has also been included in the total conservation area.

5.1.4 Removal of aquatic fauna habitat

The proposed Stage 1 construction would involve the infilling of stream reaches, including the upper reaches of Oaky Creek and smaller drainage lines that feed into Badgerys, Cosgroves and Duncans Creeks within the construction impact zone and the permanent loss of riparian and aquatic habitats associated with these features. All of the affected reaches are small and ephemeral and largely intermittent. The net impact of the removal of these stream reaches is mitigated in part by their degraded nature. All are highly modified and in poor condition as a result of historical and current land use and disturbance. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats. Fish habitat is moderate or minimal at most sites and the habitats present are not suitable for threatened fish or invertebrate species (dragonflies) known or predicted to occur in the wider locality.

Badgerys Creek, which comprises the largest watercourse at the airport site would be retained within a conservation area.

A large number of artificial wetlands (farm dams) would be removed. In total, 28.6 hectares of wetland habitat would be removed. These provide only limited habitat for native fish species, with most dams dominated by the exotic Eastern Gambusia. Farm dams are not key fish habitat and do not provide habitat for threatened species listed under the FM Act.

5.1.5 Habitat fragmentation

Habitat fragmentation can result in reduced dispersal and reproductive success of biota within the fragment, a decline in populations resulting from increased predation by introduced species or native species that do not normally occur in the community, and an increased probability that stochastic events (e.g. fire) may reduce population numbers below critical levels required for their survival (Andrews 1990). In general, larger fragments are less susceptible to adverse impacts than are smaller fragments.

Construction of Stage 1 of the proposed airport would contribute to fragmentation at a local and regional scale by removing patches of habitat, severing vegetated corridors and by creating an extensive, permanent footprint that would comprise a significant barrier to movement of many species. These include in particular those that rely on connectivity of woodland patches to move through the landscape, such as small woodland birds and certain microchiropteran bats.

The proposed airport would be located in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More mobile species such as birds and bats can readily traverse this landscape. The suite of fauna species recorded in field surveys is dominated by generalist species of open country, reflecting the fragmented nature of vegetation at the airport site (see Section 4.3.1).

Few woodland patches that would be impacted by the airport development extend across the boundary of the airport site. Much of the Badgerys Creek corridor would be retained, minimising fragmentation impacts along the southern boundary of the airport site. The project would result in the further fragmentation of a number of stands of woodland at the western boundary of the Stage 1 development. As these stands of vegetation are currently located adjacent to mostly cleared agricultural land, these have already been subject to historical fragmentation. The fragmentation of these patches would impact resident fauna, and in particular less mobile species such as the Cumberland Plain Land Snail (if present at these locations). Patches of vegetation to the west of Willowdene Avenue would be conserved and managed as part of the conservation land for the airport, and revegetation works would be carried out which would improve and expand these patches.

The geographic distribution of native vegetation on the Cumberland Plain has undergone a very large reduction since European settlement (NSW Scientific Committee 2009). The remaining area of the Cumberland Plain Woodland ecological community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches being smaller than 3 hectares (NSW Scientific Committee 2009). Any patches of the community that are greater than five hectares in area are considered inherently valuable due to their rarity (DoE 2015b). Construction within the Stage 1 airport earthworks footprint would contribute to fragmentation at a regional scale by removing patches of woodland, including a total of about 91 hectares of Cumberland Plain Woodland in mostly regenerating patches (Figure 5). Some patches are at least five hectares in area and include large, mature and hollow-bearing trees and as such meet the criteria for the most valuable remnant patches of this community (DoE, 2015c).

Overall, despite the current patchy and fragmented distribution of vegetation at the airport site and in the locality, construction of Stage 1 would comprise a significant increase in the degree of habitat fragmentation in the locality. Construction of Stage 1 would create a gap in habitat that is around 1153.8 hectares in area and about 1.5 kilometres wide from north to south and almost 7 kilometres long from east to west. This area would be mostly inhospitable to fauna given the presence of cleared areas, fences, infrastructure and lights. The gap would create a barrier to ecological processes such as dispersal, pollination and seed fall. Mobile, aerial species such as larger birds, flying foxes and microbats of open country (i.e. those that do not need connected woodland patches to traverse the landscape) would be able to traverse the site. Birds typical of open areas such as ibises and magpies or small grassland reptiles may continue to occur in areas of open space at the airport site and move through it, however there would be specific management measures incorporated into the proposed airport to make the site unattractive to birds to deter them from using the site, as they can pose a risk of aircraft strike (see Section 6.1.1). The proposed runway, terminals, carpark and other built features would comprise a significant barrier to the majority of fauna species particularly in combination with security fences. Light, noise, aircraft and vehicle movement may further deter fauna species from crossing these gaps in habitat. Many generalist species of open country that currently occur at the airport site would not be able to move over or through the proposed airport.

Long term development at the airport site, including construction of a second runway and associated infrastructure, would increase the total area up to 1773.9 hectares and further increase habitat fragmentation in the locality and region. The realignment of The Northern Road, potential future orbital road links, realigned transmission lines and future rail links to the proposed airport would further fragment habitat in the area. The Western Sydney Priority Growth Area structure plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands. The Badgerys Creek riparian corridor is identified as flood prone land and non-certified land and would be conserved under the strategic assessment (DoP 2010).

These impacts on habitat connectivity would be partially mitigated by the retention of habitat in the proposed environmental conservation zone. The conservation zone comprises around 117.1 hectares of land, including 46.8 hectares of woodland and forest and 60.3 hectares that could be revegetated. It is located around the perimeter of the airport site, encompassing the riparian corridors of Badgerys Creek and Duncans Creek and some moderate sized patches of Cumberland Plain Woodland east and west of the airport site. The environmental conservation zone would help to maintain vegetated fauna movement corridors around the airport site, and would provide habitat stepping stones to assist movement.

5.1.6 Fauna injury, mortality or displacement

Clearing of native vegetation and removal of grassland and wetland habitat would result in fauna injury, mortality and displacement of individuals. The proposed airport would cause displacement or mortality of less mobile fauna that are within the area to be cleared for the proposed airport at the time of construction activities. The magnitude of likely impacts would vary between types of fauna, depending on their size and ecology. Some fauna may be able to seek refuge and persist in alternative habitat outside the airport site; however given the size of the airport site, entire local populations of some small animals (e.g. skinks, snails) could be destroyed.

Birds are relatively mobile and so most individuals would be able to avoid vegetation clearing (which is minimal) or construction operations. Most individuals that would be directly affected by construction of the proposed airport would be displaced initially rather than killed. Continued survival of displaced fauna would depend on the carrying capacities of neighbouring remnants and the existing fauna present and their territories. Many of the small patches in nearby areas are likely to be at carrying capacity already. Given the large area of fauna habitats that would be removed and fauna that would be displaced, it is likely that many displaced individuals would not be able to compete for resources with existing resident fauna. Mortality of less mobile individuals, such as nestlings, old or sick birds would also occur. Birds that currently breed at or in the vicinity of the proposed airport, are likely to include common and widespread species such as Noisy Miners and Australian Magpies, may have breeding success disrupted for one or more seasons.

Macropods and other large terrestrial mammals are likely to readily avoid vegetation clearing or construction operations and so individuals directly affected by the proposed airport would be displaced rather than killed. Staged vegetation clearing would provide some opportunity for fauna to move to other adjacent areas, including conservation areas and areas of the site outside of Stage 1.

There would be mortality of terrestrial animals less able to avoid the disturbance. There would also be mortality of individuals sheltering in leaf litter, woody debris, tree hollows, crevices or under bark. These would include the Cumberland Plain Land Snail, smaller terrestrial mammals, nocturnal species and especially arboreal mammals and microbats which may be sheltering in felled trees. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows). This may result in impacts beyond the disturbance area by favouring aggressive or generalist species, such as the Brush-tailed Possum, over less aggressive species such as the Sugar Glider.

There will be mortality of aquatic fauna, including fish, eels, turtles and frogs, associated with the infilling of steams and draining of artificial wetlands within the Stage 1 area. The magnitude of impacts on aquatic fauna is limited to some extent by the highly modified nature of much of the aquatic habitat present and the predominance of common and widespread species that are typical of similar habitats on surrounding lands.

Recommended mitigation measures including pre-clearing surveys, fauna rescue and relocation protocols, and draining of dams are outlined in Section 9.2 to minimise the risk of mortality of fauna as a result of clearing. The southern perimeter fence would not be installed until clearing is completed to allow fauna to escape to adjacent areas.

5.1.7 Weed invasion and other edge effects

'Edge effects' refers to factors, including increased noise and light, weed invasion, tree failure or erosion and sedimentation, at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to plant community type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the proposed airport.

Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. A comparison of edge effects in a variety of different habitat types estimated that on average edge effects generally occur up to 50 metres away from the disturbed edge (Bali 2005).

Vegetation in the airport site and adjacent areas mainly occurs as small, isolated patches already subject to edge effects. Construction of the proposed airport may result in some novel edge effects where vegetation to be retained is located immediately adjacent to the Stage 1 construction impact zone. Novel edges would be created along the western and north western boundaries of the airport site and sections of the riparian corridors of Badgerys Creek and Duncans Creek that currently adjoin intact native vegetation within the airport site. The proposed environmental conservation zone would provide a buffer between the proposed airport and adjoining areas of native vegetation along its eastern, southern and western boundaries, including the majority of the vegetation within and adjoining the riparian corridors of Badgerys Creek and Duncans Creek. The northern and south western boundaries of the Stage 1 construction impact zone adjoin extensively cleared agricultural land. No new edges would be created.

The extent or severity of weed infestations may increase along the novel edges created by the proposed airport. Construction activities may further increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles.

There is also the potential for the proliferation of noxious terrestrial and aquatic weeds in reaches downstream through discharge of water from the Stage 1 area containing weed propagules. This may result in the invasion of pools and establishment in stream channels during dry conditions, resulting in deterioration of water quality, loss of native species, restrictions in flow and pool connectivity and degradation of riparian vegetation and aquatic habitats.

Edge effects can increase the incidence of aggressive bird species such as the Noisy Miner, which can in turn reduce the habitat value for smaller, less aggressive woodland birds. In particular, this may reduce habitat quality for threatened bird species such as the Varied Sittella, recorded along the Badgerys Creek riparian corridor.

Recommendations have been made in Section 9.2 to minimise the spread of weeds.

Overall given the fragmented nature of habitat in the locality and the extent of exotic plant cover, the proposed airport would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations.

5.1.8 Altered hydrology and downstream impacts

Construction of the Stage 1 development involves substantial alteration of the existing landform and hydrology within the construction impact zone and has the potential to alter the hydrological regime downstream of the airport site through:

- removal of watercourses within the construction impact zone and alteration of the catchments of Badgerys Creek, Cosgroves Creek and Duncans Creek. The total length of watercourses that would be removed is 36.5 kilometres. The majority of these watercourses are minor drainage lines and less defined channels;
- the replacement of a large tract of land with impervious surfaces, particularly in terms of the runway area, roads and other paved surfaces. This will increase surface runoff and potentially result in a minor decrease in groundwater recharge to the downstream reaches; and
- the capture and treatment of surface water to control the volume and quality of stormwater discharges from the site.

The airport site would include substantial and large-scale earthworks which would modify drainage direction and overland flow paths, changing the nature of flooding on site. As construction progresses and the area of impervious area increases, runoff from the airport site would increase due to a reduction in ground surface infiltration. Without mitigation this would result in increased flows from the site and the potential for associated flooding, geomorphological and ecological impacts downstream (GHD 2016b).

There is a potential for a minor reduction in groundwater recharge associated with the increase in paved surfaces with the establishment of the Stage 1 development. Overall, minimal change to local groundwater recharge would be expected as the existing shale derived clay soils have low permeability and the majority of rainfall is therefore released as stormwater runoff rather than infiltrating to groundwater. It is not expected that a reduction in recharge would affect any sensitive ecological receptors or beneficial uses of the groundwater system.

Groundwater drawdown is also expected during main construction works as a result of the reprofiling of the airport site and deeper excavations for the establishment of basements in the terminal complex. Due to low inherent hydraulic conductivities of the geology in these areas, it can be expected that seepage volumes would be relatively small. Groundwater seepage into excavations for building basements would need to be managed by pumping to stormwater management facilities or other suitable treatment systems.

A water management system has been incorporated into the revised draft Airport Plan to mitigate the increase in runoff and reduce offsite impacts of surface water flows and discharges from the site. The water management system would be established at the start of the main construction works (GHD 2016b) for management of stormwater discharges during both the construction and operation of the Stage 1 development. The water management system includes a series of grassed swales to convey runoff from the developed areas within the airport site, and a series of bio-retention and flood detention basins to manage flow quality and quantity prior to discharge to the receiving waters.

There is potential for impacts on downstream flows and aquatic ecology if the volume of discharge from detention basins on the site disrupts the existing flow regime downstream of the point of discharge. Depending on the nature of surface runoff water treatment, releases downstream could be more or less persistent or intermittent based on the time it takes to treat water to a sufficient level prior to release. A persistent release strategy would represent the greatest departure from current conditions given that the streams in the project area are small and ephemeral in nature. However, it would result in aeration of the waterway and the creation or enhancement of downstream riffle habitat, which would provide a beneficial outcome. An intermittent release strategy would have the opposite effect, though it may be in keeping with the existing hydrological modification associated with the presence of numerous farm dams on streams within this system. If baseflows were to be lowered, habitat deterioration in reaches downstream could occur. Results of the current study show that many of the sites downstream had low dissolved oxygen concentrations, which is probably one of the factors that contributed to the poor status of the aquatic health in those reaches. Few native species were recorded in creeks assessed in field surveys. No habitat for threatened species listed under the FM Act is present in the creeks.

The flood detention basins provide controlled release to the receiving waters in a way that mimics the natural flows as closely as possible over a range of storm durations and magnitudes. The airport site comprises approximately 4 per cent of the total catchment area for South Creek and any minor alteration to the hydrological regime is anticipated to have negligible influence on downstream flows in the catchment.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is listed as a Key Threatening Process (KTP) under the TSC Act and the FM Act. Given the above considerations, the proposed airport would have minimal influence on this KTP in particular on the airport site (see Section 8.1).

As noted above, the proposed airport design and land use plan includes measures purposefully designed to avoid further substantial alteration of hydrological regimes downstream of the airport site. A detailed Surface Water Management Plan would be developed and will consider potential adverse impacts on downstream environments throughout the course of the construction period. Mitigation measures to address impacts of changed hydrology on aquatic and riparian communities downstream of the site are detailed in the Surface Water Hydrology and Geomorphology report (GHD 2016b) and summarised in Section 9.

5.1.9 Impacts on groundwater dependent ecosystems

As noted in Section 4.2.4, all native vegetation types at the airport are considered to be groundwater dependent ecosystems. Construction of the Stage 1 development would result in direct impacts on 146.1 hectares of good condition native vegetation with an intact natural structure considered to be groundwater dependent ecosystems. There are unlikely to be impacts on the 148.6 hectares of derived native grassland given the depth to groundwater is at least 2.4m for the majority of the airport site.

Few woodland patches that would be impacted by the airport development extend across the boundary of the airport site. Much of the Badgerys Creek corridor would be retained, minimising fragmentation impacts along the southern boundary of the airport site. There would be further fragmentation of a number of stands of woodland at the western boundary of the Stage 1 development, which would mean that some groundwater dependent ecosystems located outside the project boundary would be impacted by fragmentation. As these are currently located adjacent to mostly cleared agricultural land, these have already been subject to historical fragmentation. Patches of vegetation to the west of Willowdene Avenue would be conserved and managed as part of the conservation land for the airport, and revegetation works would be carried out which would improve and expand these patches.

Sensitive vegetation would remain along the riparian corridors of Duncans, Oaky and Badgerys Creeks. This vegetation is expected to intersect alluvial deposits which historical data suggest has limited hydraulic connection to the shale aquifers potentially impacted by the establishment of the proposed airport. While there may be minor changes to groundwater flow within the shale aquifers, the overall groundwater fluctuation would be small and any drawdown impacts in areas of sensitive vegetation are expected to be minor (GHD 2016e).

Further, in riparian areas near to discharge points it can be expected that, while discharge rates would change, overall groundwater fluctuations would be small. Consequently, groundwater drawdown impacts in areas of sensitive vegetation are expected to be minor. There may be enhanced drawdown in localised areas where cuttings or building basements are present. Due to the hydraulic characteristics of the intersected geology, this impact is expected to be very localised (GHD 2016e).

It is expected that construction and development of the proposed airport would result in a minor reduction in rainfall recharge and hence reduce groundwater discharge to surrounding creek systems. Historical water quality data and the existing hydrogeological conditions suggest that groundwater discharge forms a very low component of creek flow. This implies that the overall reliance on groundwater discharge is low and that groundwater discharge changes would have minor impacts (GHD 2016e).

During no-flow periods stagnant pool Ievels may be linked to surrounding groundwater elevations. While the construction of the proposed airport may reduce overall groundwater discharge rates, it is not expected that groundwater elevations would change significantly at discharge points, such that stagnant pools will drain. Because of this, it is expected that impacts would be negligible (GHD 2016e).

Mitigation and monitoring measures have been recommended to address the identified issues and potential emergent issues that might arise during the construction and development stages of the proposed airport and are detailed in the Groundwater Report (GHD 2016e).

5.1.10 Erosion, sedimentation and contamination

The locality features existing hydrological modification as a result of numerous dams on the main stem channels of local waterways. These affect flow conditions and are often a source of nutrient rich, low oxygen water due to their accumulation of organic material and the long residence times for nutrients entering them. Sampling in this and previous studies (as outlined in SMEC 2014) has shown that the water quality of the project area is poor with high levels of nutrients and suspended solids and elevated electrical conductivity levels due to salinity issues. The combination of elevated nutrients and low flows also probably contributed to the low dissolved oxygen levels observed in this study and the generally poor aquatic health on site and in downstream reaches.

There is the potential for indirect impacts on aquatic habitats adjoining and downstream of the airport site as a result of erosion and sediment mobilisation and accidental spills or release of contaminants.

Potential sources within the airport site would include:

- runoff from areas stripped of vegetation;
- runoff from soil stockpiles;
- runoff from hardstand areas, including temporary roads, processing areas and site facilities;
- leakage or spillage of hydrocarbon products from vehicles, wash down areas and workshops;
- refuelling bays and fuel, oil and grease storages; and
- release of contaminants contained in soil disturbed during earthworks.

There is a considerable risk of biodiversity impacts arising from these factors because of the scale of the construction impact zone and especially the volume of earthworks. Clearing and bulk earthworks would increase the surface area and in some instances the slope of exposed soil surfaces at the airport site. These conditions would present a risk of erosion and associated surface water quality impacts (GHD 2016b).

There are sensitive environmental receptors adjacent to the Stage 1 construction impact zone, including the Badgerys Creek riparian corridor and associated native vegetation. The downstream riparian corridors of Cosgrove Creek, Badgerys Creek and Duncans Creek would be particularly susceptible to impacts, although these reaches already exhibit poor aquatic health.

There is a risk of sediment mobilisation and transportation to downstream environments given the extent and magnitude of clearing and earthworks proposed. Increased sediment mobilisation could result in short term elevations in turbidity, but in worse cases, could result in the short to medium term infilling of pool habitat and smothering of riffle habitat downstream. This would markedly reduce the habitat quality for aquatic fauna. Elevated turbidity can have both direct and indirect effects on aquatic flora and fauna. Suspended sediment particles, if in high enough concentrations, can clog the gills of macroinvertebrates, abrade and damage the gills of fish and clog the filter feeding apparatus of some macroinvertebrate species. Prolonged periods of elevated turbidity can lead to reduced growth of periphyton and submerged aquatic macrophytes, which are a food and habitat source for resident aquatic fauna. Unless there is catastrophic uncontrolled sediment runoff, it is likely that elevated turbidity will be short lived. Local aquatic flora and fauna are likely to be adapted to experiencing short pulses of elevated turbidity during rainfall events. Given these considerations and proposed mitigation measures, potential impacts are likely to be both short term and limited.

Contamination of downstream waterways as a result of fuel, oil or chemical spills may occur during construction. If not properly contained, these could potentially result in reduced habitat quality and potentially the direct mortality of aquatic fauna and flora. In general, most fuel and oil spills will be small in size such that their potential impacts will be highly localised. Fuel also volatilises such that small spills are likely to result in short-lived impacts to aquatic flora and fauna. There is always the potential for larger spills to occur, which could lead to more extensive and medium term impacts in reaches downstream. Surfactants used to clean up large fuel and oil spills can also be toxic to aquatic flora and fauna.

The airport site has historically comprised a variety of land uses, including rural residential, agricultural, poultry farming and light commercial activities. High risk areas for potential contamination typically comprised sites of demolished buildings, significant disturbance of earth (indicating filling with material of unknown origin), the dumping and/or stockpiling of waste material that may contain asbestos and current or historic fuel storage areas (refer to chapter 14 of the EIS). Given the historic landuse at the airport site, it is possible that soil excavation could result in contaminants being unearthed. If not properly identified and contained/removed, those chemicals could be mobilised to local waterways as part of surface water runoff. It is possible that these chemicals may result in acute toxicity effects to local aquatic fauna, though it is likely that their influence would be temporary, small in extent and somewhat nullified by dilution during runoff events.

The design capacity and placement of the water management system would ensure that all drainage water from disturbed areas would typically be captured prior to discharge. The drainage system would include the main detention basins (see Figure 1–1) supplemented by a series of interim sediment basins and control measures within the immediate work area. The drainage system would have the effect of improving the quality of the surface water prior to release by allowing sediment to settle within the basins. The drainage system, in combination with other standard construction erosion control measures, would readily mitigate the potential impacts of sedimentation (GHD 2016b).

Recommended soil protection measures and techniques and management of chemicals and spills are outlined in Section 9.2. Any localised increases in erosion hazard or sources of other contaminants as a result of construction would be limited to the immediate earthworks footprint and there would be appropriate control devices and buffers between the earthworks footprint and sensitive receptors, staged clearing and rapid stabilisation of soil surfaces.

With the sediment basins and other mitigation measures in place, construction is not expected to have any significant impact on existing water quality concentrations in the receiving waters downstream of the site. Any exceedances would likely be localised and short term (GHD 2016c). As such the Stage 1 development is not likely to affect water quality of downstream aquatic habitats.

The water management system includes a series of grassed swales to convey runoff from the developed areas within the airport site, and a series of bio-retention and flood detention basins to manage flow quality and quantity prior to discharge to the receiving waters. Low flows are diverted to the bio-retention system for water quality treatment, while the higher flows are designed to bypass the system and discharge directly into the flood detention basins. The flood detention basins provide controlled release to the receiving waters in a way that mimics the natural flows as closely as possible over a range of storm durations and magnitudes.

5.1.11 Dust generation

Construction of the Stage 1 development would result in dust emissions generated during both the bulk earthworks and the aviation infrastructure activities. High dust levels could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation. Dust may affect photosynthesis, respiration and transpiration in plants and allow the penetration of gaseous pollutants. This then leads to decreased productivity, and in the long-term can alter community structure (Farmer 1993). Dust would also impact health of fauna, such as through respiratory disease, and the reduction in health of animals would be exacerbated by changes to plant health and community structure. Recommended mitigation measures to minimise impacts of dust are identified in Section 9.2.

5.1.12 Generation of light, noise and vibration

There would be noise impacts during construction as a result of vegetation clearing, the movement of vehicles and operation of plant. Much of the airport site currently experiences ongoing noise from vehicles travelling along roads, from agricultural activities and from light aircraft operating from existing aerodromes. Given the existing noise levels in the vicinity of the proposed airport, clearing and construction noise is not likely to be a novel impact for most fauna species. Background noise levels associated with clearing and construction would increase, and would persist for many years. This would impact fauna both within the site and in adjacent areas. There is the potential for individuals that nest or den in trees that are close to the proposed airport edge abandoning their nests and dens as a result of noise during construction. Noise may also affect general fauna activity in these areas. Many fauna individuals are, however, likely to become habituated to the increased noise levels in the long-term.

Light spill from construction areas may occur at night. Parts of the airport site are already subject to light from streetlights, residences and other buildings. Construction would change the location of lighting, introducing light to areas previously not subjected to artificial light, and increasing light levels in areas already subject to existing light. This may disturb fauna in adjacent vegetation, changing their behaviour patterns. Fauna are likely to become habituated to light in the long-term.

Vibration impacts may result from works associated with the proposed airport, such as heavy vehicle movement and construction activities. Vibration may deter native fauna from using the area surrounding the source of vibration. This may potentially interrupt dispersal within the locality if an individual is unwilling to travel through an area where vibration is detectable, or may cause some species to abandon an area in search of areas where vibration is not detectable. Within the airport site, some level of vibration is already present as a result of vehicles travelling along roads in the area. Vibration throughout the airport site and adjacent areas during construction would increase.

5.1.13 Spread of pests and pathogens

Construction activities within the airport site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can cause 100% mortality in some populations once introduced into an area. Recommended mitigation measures to prevent the introduction or spread of disease that could potentially impact threatened biota in adjacent areas are identified in Section 9.2.

5.1.14 Fire

Construction of the proposed airport has a risk of fire, for example from storage of combustible fuels or ignition from works areas. The risk of fires spreading to adjacent areas would be expected to be minimal given the fire hazard management plan and other measures to contain and control the outbreak of fire.

5.2 Long term development

5.2.1 Direct impacts

The construction impact zone for long term development at the airport site is assumed to comprise the entire area of the airport site outside of the Stage 1 construction impact zone. This comprises the maximum extent of vegetation clearing and grubbing, earthworks and the permanent infrastructure that would be constructed for long term development at the proposed airport. Construction of long term development would result in direct impacts within a maximum 503.0 hectare disturbance footprint, including 93.6 hectares of native vegetation as shown on Figure 4. The extent of clearing of vegetation and habitats within the long term development impact zone is summarised in Table 60 and Table 61. The long term development would also subsume additional watercourses, primarily first and second order tributaries of Badgerys Creek.

Long term development at the airport site would further increase the degree of fragmentation of native vegetation and habitat in the locality and the region as well as increase the loss of streams, artificial wetlands and associated aquatic habitats. A second runway and associated infrastructure would increase the gap in habitat at the airport site to a total area around 1773.9 hectares and would be around 2.5 kilometres wide from north to south. The realignment of The Northern Road, potential future orbital road links, realigned transmission lines and future rail links to the proposed airport would further isolate or fragment habitat.

Long term development at the airport site would further reduce the extent of native vegetation and habitat and result in additional direct and indirect impacts on flora and fauna populations on site and aquatic habitats downstream. Long term development at the airport site would further increase the significance of impacts of Stage 1 and would comprise a substantial impact in its own right

Table 60 Estimated area of vegetation removal for long term development

Vegetation Zone	TSC Act Status	EPBC Act Status	Maximum long term development area of impact (hectares)
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	37.5
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC		14.2
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	7.3
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC		3.4
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		18.6
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		5.3
Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC	CEEC	0.5
Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC		0.5
Good condition artificial freshwater wetland on floodplain (HN630)			6.3
Total native vegetation			**93.6**
Exotic grassland			243.1
Cleared land or cropland			166.3
Total			**503.0**

Notes: EEC – endangered ecological community; CEEC – critically endangered ecological community.

Table 61 Estimated area of fauna habitat to be impacted by the long term development

Habitat type	Area to be impacted by the long term development (hectares)	Area in environmental conservation zone (hectares)[3]
Woodland[1]	45.8	7.3
Riparian forest[1]	18.6	39.5
Total woodland and forest	**64.4**	**46.8**
Wetlands[2]	6.3	0.5
Grassland[2]	266.0	60.1
Cleared land and cropland	166.3	9.8

Notes: 1) Based on GHD mapping within the airport site and on a composite of Tozer et al (2010) and NPWS (2002) mapping in the locality. 2) Grassland and wetland vegetation has not been mapped by Tozer et al (2010) or NPWS (2002)

5.2.2 Indirect impacts

Long term development at the airport site would result in a similar set of indirect impacts as for Stage 1 (see Section 5.1). Potential indirect impacts include:

- weed invasion of adjacent vegetation or aquatic areas, which may reduce habitat quality for native flora and fauna;
- edge effects, which may reduce habitat quality for native flora and fauna in adjacent areas;
- erosion, mobilisation and transportation of sediment, which could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation and aquatic areas downstream;
- generation of dust, which could reduce plant and animal health in adjacent areas of vegetation;
- the risk of toxicity or degradation of habitat due to generation of contaminants from accidental spills of fuel or mobilisation of contaminants due to earthworks;
- further alterations to the hydrology of catchments (noting that the proposed airport would be designed to avoid adverse changes to hydrology and water quality);
- further impacts on groundwater recharge, drawdown and quality, noting that impacts are likely to be very localised and minor (see GHD 2016e);
- generation of noise, light and vibration, resulting in disturbance of fauna that reside or use habitats near the construction area; and
- potential spread or introduction of pathogens such as Phytophthora, Myrtle Rust and Chytrid fungus into adjacent native vegetation and downstream habitats through vegetation disturbance and increased visitation.

Environmental management and mitigation measures to prevent the introduction or spread of disease, minimise sedimentation and erosion, limit the generation of dust and minimise the potential spread of pathogens would be implemented with long term development at the airport site. These measures would be similar to those proposed for stage 1 (see Section 9.2) but would be refined as appropriate to the specific infrastructure and receiving environments associated with long term development.

6. Operation impacts

6.1 Stage 1 development

6.1.1 Bird and bat strike

The presence of the proposed airport would create a risk of mortality for birds and bats at or near the proposed airport. Birds are often attracted to airports because of grass, lights, water, feeding trees, or roosts, while flying-foxes tend to come in contact with aircraft while transiting between roosting sites and foraging areas (Parsons et al 2009).

Most bird strikes occur at take-off or landing and within 5 kilometres of aerodromes, regardless of the type of aerodrome (ATSB 2009). Species involved in bird strikes are generally typical of the habitats that occur in close proximity to the site of the airport, rather than migratory species moving at higher altitude across the landscape. Ninety-three per cent of bird strikes occur below 3500ft.

Analysis of strike data from 2002-2009, found that in general lapwings and plovers were the most common species to be involved in aircraft strike in Australia (597 incidences), followed by flying-foxes (542 incidences) and Galahs (532 incidences). In NSW, this order is reversed, with Galahs being the most common species struck by aircraft, followed by flying-foxes then lapwings and plovers (ATSB 2009). Galahs are the species for which strikes of more than one bird (i.e. a flock) are most likely to occur, according to data collected between 2004 and 2014 (ATSB 2014). Combining raptor groups, kites, hawks and eagles were struck 769 times over the period in Australia, and 98 times in NSW (ATSB 2009). Large water birds, such as ibis and herons, were struck 170 times between 2002 and 2009 (ATSB 2009) and waders such as curlews and sandpipers (i.e. migratory waders), were hit 187 times in this period, the majority (180) being from Queensland and the Northern Territory (ATSB 2009). The highest rate of bird strike was found to occur at Darwin and Cairns, likely due to the higher bird populations present in tropical areas (ATSB 2009).

A high diversity of bird species was recorded at the airport site, including many species that occur in large flocks, or would fly at heights where aircraft strike is a risk. A small number of large raptors were observed in the airport site, including Wedge-tailed Eagles, White-bellied Sea-eagles, Little Eagles, Black Kites and Whistling Kites. It is most likely that one or two pairs of each species occur in or near the airport site. Large flocks of ibis and herons occur in and around the airport site, due to the large number of farm dams as well as fertilised crop fields, as do a wide variety of ducks and other water birds. Few migratory wader species are likely to occur in and around the airport site, although at least two species were recorded. A wide range of other bird species is also likely to be at risk of aircraft strike, including magpies, swallows, ducks and ravens.

The bird and bat strike risk assessment prepared for the proposed airport (Avisure 2015) found that these species would be likely to remain in the area and present at least a moderate strike risk during operation of the proposed airport. Farm dams are common in the surrounding area and present the greatest bird hazard for the proposed airport. Nearby landfills, such as Spring Farm Landfill, also support high numbers of large birds, which may result in birds transiting operational airspace (Avisure 2015). Although potentially moderate and high risk species were recorded in surveys by both Avisure and GHD, their numbers were not unusually large and there were limited transits through the air (Avisure 2015). While birds are likely to be struck on occasion, management measures (see Section 9.2) would minimise the risk of this occurring, and as such the viability of populations in the local area are not likely to be threatened.

As noted above, flying-foxes are one of the more common species hit by aircraft in Australia and NSW. Flying-foxes can be resident at a camp, may migrate locally between nearby camps, or may move nomadically long distances (Eby 1996). Camp populations do not function as a unit. Individuals or small groups move independently of other flying-foxes (Eby 1991), and may therefore move between camps at different times. A radio-tracking study of Grey-headed Flying-foxes in Sydney found that individuals or small groups were frequently found to roost at various sites throughout metropolitan Sydney, and interchange between the Cabramatta and Gordon colony sites was observed. Gordon colony bats were also recorded at various camps on the NSW north and south coasts (Augee and Ford 1999). A previous radio-tracking study had also found considerable interchange between bats in adjacent colonies (Spencer et al 1991). Based on bat strike data collected at Australian airports between 1996 and 2006, most bat strikes occurred around sunset, and about three quarters of recorded bat strikes occurred during landing of aircraft. Grey-headed Flying-foxes typically leave their day roost within 30 minutes after sunset. Bat strike rates differed in airports depending on location, with the five highest rates of bat-strike occurring in tropical regions (Parsons et al 2009).

Given these results, movement of flying-foxes can occur between the camps present near the proposed airport at any time. There are at least seven camps located within 20 kilometres of the proposed airport (Avisure 2015), and the locations of these may result in individual bats flying across the proposed airport and approaches and being at risk of mortality from aircraft strike. In addition, bats travelling from local camps to foraging areas may also fly across the proposed airport and approaches and be at risk of mortality from aircraft strike. While occasional bats may be killed by aircraft strike, this is not likely to substantially change the population numbers in nearby camps.

Despite the risk of bird and bat strike due to species presence and abundance, habitat availability on and around the site, and projected aircraft movements, the location of the proposed airport would reduce the overall risk relative to other possible locations. For example, the airport site is not located in a tropical area, is not near an estuary, is not within a major bird migratory route, and does not have flying-fox camps in close proximity. As such the overall abundance of birds and bats would be lower than if these were the case. Habitats currently on the airport site that are attractive to birds, including in particular farm dams and wetlands, will be removed during construction of the Stage 1 development. In addition, the available habitat in the locality would reduce over time as areas around the proposed airport urbanise (Avisure 2015). Furthermore, each potential contributor to bird and bat strike risk at the proposed airport can be managed to an acceptable risk level so the overall bird and bat strike risk for the proposed airport is low (Avisure 2015).

Given the presence of proximate suitable habitat and the movements of birds and bats through the local landscape, there is a potential for birds to be struck on occasion. A commitment has been made in the EIS to conduct additional surveys, prior to the commencement of construction, to confirm the findings of the preliminary bird and bat strike study and to develop and implement planning, design and mitigation measures to reduce the risks of bird strikes and associated impacts on biodiversity (Table 14-5: EIS Chapter 14 Hazard and Risk). Based on existing data for airports throughout Australia and the findings of the bird and bat strike assessment (Avisure 2015), the numbers of birds and bats likely to be involved in air strikes over time is unlikely to be of a magnitude that would adversely affect the viability of populations of native fauna in the local area. Recommended mitigation measures to minimise the risk of bird and bat strike are detailed in Chapter 14 of the EIS and outlined in Section 9.2.

6.1.2 Terrestrial fauna strike

Movement of aircraft and support vehicles on the tarmac has the potential to result in mortality or injury of fauna that reside or forage in cleared areas alongside the tarmac. These fauna species may attempt to cross the tarmac and thus be struck by aircraft and support vehicles. Fencing of the proposed airport is likely to prevent large mammalian fauna such as kangaroos and wallabies occurring within the proposed airport, thus minimising the potential for impact. The proposed airport would be designed to be unattractive to wildlife and would be managed to deter occurrence. Recommended mitigation measures to minimise the risk of terrestrial fauna strike are outlined in Section 9.2.

Operation of the proposed airport would increase general traffic in the area surrounding the proposed airport, and could result in increased risk of fauna mortality on surrounding roads. Vehicle strike on surrounding roads is already likely to be high, given the presence of vegetated and agricultural areas. As further development occurs as a result of the proposed airport and more areas of agricultural and forested land are removed, fauna mortality from vehicle strike would reduce.

6.1.3 Noise and vibration

Increased noise and vibration would occur in adjacent vegetated areas from the operation of the proposed airport, via both aircraft and vehicle movements. Fauna most at risk would be those residing in close proximity to the proposed airport. Most fauna species are likely to become accustomed to the noise and vibration, as many species that occur in the surrounding area are already accustomed to noise from roads and agricultural areas. The increased noise and vibration may result in the displacement of less-tolerant species.

Noise would extend into surrounding areas as a result of landing and take-off of aircraft. Indicative flight paths for the Stage 1 operation of a single runway are included in the conceptual airspace design. Final flight paths for the proposed airport will be developed through the formal airspace design process, and will include consideration of noise abatement procedures (refer to Chapter 7 of the EIS). Based on the 05/23 runway orientation for Stage 1, there are two main operating modes that will occur, depending on the prevailing meteorological conditions (refer to Chapter 7 of the EIS). Aircraft may approach the proposed airport from the south-west and take off to the north-east or approach the proposed airport from the north-east and take off to the south-west The indicative flight paths presented in Chapter 7 of the EIS show two major departure tracks in each direction, which each branch off to other flight paths at distances that are relatively far from the proposed airport. For departures to the south-west there is a third flight path passing roughly over the township of Warragamba that then extends in a northwest direction. This flight path was designed for use by non-jet aircraft only, which would limit predicted noise exposure in areas beneath this route. Total numbers of aircraft movements per day are predicted to be about 198 in 2030, increasing to over 1000 in 2063. The majority of aircraft movements are likely to be by large aircraft, such as the Airbus A320 (refer to Chapter 7 of the EIS).

An overall sound power level (noise level at source) of 151 dBA has been assumed for take-off of aircraft based on previous measurements of a number of aircraft types. Reverse thrust during landing would result in an overall sound power level (noise level at source) of 154 dBA. Taxiing aircraft may produce a sound power level (noise level at source) of 138 dBA. Noise levels above 65 dBA are expected to extend up to about 4 kilometres outside the northern boundary of the airport (Wilkinson Murray 2015a).

Given the removal of vegetation during construction, there would be minimal impact of noise on fauna within the airport itself, as most fauna would no longer occur within the airport site. Aircraft operations to the north-east of the proposed airport will occur over areas where there is minimal native vegetation. Aircraft noise would impact fauna that occur along riparian corridors such as South Creek, and at farm dams in the area. Aircraft operations to the south-west of the proposed airport, would occur over relatively small patches of vegetation in close proximity to the proposed airport. Some aircraft noise would also occur over portions of the Greater Blue Mountains World Heritage Area closest to the proposed airport (see Section 8.2.5).

Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences (Barber et al 2009). A number of studies have investigated the effect of aircraft noise on fauna. Peregrine Falcons (*Falco peregrinus*) have been shown to be tolerant of aircraft noise in the range 80-87 dBA, but low level aircraft flights have resulted in flight response, nest abandonment or reproductive failure (Ellis, Ellis, & Mindell, 1991). Anderson et al (1996) found that Red-tailed Hawks (*Buteo jamaicensis*) show strong avoidance behaviour as a result of novel impacts from low-level helicopter flights, but do habituate to the noise over time. Ducks have been shown to react to low-flying aircraft, but the energetic costs to each species were deemed low because disruptions represented a low percentage of their time-activity budgets, only a small proportion of birds reacted to disturbance, and the likelihood of resuming the activity disrupted by an aircraft disturbance event was high (Conomy et al 1998). Some animals have been shown to change their distributions in response to anthropogenic noise. The response of Sonoran Pronghorn (*Antilocapra americana sonoriensis*) to military jets (avoiding high areas) could exacerbate habitat fragmentation and connectivity (Landon et al 2003).

A number of studies have investigated impacts of road traffic noise on fauna. Studies on bats have found that some species avoid foraging in noisy areas such as near highways (noise levels between 68-80 dBA) as the noise may interfere with listening for prey (Schaub et al 2008). Similarly, highways have also been shown to have an impact on woodland birds, resulting in lower incidence of bird occurrence near noise (Reijnen et al 1995). Traffic noise has also been shown to interfere with frogs, resulting in decreases in calling activity, and preventing females from easily locating the source of male calls, both of which could reduce reproductive success (Bee and Swanson 2007, Lengagne 2008).

Most impacts on fauna are likely to occur near the proposed airport, where aircraft are low and noise levels are highest. Many species would have already relocated given the removal of vegetation associated with construction of the proposed airport. Given the patchy nature of surrounding vegetation, this may increase competition for resources in other areas of native vegetation. Species less tolerant to disturbance may be displaced as a result of the proposed airport. Constant noise from aircraft and other vehicles would make the surrounding area less suitable for species that are less tolerant of disturbance. Species that remain in the area may be affected by aircraft and other noise at the proposed airport. Some birds are known to abandon their nests in response to noise. This would be of particular concern for the White-bellied Sea-eagle and Little Eagle as these large raptors are likely to use permanent nest sites near the proposed airport. These species may have the initial breeding season disrupted when the operation of the airport commences, but are likely to relocate and breed elsewhere. Other more resilient fauna species are likely to become accustomed to the noise, and this increased or novel impact is unlikely to result in a decrease in population numbers or diversity of these species.

6.1.4 Light

Increased light would result from the operation of the proposed airport, via landing lights, tarmac lighting, terminal lighting and aircraft and vehicles. Impacts would be greatest in areas immediately adjoining the proposed airport. Some fauna species are likely to become accustomed to the light, including species such as possums and the Tawny Frogmouth which are common and widespread in areas with street lights across suburban Sydney. Many fauna individuals and species that are currently resident at the airport site would already be accustomed to existing residential and road lighting. The increased light may result in the displacement of less-tolerant species, but could also attract some birds and bats that forage on insects attracted to light. These species may then be susceptible to aircraft strike in the absence of mitigation (see Section 6.1.1).

6.1.5 Fire

Operation of the proposed airport will create a risk of fire, for example from storage of combustible fuels, and ignition from works areas. The risk of fires spreading to adjacent areas would be expected to be minimal given the fire hazard management plan and other measures to contain and control the outbreak of fire.

6.1.6 Contamination

Operation of the proposed airport could result in spills of aviation fuel, vehicle fuel and other chemicals. Management of the proposed airport is also likely to require the use of pesticides and/or herbicides in mown areas near the tarmac and along roadsides. These chemicals could potentially enter local waterways and impact aquatic and riparian habitat downstream of the proposed airport. Appropriate mitigation measures would be incorporated into the management of the proposed airport and other infrastructure to minimise the risk of impact of chemical spills.

6.1.7 Water quality

The change in land use from a largely rural-residential area to an airport facility will have long-term effects on water quality in downstream reaches close to the airport site. Existing water quality at the airport site is poor, with high levels of nutrients and suspended solids and elevated electrical conductivity levels. Nutrient loads in the existing waterways are generally high and do not achieve ANZECC water quality objectives for total phosphorus and total nitrogen. However, total suspended solids loads are generally low and below ANZECC Guideline levels (GHD 2016c).

Nine bio-retention basins would be located along the perimeter of the airport site. Basins 1, 2, 3, 4, and 5 would be located along the southern boundary to provide water quality treatment of the stormwater flows prior to discharge to Badgerys Creek. Basins 6 and 7 would be situated along the northern boundary to manage the flows discharging into Oaky Creek and Cosgroves Creek. Basins 8 and 9 would be positioned to manage flows discharging into Duncans Creek. All the basins are proposed for construction during Stage 1 of the project, except for basins 4 and 5, which would be constructed during the long term development phase (GHD 2016c).

Modelling the impact of surface water runoff pollutants on the receiving water environment has been undertaken for suspended solids, nutrients (phosphorous and nitrogen) and gross pollutants. The modelling has considered the effectiveness of the proposed water management system to meet the objectives for the receiving waters in accordance with:

- existing or pre-development pollutant loads for consideration of a neutral or beneficial effect (NORBE);
- the Western Sydney Urban Design (WSUD) Guidelines; and
- the ANZECC Guidelines / Airports (Environment Protection) Regulations 1997

The NORBE approach to water quality management requires that post development pollutant loads discharging from a site are managed such that the water quality is equal to or better than the pre-development or existing loads. The approach is typically extremely difficult to achieve when modifying land use from a rural to an urbanised or developed catchment.

The Stage 1 development would result in increased loads of phosphorous and nitrogen, largely as a function of the increase in runoff volumes associated with the modified catchment areas and changes to land use. Relative increases in phosphorous and nitrogen loads attributed to the proposed airport would be most pronounced at the airport site and would progressively decrease downstream of the airport site as receiving waterways receive flows from the wider catchment. The proposed drainage system would be effective at reducing loads of suspended solids in surface water in comparison to existing conditions.

The WSUD Guidelines specify pollutant reduction targets as a practical way of treating urban stormwater quality, with targets of 80 per cent of suspended solids, 45 per cent of total phosphorus, and 45 per cent of total nitrogen should be retained on the airport site. The proposed water management system has been designed to achieve the WSUD Guidelines and the civil design has allowed for flexibility to increase the level of treatment in the future. The nine basin outlets effectively represent the locations where the pollutant loads generated from the proposed airport would discharge into the downstream environment. The results show that, in terms of suspended solids, total phosphorus and total nitrogen Basins 1, 3, 6, 7 and 8 satisfy the reduction target. Basins 2 and 9 do not completely satisfy the retention target and increasing the treatment area is recommended during the detailed design of these basins.

The ANZECC Guidelines take into account the relative health and assimilative capacity of the receiving waterways and aim to keep the pollutant concentrations exported from a site to levels that the receiving waterways can sustain. While the Stage 1 development will generally result in improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet the default ANZECC guideline objectives due to the degraded nature of the existing catchment. Nevertheless, it is noted that the proposed airport does not preclude the opportunity to make further improvements in downstream water quality in South Creek in the future, to work towards satisfying the NSW Water Quality Objectives.

Additional design measures would need to be assessed and included for implementation during the detailed design phase. These would include the provision of enhanced bioretention systems and the provision of diversion drains to convey flows from residual sub-catchment areas to the proposed bio-retention basins. Additional mitigation and management measures, including water quality monitoring, should also be implemented during the construction and operational phases of the project (GHD 2016c).

An estimated 2.5 ML of wastewater per day would be generated during operation of the Stage 1 development. The wastewater would be reticulated, treated and recycled (as grey water) or irrigated on site. Treatment and irrigation methods would be determined in detailed design, but it is expected that wastewater would be treated to a high quality with membrane biological reactor technology to produce high quality reclaimed water suitable for beneficial reuse or irrigation.

The key risks to surface water and groundwater associated with the irrigation of reclaimed water are runoff to surface water or infiltration to groundwater. These risks would be limited as reclaimed water would be relatively high quality and appropriate management practices such as balancing storages and proper irrigation scheduling to avoid excessive irrigation are proposed.

Given the existing poor water quality downstream of the site and with the implementation of the above mitigation measures, it is expected that the proposed airport would have no adverse impact on downstream water quality and aquatic health (GHD 2016c). As such, the airport is unlikely to have an adverse impact on downstream key fish habitat and other aquatic or riparian habitat, or on threatened species that may occur downstream of the airport site.

6.1.8 Hydrology and downstream impacts

The alterations to the topography and permeability of the airport site made during the main construction works would persist through operation of the Stage 1 development. Flows in receiving watercourses upstream and downstream of the airport site would be affected, relative to existing conditions. The Stage 1 development would result in a portion of the airport site currently draining towards the catchments of Oaky and Cosgroves Creeks to the north being diverted south towards Badgerys Creek whilst a portion of the airport site draining to Badgerys Creek would be diverted to Duncans and Oaky Creeks.

Changes to flooding have the potential to affect the physical condition of watercourses. Hydrologic and hydraulic modelling indicates that duration, volume and velocity of surface water flows in watercourses would be generally similar or reduced when compared to existing flow conditions (GHD 2016b).

Minor impacts on aquatic habitat downstream of the site may occur as a result of altered hydrology. These impacts are likely to be generally restricted to reaches close to the airport site. Further downstream, inflow from other creeks will dissipate these changes. Given the existing generally poor quality of aquatic habitats at the airport site and downstream of the airport site, the proposed airport is unlikely to have a substantial impact on fish habitat in downstream areas. No threatened species listed under the FM Act are likely to occur immediately downstream of the airport site. The proposed airport is unlikely to have an impact on the habitat of terrestrial threatened species that may occur downstream of the airport site.

The surface water management systems at the airport site will be designed to avoid substantial alteration to surface water drainage patterns and the volume of downstream flow. This will minimise the potential for adverse impacts to the downstream environment (GHD 2016b). Detention basins are the primary design control measure proposed to mitigate increases in peak flow and changes to the timing of flows as well as manage discharge velocities.

An estimated 2.5 ML of domestic wastewater per day would be generated during operation of the Stage 1 development. The wastewater will be reticulated, treated and recycled (as grey water), or potentially used for irrigation on site. Irrigation water has the potential to affect the quantity of flow into receiving waterways depending on the means of application and irrigation technology. The irrigation area would be designed and operated in accordance with the risk framework and management principles contained in the *National Guidelines on Water Recycling (Environment Protection and Heritage Council 2006)* and the Environmental guidelines: *Use of effluent by irrigation* (NSW DEC 2004). It is considered that this approach would minimise potential impacts to the patterns of flow in the downstream environment.

Treatment and irrigation methods would be determined in detailed design but is expected that wastewater would be treated with Membrane Biological Reactor technology. This technology produces high quality reclaimed water suitable for beneficial reuse or irrigation (refer to GHD 2016b).

Any groundwater seepage into cuts and subsurface basement areas would be treated and discharged back to the environment and/or removed offsite to a treatment facility. Groundwater seepage is not considered likely in significant volumes and discharge of high volumes into the surface water system would not be required (GHD 2016b).

Mitigation measures to address operational impacts of changed hydrology on aquatic and riparian communities downstream of the site are detailed in the Surface Water Hydrology and Geomorphology report (GHD 2016b) and summarised in Section 9.

6.1.9 Impacts on groundwater dependent ecosystems

While the sources of groundwater quality impacts during airport operation would be slightly different to those present during construction (refer to Section 5.1.9), the overall migration pathways and risk to sensitive receptors would be similar. As noted for construction, there will always be an inherent risk (albeit very low) to water quality at surrounding surface water features and sensitive groundwater reliant vegetation (GHD 2016e). Mitigation and monitoring of groundwater is proposed to address the identified issues and potential emergent issues that might arise during the operational stages of the airport and to allow remedial action to be taken where required (GHD 2016e).

6.1.10 Fuel jettisoning

Emergency fuel jettisoning (commonly referred to as fuel dumping) could result in impacts on biodiversity values by introducing harmful contaminants into sensitive environments. The region surrounding the proposed airport includes sensitive receptors, including native terrestrial vegetation and freshwater, estuarine and marine environments. However, given the rarity of fuel jettisoning globally, the low known occurrence in Australian airspace, and the high evaporation rates known to occur at high altitude, it is unlikely that fuel jettisoning from aircraft using the proposed airport would have any impact on biodiversity values.

Fuel jettisoning is extremely rare and usually related to emergencies for civilian aircraft where aircraft need to make an unscheduled landing. Aircraft do not jettison fuel as a standard procedure when landing. Many of the commonly used aircraft that perform the majority of domestic flights in Australia (e.g. the Boeing 737 and the Airbus 320) do not have fuel jettisoning capability as they do not need to reduce their weight in order to make an emergency landing. All international long haul aircraft, and some medium-to-long haul aircraft are able to jettison fuel (refer to Chapter 7 of the EIS).

Instance of fuel jettisoning are extremely rare worldwide. In Australian airspace, there were 10 reported instances of civilian aircraft dumping fuel in 2014 from 698,856 domestic air traffic movements and 31,345 international movements (approximately 0.001 per cent of all movements). There are no recorded cases in Australia of fuel from civil aircraft reaching the ground.

The procedure for fuel jettisoning is specified in the En Route supplement of the Aeronautical Information Package published by Airservices Australia as outlined in Chapter 7 of the EIS. When fuel jettisoning is required, the pilot in command requests authority from air traffic control before commencing the operation and must:

- take reasonable precautions to ensure the safety of persons or property in the air and on the ground;
- where possible, conduct a controlled jettison in clear air at an altitude above 6,000 feet (approximately 1.8 kilometres) and in an area nominated by air traffic control; and
- notify air traffic control immediately after an emergency jettison.

The unauthorised jettisoning of fuel in flight is an offence. The Air Navigation (Fuel Spillage) Regulations 1999 prescribe penalties for the unauthorised release of fuel from an aircraft other than in an emergency. The effects of fuel jettisoning on local air quality would be limited due to the inability of many aircraft to jettison fuel, the rapid vaporisation and dispersion of jettisoned fuel and the strict regulations on altitudes and locations for fuel jettisoning. For these reasons, fuel jettisoning is not considered likely to have any immediate or future impact on local air quality or biodiversity values.

6.1.11 Introduction of novel species

As with any international airport or seaport, operation of the proposed airport poses a biosecurity risk. There is the potential for the introduction of exotic species as a result of the transport of goods on aircraft. For example, the one record of Yellow Crazy Ants (*Anololepis gracilipes*) from New Zealand is likely to have been a transit passenger (on taro in air baggage) (Biosecurity New Zealand, undated). Invasion of Yellow Crazy Ants is listed as a key threatening process under the TSC Act (see Section 8.1). Any escaped novel species could potentially establish in nearby vegetated areas, or be transported to other areas of native vegetation with cargo, and impact the local native flora and fauna.

All aircraft arriving in Australia from overseas are subject to Australian biosecurity requirements administered by the Department of Agriculture. Further, the proposed airport and airlines using the proposed airport would be expected to comply with all Australian laws relating to biosecurity, similar to existing airports already in operation.

6.2 Long term development

Long term development at the airport site would result in a similar set of operational impacts as for Stage 1 (see Section 6.1). Potential operational impacts arising from long term development at the airport site would include:

- the risk of bird and bat strike would increase with the increased aircraft traffic;
- the risk of terrestrial fauna mortality through vehicle strike may increase, although the increased development of industrial and commercial areas around the proposed airport is likely to result in a reduced risk over time, as less habitat is available for these fauna species;
- the risk of toxicity or degradation of habitat due to generation of contaminants from accidental spills of fuel, pesticides, herbicides or transported goods;
- increased noise, light and vibration which may result in the further displacement of less-tolerant species from habitats adjoining the airport site;
- the risk of fires which may spread to adjacent vegetation; and
- introduction of novel species.

Environmental management and mitigation measures to prevent the introduction or spread of disease, minimise sedimentation and erosion, limit the generation of dust and minimise the potential spread of pathogens would be implemented with long term development at the airport site.

7. Cumulative impacts

The potential for cumulative impacts due to the Stage 1 development and the long term development at the airport site has been considered.

Other planned and potential infrastructure developments in the locality include the realignment of The Northern Road around the airport site, implementation of the Western Sydney Infrastructure Plan which includes the M12 motorway and The Northern Road upgrades, potential future orbital road links, realignment of transmission lines and potential extension of the South West Rail Link, including a potential rail connection to the proposed airport. The Western Sydney Priority Growth Area structure plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands (DoP 2010).

The proposed airport is likely to result in facilitated impacts on biodiversity values (i.e. impacts that are more likely to occur because the proposed airport has been developed). Construction of the proposed airport is likely to accelerate economic activity in the locality, commercial developments in the surrounding Broader Western Sydney Employment Area and housing development in the South West Growth Centre. These developments and activities would result in cumulative and facilitated impacts connected to Stage 1 of the proposed airport, including:

- additional removal of native vegetation and habitat resources;
- additional injury, displacement or mortality of individuals within local flora and fauna populations;
- increased fragmentation of habitat and creation of novel edge effects in remnant native vegetation;
- increased generation of noise and light and increased risk of plane strike associated with a second runway at the airport site and vehicle collisions associated with other transport infrastructure;
- increased risk of the spread of weeds, pathogens or pest fauna and/or increased negative impacts arising from these factors;
- increased risk of toxicity or degradation of habitat due to the generation of contaminants; and
- further alterations to the hydrology of catchments (noting that the proposed airport would be designed to avoid adverse changes to hydrology and may result in an overall improvement in water quality).

Many of these cumulative impacts would exacerbate the effect of already significant impacts of Stage 1, such as the reduction in extent of Cumberland Plain Woodland, removal of Grey-headed Flying Fox habitat and removal of small terrestrial fauna populations at the airport site (see Section 5). Impacts of construction of the long term development would be significant in their own right. Other infrastructure proposals and larger-scale commercial developments in the locality would also likely result in a significant impact on Cumberland Plain Woodland and habitats for certain threatened fauna species.

The biodiversity values that are likely to be affected have relatively low ecosystem resilience because of the existing cumulative impacts of development in Western Sydney. At least 90% of the estimated pre-European extent of each of the native vegetation types at the airport site have been removed (OEH 2015c). Remnant vegetation is also severely fragmented at a regional scale, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches of Cumberland Plain Woodland being smaller than three hectares (NSW Scientific Committee 2009). Future biodiversity assessments and development approvals will need to consider carefully the avoidance, mitigation and offsetting of impacts in order to ensure that cumulative impacts do not result in unacceptable impacts such as the local or regional extinction of any biota.

Cumulative impacts connected to the proposed airport would occur in the context of human induced climate change, which is recognised as a serious threat to biodiversity values. Climate change threatens biodiversity values directly, by affecting ecosystem processes and habitats, and indirectly, by compounding the impacts of existing and ongoing pressures on biodiversity values (Steffen et. al 2009; DoE 2015e). Stage 1 of the proposed airport, long term development at the airport site and related development in the locality would contribute to the impacts of climate change through removal of vegetation and production of greenhouse gases.

'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a key threatening process (KTP) under the EPBC act and consists of reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human production of greenhouse gases (DoE 2015d). Ecosystems in which the KTP occurs include: alpine habitats; coral reefs; wetlands and coastal ecosystems; polar communities; tropical forests; temperate forests; and arid and semi-arid environments (DoE 2015d). Although temperate forests such as the ecosystems at the airport site are included in this list, they would not be particularly susceptible to the impacts of climate change. The species ecosystems which are most at risk are those which function within a limited range of climatic parameters such as tropical coral reefs or alpine environments (Steffen et. al 2009). The temperate woodlands and forests at the airport site are associated with a comparatively broad and mild set of climatic conditions. The climate of Western Sydney includes pronounced seasonal and multi-annual variability in temperature and especially rainfall. It is widely accepted that the ecological communities associated with *Eucalyptus* woodlands of south eastern Australia are tolerant of this variability. This is apparent in the presence of adaptive characteristics or life history strategies that provide resilience to drought or wildfire.

The biodiversity values of sclerophyllous vegetation in south-eastern Australia may be at risk of negative impacts as a result of increased wild fire frequency or intensity due to climate change, with pockets of fire-sensitive vegetation that occur in flammable matrices most at risk (Steffen et. al 2009). Pockets of Western Sydney Dry Rainforests and Moist Shale Woodland in the locality would be susceptible to these impacts (TSSC 2013) however the majority of the region features grassy woodland or forest vegetation that is tolerant of fire (DEC 2005; NPWS 2006; Tozer 2010). The recommended fire regimes for grassy woodland or forest vegetation types on the Cumberland Plain is no more frequently than every five to seven years but no less frequently than every 35 years (DECCW 2010).

Climate change is not recognised as a specific threat in the conservation advice for Cumberland Plain Woodland (Threatened Species Scientific Committee 2008), *Pultenaea parviflora* or other threatened biota known or likely to occur at the airport site (DoE 2015b). Climate change is recognised as a threat, priority unknown, in the recovery plan for the Grey-headed Flying-fox due to the potential for changes in the distribution or reproduction of some *Eucalyptus* food tree species or the increased occurrence of extremely high temperatures (DECCW 2009a). Overall climate change is likely to have a relatively minor effect on ecosystem resilience and potential cumulative impacts on biodiversity values at the airport site when compared to more immediate threats such as removal of vegetation and habitat.

The biodiversity offsets summarised in Section 9.3 would help mitigate the impacts of Stage 1, including likely cumulative impacts. Offsets will be delivered via a staged approach as follows:

- The biodiversity offset package (Appendix K2) included in the EIS, which outlines the approach to the delivery of biodiversity offsets for the proposed airport, including an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.

- The biodiversity offsets delivery plan which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in the biodiversity offset package.

At this stage of the planning and assessment for the proposed airport, the intent is to deliver most biodiversity offsets through conservation of suitable offset sites. The quantum of biodiversity offsets required has been estimated with consideration of the EPBC Act Offsets Policy (DSEWPaC 2012). Offset sites would be conserved in the locality and surrounding region and would be managed within the framework of BioBanking.

The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the proposed airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

Long term development at the airport site would require separate calculation of any additional biodiversity offsets with reference to the prevailing airport master plan(s) and the EPBC Act Offsets Policy. Other major developments in the locality would need to deliver biodiversity offsets in accordance with the NSW Framework for Biodiversity Assessment and/or the EPBC Act Offsets Policy. The cumulative benefits of biodiversity offsets should help to compensate for the cumulative impacts of the various developments.

The Growth Centres strategic assessment has considered development impacts and biodiversity offsets at the regional scale and has provided for the conservation of the Western Sydney Parklands and other substantial conservation areas (DoP 2010). Through the strategic assessment the NSW Government has committed to delivering conservation outcomes for a range of matters of national environmental significance including:

- A minimum of 998 ha of Cumberland Plain Woodland that will be retained and protected within the Growth Centres, including a minimum of 363 ha of high management viability examples of these communities.
- At least 2,400 ha of either Cumberland Plain Woodland or other grassy woodland communities which are similar to Cumberland Plain Woodland in floristic structure will be protected outside of the Growth Centres (DoP 2010).

Conservation of Cumberland Plain Woodland and other biodiversity values as part of the Growth centres strategic assessment would help to conserve local and regional populations of these biota in conjunction with the offset package for the airport.

The Cumberland Plain Recovery Plan identified priority conservation lands that are intended to maintain the biodiversity values of the Cumberland Plain (DECCW 2010). Many of these priority conservation lands have been securely titled for conservation under BioBanking agreements, through the South West Growth Centres strategic assessment or other mechanisms. These conservation areas are located in the same region as the airport site and include Cumberland Plain Woodland, Grey-headed Flying-fox habitat and other biodiversity values that would be affected by the proposed airport. Future development in the region should be linked to the conservation of additional areas through the provision of biodiversity offsets. This approach should help to maintain biodiversity values at the local and regional scale despite potentially serious cumulative and/or facilitated impacts connected to the proposed airport.

8. Assessment of Significance

8.1 Key threatening processes and threat abatement plans

A threatening process is defined as a key threatening process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community (DoE 2015d). A process can be listed as a KTP if it could:

- cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category); or
- cause an already listed threatened species or threatened ecological community to become more endangered; or
- adversely affect two or more listed threatened species or threatened ecological communities.

KTPs are listed under the EPBC Act, TSC Act and FM Act. Some KTPs are listed under more than one Act.

Threat abatement plans (TAPs) establish a national framework to guide and coordinate Australia's response to key threatening processes registered under the EPBC Act. TAPs have also been listed under the TSC Act The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by KTPs.

KTPs of relevance to the proposed airport are discussed in Table 62. Where TAPs have been published for the KTPs, these are also noted.

Mitigation measures have been recommended where relevant for KTPs detailed in Table 62 (see Section 9.2). These have been developed with reference to the information provided in the KTP listing and the relevant TAPs. The construction and operation of the airport would not result in any actions that would contravene any relevant TAPs.

Table 62 Key Threatening Processes and Threat Abatement Plans of relevance to the proposed airport

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Status	Comment
EPBC Act key threatening processes				
Clearing of native vegetation	EPBC Act, TSC Act			It is expected that approximately 318.5 hectares of native vegetation would be cleared in the Stage 1 construction impact zone. This includes around 141.3 hectares of good condition vegetation with a forest or woodland structure and 148.6 hectares of derived native grassland or scrub, as well as 28.6 hectares of wetlands. Given the extent of vegetation removal and habitat fragmentation on the Cumberland Plain this would comprise a substantial contribution to the operation of this KTP. Mitigation measures are proposed in Section 9.2 to minimise the impact of the proposed airport on native vegetation as far as possible.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	EPBC Act, TSC Act			Garden plants are present at the airport site, particularly in proximity to existing or recently demolished residences. Garden plants were also observed in native vegetation that had regrown where a nursery used to be located. Clearing of vegetation for the proposed airport is not likely to further increase the spread of these garden plants. Alligator Weed was recorded at a large dam at the western end of Elizabeth Drive and Salvinia and Water Hyacinth were recorded in the broader study area. Construction of the proposed airport could result in the spread of these aquatic Weeds of National Significance to downstream areas outside the proposed airport. Mitigation measures are proposed in Section 9.2 to minimise the spread of weeds.
Novel biota and their impact on biodiversity	EPBC Act			Airports create a biosecurity risk by providing a means for novel biota to enter an area. Management of biosecurity at airports is carried out by the Australian Quarantine Inspection Service (AQIS). Mitigation measures are proposed in Section 9.2 to minimise the risk of impact during operation of novel biota in the area.

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Status	Comment
Infection of native plants by *Phytophthora cinnamomi*	EPBC Act, TSC Act	Disease in natural ecosystems caused by *Phytophthora cinnamomi*	EPBC Act	Cumberland Plain Woodland is identified in the *Phytophthora cinnamomi* TAP (DoE 2014b) as a TEC that may be impacted by disease. Construction activities have the potential to introduce Phytophthora into the airport site, through the transport and movement of plant, machinery and vehicles, as well as through any landscaping works following construction. The Construction and Environment Management Plan (CEMP) would include environmental management measures to reduce potential impacts on soil, water and native vegetation (see Section 9.2).
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act, TSC Act	Infection of amphibians with chytrid fungus resulting in chytridiomycosis	EPBC Act	Chytrid fungus is a water borne pathogen and could be spread through water or mud on vehicles, machinery, footwear and other equipment. Chytrid invades the skin of frogs causing skin legions, which can kill them or make them susceptible to other threats (e.g. predators, climate change). This highly virulent fungal pathogen of amphibians is capable at a minimum of causing sporadic deaths in some populations, and 100 per cent mortality in other populations. It is unknown if the disease occurs at the airport site. Construction activities have the potential to introduce or spread chytrid fungus in adjacent areas. Mitigation measures are proposed in Section 9.2 to minimise the risk of introduction or spread of chytrid fungus at the airport site, in line with recommendations in the TAP (DEH 2006).
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	EPBC Act, TSC Act			Noisy Miners are a dominant species at the airport site. Clearing of vegetation for the proposed airport may increase the incidence of this species in adjacent woodland and forest habitat, either through displacement of individuals or an increase in patchiness which may encourage their presence, further exacerbating this KTP.
Predation by the European red fox	EPBC Act, TSC Act	Predation by the red fox (*Vulpes vulpes*)	EPBC Act TSC Act	The European Red Fox was recorded at the airport site during field surveys. Predation by the Red Fox has the potential to affect the Grey-headed Flying-fox and migratory species (mainly wetland birds) assessed in this report. Clearing of vegetation would remove habitat for this species at the airport site, but may result in displacement of individuals into adjacent areas, increasing the risk of predation by the species in the short term. The operation of the proposed airport is not likely to exacerbate the operation of this KTP as the site would be fenced.

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Status	Comment
Predation by feral cats	EPBC Act, TSC Act	Predation by feral cats	EPBC Act	The Feral Cat *Felis catus* was not recorded at the airport site during field surveys but it is likely that feral cats occur at the airport site and prey on individuals of relevant threatened fauna. Clearing of vegetation would remove habitat for this species at the airport site, but may result in displacement of individuals into adjacent areas, increasing the risk of predation by the species in the short term. The operation of the proposed airport is not likely to exacerbate the operation of this KTP as the site would be fenced.
Competition and land degradation by rabbits	EPBC Act, TSC Act	Competition and land degradation by rabbits	EPBC Act	The Rabbit was recorded at the airport site. The proposed airport is unlikely to lead to an increase in the abundance or distribution of rabbits within the airport site, but may displace individuals to adjacent areas in the short term. The operation of the proposed airport is not likely to exacerbate the operation of this KTP as the site would be fenced and feral animal control would likely be carried out.
Human-caused climate change	EPBC Act, TSC Act			Deforestation associated with construction of the proposed airport and combustion of fuels associated with construction and operation will contribute to anthropogenic emissions of greenhouse gases. The proposed airport would remove about 318.4 hectares of native vegetation. Construction and operation of the proposed airport would lead to considerable fuel combustion. Hence, the proposed airport would exacerbate this KTP. Mitigation measures are proposed in Section 9.2 to minimise the clearing of vegetation where possible. The proposed airport is located in western Sydney, a region undergoing substantial urban development. All development in the region would contribute to the increase in greenhouse gas emissions, further increasing the risks associated with climate change. Hence, the proposed airport would exacerbate this KTP.
TSC Act and FM Act key threatening processes				
Clearing of hollow-bearing trees	TSC Act			Hollows are not abundant at the airport site given the young age of much of the regenerating woodland. Some large hollow-bearing trees are present along riparian corridors and in larger patches of woodland that contain remnant vegetation. Given the area of vegetation to be cleared, a large number of hollows would be lost, reducing breeding habitat for species such as possums, bats and parrots. Few large hollows suitable for forest owls and large cockatoos are present. Habitat management procedures, including the use of nest boxes in the conservation areas, are recommended to

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Status	Comment
				limit impacts on fauna and their habitats (see Section 9.2).
Removal of dead wood and dead trees	TSC Act			The airport site contains areas with fallen timber. The proposed airport will result in the removal of this timber during construction of the proposed airport. The implementation of habitat management procedures, including the use of nest boxes in the conservation areas, is recommended to limit impacts on fauna and their habitats (see Section 9.2).
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act			Construction activities have the potential to introduce Myrtle Rust to the airport site. The proposed airport would include environmental management measures, including specific consideration of measures to reduce potential impacts on soil, water and native vegetation (see Section 9.2).
Invasion of plant communities by perennial exotic grasses	TSC Act			The airport site features large areas of exotic grassland. There is the potential for perennial exotic grasses to invade adjacent native vegetation through disturbance during construction of the proposed airport. The CEMP would include weed management measures and specific consideration of potential impacts on soil, water and native vegetation (see Section 9.2).
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	TSC Act			Bell Miners were recorded at the airport site. Clearing of vegetation for the proposed airport and associated displacement of birds may increase the incidence of this species in adjacent woodland and forest habitat, further exacerbating this KTP.
Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.	TSC Act			The airport site contains areas already infested with African Olive. There is the potential for this species to invade adjacent native vegetation through disturbance during construction of the proposed airport. The CEMP would include environmental management measures, including weed management and specific consideration of potential impacts on soil, water and native vegetation (see Section 9.2).
Invasion of the Yellow Crazy Ant *Anoplolepis gracilipes* (Fr. Smith) into NSW	TSC Act			Crazy ants have been intercepted in Australian ports at least 161 times since 1988 (OEH 2014). Crazy ants have the potential to displace native fauna and to kill invertebrates, reptiles, hatchling birds and small mammals. The operation of the proposed airport has the potential to be a means by which this species enters the Western Sydney area and other areas of NSW and Australia. Management of biosecurity at airports is carried out by the Australian Quarantine Inspection Service (AQIS). Biosecurity measures are proposed in Section 9.2 to minimise the risk of impact of novel biota during operation of the proposed airport.

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Status	Comment
Predation by the Plague Minnow (*Gambusia holbrooki*)	TSC Act	Predation *by Gambusia holbrooki* (plague minnow)	TSC Act	Eastern Gambusia are the most abundant fish species at the airport site. Dewatering of farm dams during construction has the potential to increase the incidence of this species in local waterways. Implementation of a protocol for the management of removal of dams is recommended (see Section 9.2), in order to minimise human dispersal of the species, in line with the TAP (NPWS 2003).
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act; FM Act			Construction of the proposed airport would remove sections of creeks, including the upper reaches of Oaky Creek. The proposed airport would alter the natural landform through placement of fill, increasing the proportion of hardstand surfaces in the airport site and modifying surface water flows. The proposed airport has been designed to mitigate impacts on aquatic habitats downstream of the site. Further monitoring of surface water is recommended (see Section 9.2).
The degradation of native riparian vegetation along NSW water courses	FM Act			The riparian corridor along Badgerys Creek would be protected and managed as an offset. Other riparian vegetation within the airport site would be removed. There is the potential for downstream impacts on riparian vegetation resulting from the removal of vegetation upstream. Mitigation measures are recommended to limit the potential for adverse impacts on riparian vegetation during construction (see Section 9.2). The proposed airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site.
The removal of large woody debris from NSW rivers and streams	FM Act			Construction of the proposed airport would remove sections of creeks, including the upper reaches of Oaky Creek, and would remove large woody debris from these creeks. The removal of creeks and large woody debris would reduce breeding habitat for fish in the locality. There would be no disturbance of large woody debris in Badgerys Creek.

8.2 Impacts on MNES

8.2.1 Threatened ecological communities

The Referral determination

The airport proposal was referred to the Department of the Environment on 4 December 2014 (DIRD 2014) and determined to be a controlled action under the EPBC Act. The proposal was considered likely to have a significant impact on the following TECs:

- critically endangered - Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cumberland Plain Woodland); and
- critically endangered - Western Sydney Dry Rainforest and Moist Woodland on Shale.

Identification of affected TECs

Much of the native vegetation at the airport site is Cumberland Plain Woodland (Table 63).

Western Sydney Dry Rainforest and Moist Woodland CEEC was not recorded at the airport site during the field surveys for this assessment (see Section 4.2.2). A patch of Moist Shale Woodland considered to comprise a local occurrence of the TEC was previously identified by SMEC (2014) at the airport site. Consequently, this ecological community was included in the EIS guidelines (DoE 2015f) as a TEC likely to be impacted significantly by the proposal. Additional assessment of this area conducted as part of the current surveys concluded that it contained Cumberland Plain Woodland (i.e. the vegetation types Grey Box - Forest Red Gum grassy woodland on hills and Grey Box - Forest Red Gum grassy woodland on flats) with relatively few species representative of Moist Shale Woodland. These vegetation types collectively comprise an occurrence of Cumberland Plain Woodland. 20m x 20m vegetation plot data was compared with Tozer (2010) diagnostic species lists to confirm the identity of these vegetation types. The absence of characteristic mesic trees, shrubs, climbers and ferns and a generally grassy rather than shrubby understorey (TSSC 2013) further support the classification as Cumberland Plain Woodland (noting that the only widespread shrub species present is Native Blackthorn which is a diagnostic species in all three vegetation types (Tozer 2010) and is widely recognised as indicating a response to fire regime or other disturbance within Cumberland Plain Woodland rather than any environmental factor characteristic of another ecological community (NSW Scientific Committee 1997; DECCW 2010; TSSC 2008).

Western Sydney Dry Rainforest and Moist Woodland is not present at the airport site and as such the construction and operation of the proposed airport would not have an impact on an occurrence of this TEC. Impacts on this TEC are not considered further in this assessment.

No other TECs listed under the EPBC act are known or likely to be affected by construction or operation of the proposed airport.

Table 63 Threatened ecological communities listed under the EPBC Act within the Stage 1 area

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Cumberland Plain Woodland	CEEC	Present.	Certain. Direct impacts within a local occurrence of the community.	Direct removal of up to 104.9 hectares of vegetation in a local occurrence of the community[1]	Likely.

CEEC – critically endangered ecological community

Notes: 1) Comprising the areas of Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529), and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

Significance of Impacts on Cumberland Plain Woodland

An assessment of significance has been prepared in accordance with the '*Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999'* (DoE 2013a) for impacts on Cumberland Plain Woodland and is included as Appendix D.

The Stage 1 development would include the permanent removal of 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the form of the community listed under the EPBC Act as shown on Figure 5. Long term development at the airport site would further reduce the extent of the community by up to 46.4 hectares. A permanent reduction in extent of this magnitude would threaten the viability and persistence of Cumberland Plain Woodland within the locality.

The outcome of the assessment of significance included as Appendix D is that Stage 1 of the proposed airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland. A significant impact would occur through a substantial reduction in the extent of the community and increase in the degree of fragmentation which would in turn result in a substantial negative effect on the potential for recovery of the community. Long term development at the airport site would further reduce the extent of the community, fragment habitat and interfere with its recovery. This additional reduction would further increase the significance of impacts of Stage 1 and would comprise a significant impact in its own right.

An offset package has been prepared for the proposed airport to compensate for these significant impacts (see Section 9.3). This would include the protection and management of Cumberland Plain Woodland at offset sites in perpetuity.

8.2.2 Threatened flora species

The Referral determination

The Department of the Environment (hereafter the Department) determined the airport proposal to be a controlled action and considered it likely to have a significant impact on *Pultenaea parviflora*, listed as a vulnerable species under the EPBC Act. In addition, the Department indicated a significant impact could not be ruled out for the following species (DoE 2015f):

- White-flowered Wax Plant (*Cynanchum elegans*), listed as an endangered species under the EPBC Act;

- Spiked Rice-flower (*Pimelea spicata*), listed as an endangered species under the EPBC Act;
- Downy Wattle (*Acacia pubescens*), listed as a vulnerable species under the EPBC Act;
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*), listed as a vulnerable species under the EPBC Act; and
- Austral Toadflax, Toadflax (*Thesium australe*), listed as a vulnerable species under the EPBC Act.

Identification of affected flora species

The desktop assessment, field surveys and habitat assessments described in this report have been used to identify the threatened plants that may be affected by the proposed airport, through either direct or indirect impacts. The outcome of these assessments is summarised in Appendix A.

The Stage 1 construction impact zone includes at least four individual *Pultenaea parviflora.* There is potential habitat for the additional five threatened flora species identified by the Department at the airport site. They are at a moderate risk of impact as a result of the proposed airport Table 64 based on an assessment of the numbers of local records and presence and quality of potential habitat (Appendix A).

The remainder of the threatened flora species previously recorded or predicted to occur in the locality would not occur because the airport site is outside of their known distribution and/or does not contain suitable habitat (Appendix A). The airport site does not contain any sandstone outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any threatened plant species that have habitat requirements specific to these soil types. Construction and operation of the proposed airport would not have an impact on these threatened species or their habitat.

Table 64 Threatened species listed under the EPBC Act with a moderate to high risk of impact in the Stage 1 area

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Pultenaea parviflora	Vulnerable	Present. Four individuals were recorded at the airport site.	Certain. The recorded individuals and a large area of potential shale woodland habitat would be removed.	Four individuals and up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat.[1]	Unlikely.
White-flowered Wax Plant	Endangered	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A large area of potential habitat in woodland and forest would be removed.	Up to 141.3 hectares of better quality potential habitat and a further 148.6 hectares of poor quality potential habitat.[2]	Unlikely.

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Spiked Rice-flower	Endangered	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A large area of potential habitat in shale woodlands would be removed.	Up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat.[1]	Unlikely.
Downy Wattle	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A small area of potential habitat in Shale-Gravel Transition Forest would be removed.	Up to 4.4 hectares of better quality potential habitat and a further 0.6 hectares of poor quality potential habitat.[3]	Unlikely.
Small-flower Grevillea	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A small area of potential habitat in Shale-Gravel Transition Forest would be removed.	Up to 4.4 hectares of better quality potential habitat and a further 0.6 hectares of poor quality potential habitat.[3]	Unlikely.
Austral Toadflax	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. There is potential habitat at the airport site.	Possible. A large area of potential habitat in grassy woodland or grassland would be removed.	Up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat.[1]	Unlikely.

Notes: 1) Comprising the areas of Good and poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529) and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

2) Comprising the areas of Good and poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529), Forest Red Gum - Rough-barked Apple grassy woodland (HN526) and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

3) Comprising the areas of Good and poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

Significance of impacts on threatened plants

Assessments of significance have been prepared in accordance with the Significant impact guidelines 1.1 (DoE 2013a) for threatened plant species that are known or likely to be impacted by the proposed airport. Assessments of significance are included as Appendix D and the key findings are summarised below.

Construction of Stage 1 of the proposed airport would remove four individual *Pultenaea parviflora* which would remove the known local population at the airport site. The proposed airport would also require the removal of 107.1 hectares of better quality potential habitat for Stage 1 and up to 45.3 hectares of better quality potential habitat for long term development at the airport site. The EPBC Act assessment of significance guidelines 1.1 includes specific criteria for assessing impacts on a vulnerable species, which primarily relate to impacts on an important population (DoE 2013a).

The population of *P. parviflora* at the airport site is not an important population because:

- it is not identified in a recovery plan;
- it would not be important for breeding or dispersal because it includes only four plants and it is in a comparatively isolated and poor quality patch of habitat that is surrounded by extensive areas of cleared cropland or grazing country;
- it is not important for maintaining genetic diversity because it comprises only four plants that are in close proximity and as such would be unlikely to contain much genetic diversity. Further, this genetic material has already been retained via the Royal Botanic Gardens Trust sampling and propagation programme (RBGS 1992); and
- this population is near the limit of the species range as it is at the western extent of recognised outlier populations near Kemps Creek (OEH 2015b). The majority of the known population at Kemps Creek is associated with a parcel of land within tertiary gravel and shale/gravel transition habitat located around three kilometres to the east of the site (OEH 2015a). This land parcel is to be set aside as an offset for the South West Growth Centres. The population at the airport site would probably make a very minor contribution to the viability of this population.

Therefore, the proposed airport would not result in any direct impacts on an important population of the species and would not substantially interfere with the recovery of *P. parviflora.* The proposed airport would not result in a significant impact on *P. parviflora*. As discussed in Section 4.5.2, collection and propagation of this population has previously been carried out, with plants located at the Australian Botanic Garden, Mount Annan. Further propagation may be carried out as part of a threatened flora management plan (see Section 9.2).

Construction and operation of the proposed airport would not affect any known populations of the White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle; and the vulnerable species Small-flower Grevillea and Austral Toadflax. Despite targeted surveys there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (Biosis 1999; SMEC 2014; OEH 2015a). There is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site. Any populations of these threatened plant species at the airport site are likely to have relatively low viability since they are not abundant or extensive enough to have been detected by surveys, the airport site is extensively degraded and modified and there is limited potential for either recruitment or population expansion given the extent of habitat fragmentation. Any local populations of these species, if present, would probably make a minor contribution to the maintenance or recovery of these species. Given these considerations, the proposed airport is unlikely to interfere with the recovery of any of these threatened plant species. The proposed airport would not result in a significant impact on these threatened plant species.

Changes to water quality or hydrology are unlikely to impact threatened flora habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c).

Since the proposed airport is not likely to result in a significant impact on any of these threatened plant species there is no requirement to calculate or to deliver direct biodiversity offsets in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012). However, any potential impacts on these threatened plant species and populations would be substantially offset through the conservation and management of Cumberland Plain Woodland and other native vegetation in the locality and region as part of the biodiversity offset package for the project (see Section 9.3).

8.2.3 Threatened fauna species

The Referral determination

The airport proposal is a controlled action under the EPBC Act. A significant impact could not be ruled out by the Department of the Environment for the following threatened fauna species (DoE 2015f):

- Grey-headed Flying-fox (*Pteropus poliocephalus*), which is listed as a vulnerable species under the EPBC Act;
- Giant Burrowing Frog (*Heleioporus australiacus*), which is listed as a vulnerable species under the EPBC Act;
- Green and Golden Bell Frog (*Litoria aurea*), which is listed as a vulnerable species under the EPBC Act; and
- Large-eared Pied Bat (*Chalinolobus dwyeri*), which is listed as a vulnerable species under the EPBC Act.

Identification of affected fauna species

The desktop assessment, field surveys and habitat assessments described in this report have been used to identify the threatened fauna species that may be affected by the proposed airport, through either direct or indirect impacts. The outcome of these assessments is summarised in Appendix A.

One threatened fauna species listed under the EPBC Act and identified in the EIS guidelines (DoE 2015f) as having the potential to be impacted significantly by the proposed airport was recorded at the airport site. The Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging at the site or flying over the site during the current surveys, as well as in previous surveys (Biosis Research 1999). No other threatened fauna species listed under the EPBC Act have been recorded at the airport site. The Swift Parrot is likely to forage at the airport site on occasion during its winter migration to the mainland. Construction of the proposed airport would remove potential habitat for this species. This species was not identified in the referral or EIS guidelines as one that was likely to be significantly impacted by the proposed airport. The risk of impact and quantum of impact on these threatened fauna species is summarised in Table 65.

Table 65 Threatened fauna species listed under the EPBC Act with a moderate to high risk of impact in the Stage 1 area

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impacts
Grey-headed Flying-fox	V	Present. Would forage in woodland stands at the airport site. No roost camps present at the airport site.	Certain. Large area of potential foraging habitat would be removed. Moderate risk of aircraft strike during operation.	141.8 hectares of foraging habitat [1] Low numbers of bats likely to be subject to aircraft strike.	Likely
Swift Parrot	CE	Likely. May forage on occasion in the airport site during winter when trees are flowering. 8 records within the locality (OEH 2015a).	Moderate. Large area of potential foraging habitat would be removed. Low risk of aircraft strike during operation.	Up to 141.8 hectares of potential foraging habitat.[1] Very low numbers of birds likely to be subject to aircraft strike.	Unlikely

V = vulnerable species; CE = critically endangered species

Notes: 1) Comprising the area of woodland and forest habitat at the airport site as shown in Table 59.

As described in Section 4.5.3, no habitat for the Giant Burrowing Frog is present at the airport site. The proposed airport would not directly impact a population of this species. Potential indirect impacts on the Blue Mountains World Heritage Area would be highly unlikely to impact a population of this species. The proposed airport would not have a significant impact on this species as there is no potential habitat for the species at the airport site.

The Large-eared Pied Bat has not been recorded at the airport site during either the recent or previous surveys. The airport site does not contain habitat critical for the survival of the Large-eared Pied Bat as defined in the Recovery Plan (DERM 2011) and as described in Section 4.5.3. The proposed airport will not destroy or interfere with maternity or other roost sites or remove foraging habitat proximate to such habitat features. It is likely that the airport site is too distant from sandstone escarpment areas and contains remnant vegetation that is too fragmented and isolated to comprise important habitat for this species (see Section 4.5.3). Whilst it is conceivable that this species could occur at the site on occasion, it is unlikely that a local population would be dependent on the site for its persistence and the proposed airport is therefore unlikely to have a significant impact on the Large-eared Pied Bat.

As described in Section 4.5.3, no Green and Golden Bell Frogs were recorded during the current targeted surveys at the airport site, or during previous targeted surveys carried out at the airport site (Lemckert 1999). There are no previous records of the species at the airport site (OEH 2015a). This species is likely to have become extinct in the area many years ago, if it was present at all (Lemckert 1999). Based on this evidence, the proposed airport is highly unlikely to have a significant impact on this species.

Low quality potential habitat is present in the airport site for a number of other threatened fauna species listed under the EPBC Act as described in Appendix A. These species may occur on a transient or opportunistic basis only. The proposed airport is highly unlikely to have a significant impact on these species. These species are not considered further in this report.

No threatened aquatic fauna species listed under the EPBC Act were recorded or are likely to occur at the airport site or in upstream or downstream habitats.

Significance of impacts on threatened fauna

Assessments of significance have been prepared in accordance with the Significant impact guidelines 1.1 (DoE 2013a) for these threatened fauna species and are included as Appendix D. The conclusions of these assessments of significance are summarised below.

Grey-headed Flying-fox

The Grey-headed Flying-fox occurs along the eastern coastal plain of NSW extending into Queensland and Victoria. It roosts in camps, usually in dense riparian habitats. At dusk this species disperses in search of its preferred food source, mainly eucalypt blossom and rainforest fruits. Individuals may disperse over a 50 kilometres radius from camp sites in search of food though commuting distances of around 20 kilometres are more typical (OEH 2015b).

Two foraging periods of the year are identified as particularly important for the Grey-headed Flying-fox. The breeding period, which occurs from October to January, includes the final weeks of gestation, and the weeks of birth, lactation and conception. The 'food bottle neck', which occurs during the May to August period, is a time where foraging resources are limited. Resource demands during these periods are important to the Grey-headed Flying-fox. As detailed in Section 4.5.3, none of the eucalypts at the airport site are highly productive of nectar, and as such, habitat in the airport site is only somewhat productive during these food bottlenecks. Habitat in the airport site is thus somewhat productive during food bottlenecks, and is not likely to qualify explicitly as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

The draft recovery plan also notes that it is not possible to predict what localities will be productive in which months, and therefore what localities will provide essential habitat for the species. All foraging habitat has the potential to be productive during general food shortages and to therefore provide a resource critical to survival. The proposed airport would require the removal of 141.8 hectares of foraging habitat for Stage 1 and an additional 64.4 hectares of foraging habitat for long term development, which is a substantial area of foraging habitat in a fragmented rural landscape. All of the native woodland and forest patches on the airport site are considered foraging habitat for this species and have been included in these calculations. These habitat areas contribute to foraging resources at critical times in the lifecycle of the species, and may provide critical resources during food shortages. In this sense, habitat at the airport site provides a resource critical to survival. When considered in the context of further loss from long term development at the airport site, and other facilitated and cumulative impacts in the locality, this clearing could contribute to the long-term decline of the Grey-headed Flying-fox important population. Given the size of foraging habitat at the airport site, and area of habitat that would be lost through cumulative and facilitated impacts, the proposed airport does have the potential to affect habitat critical to the long-term survival of the species.

As discussed in Section 6.1.1, while individuals may be at risk of mortality from aircraft strike during operation, this is unlikely to substantially impact the population as a whole. Operation of the proposed airport would increase general traffic in the area surrounding the airport site, and could result in increased risk of fauna mortality on surrounding roads. In the context of the current level of development and volume of traffic in the locality these additional impacts are unlikely to substantially impact any populations as a whole.

Changes to water quality or hydrology are unlikely to impact Grey-headed Flying-fox foraging or roosting habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c).

About 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. The construction of the proposed airport may interfere substantially with the recovery of the Grey-headed Flying-fox and is likely to have a significant impact on the species (see Appendix D). A significant impact would occur through:

- construction of the proposed airport, which would remove 141.8 hectares of potential habitat for Stage 1 which represents 0.70 per cent of the potential foraging habitat for the Grey-headed Flying-fox within the locality;
- reducing areas of habitat that contribute to the availability of foraging resources for local camps when resources are scarce and at critical lifecycle stages;
- further fragmentation of foraging habitat within an already highly fragmented landscape; and
- possible further clearing of foraging habitat for the species as a result of cumulative and facilitated development in the locality following construction of the proposed airport.

A detailed plan will be prepared for the proposed airport to compensate for these significant impacts (see Section 9.3). This would include the protection and management of Grey-headed Flying-fox habitat at offset sites in perpetuity.

Swift Parrot

There are scattered records of the Swift Parrot across the Cumberland Plain, but limited evidence of any concentration of records at any locations (OEH 2015a). In addition, there are very few records of the species in southwest Sydney. There are no records of the species in the area bounded by the M4 motorway, The Northern Road, the M7 and Camden Valley Way. Local records are from Mulgoa and Mulgoa Nature Reserve to the north-west, the Western Sydney Parklands at Cecil Hills to the east and Cobbitty to the south. These records are all located about 8-10 kilometres from the airport site. There are no previous records (last 30 years) from within the airport site or immediate surrounds. GHD obtained atlas records from both OEH and BirdLife Australia. A number of BirdLife atlas locations are situated within the airport site boundary. No records of the Swift Parrot were located at any of these sites. A broad-scale habitat map prepared for the Greater Southern Sydney Region (DECC 2007) identifies the largest area of habitat within the Burragorang Valley (approximately 30 kilometres to the southwest of the airport site), with smaller patches around Glenmore, west of Liverpool, and around Wedderburn. Based on these points, the airport site is unlikely to be a core winter foraging site for the species.

The Swift Parrot may occur at the airport site on occasion outside the breeding season when the eucalypts are in flower. The principal over-wintering habitats for the Swift Parrot on the mainland are the inland slopes of the Great Dividing Range and along the eastern coastal plains (DoE 2015b). Dominant canopy species in the airport site include Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*), which may provide nectar and lerp foraging resources during the species' winter migration. Much of the airport site is vegetated with relatively young regrowth, which is not the preferred foraging habitat of the species. A range of aggressive competitors such as the Noisy Miner (*Manorina melanocephala*) and the Bell Miner (*Manorina melanophrys*) are common at the airport site, potentially further reducing habitat suitability for the Swift Parrot. The airport site is unlikely to represent core winter foraging resources for the Swift Parrot due to the lack of evidence of the species in the airport site and immediate surrounds (both during recent surveys and from historical records), and the presence of mainly young regrowth and aggressive competitors such as the Noisy Minor. The airport site may provide shelter or supplementary foraging resources for migrating individuals.

Construction of Stage 1 of the proposed airport would remove 141.8 hectares of highly fragmented, relatively low quality potential foraging habitat. 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. A total of about 17,393 hectares of potential foraging habitat (woody native vegetation) is mapped in the locality, although not all of this vegetation is likely to be suitable for the species. There is a low risk of aircraft strike for this species given the low numbers that may forage in the area, and lack of good quality foraging habitat in surrounding areas. Operation of the proposed airport would increase general traffic in the area surrounding the proposed airport, and could result in increased risk of fauna mortality on surrounding roads. This is unlikely to substantially impact the Swift Parrot, given its low incidence in the area.

An assessment of significance for this species is provided in Appendix D. The proposed airport is unlikely to result in a significant impact on this species as:

- there is no evidence of Swift Parrots occurring in the airport site;
- only few records are known from the locality;
- native vegetation at the airport site is relatively young regrowth, which is not the preferred foraging habitat of the species;
- aggressive competitors such as the Noisy Miner are dominant species in the area; and
- there is a very low risk of individuals being subject to aircraft strike.

8.2.4 Migratory species

Migratory wetland species

Two migratory shorebird species were recorded in the airport site: one Latham's Snipe (*Gallinago hardwicki*) and a flock of an unidentified sandpiper species (see Section 4.3.2). The Stage 1 development would remove 28.6 hectares of artificial wetlands. While birds are likely to be struck by aircraft on occasion, recommended management measures (see Section 9.2) would minimise the risk of this occurring, and as such the viability of populations in the local area are not likely to be threatened. Given the low numbers of migratory wetland birds recorded at the airport site, the risk to these species is very low. Changes to water quality or hydrology are unlikely to impact migratory wetland bird habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c).

Impacts on migratory shorebird species are assessed according to the Draft significant impact guidelines for 36 migratory shorebird species (DEWHA 2009b), and focus on impacts on important habitat. As described in Section 4.5.4, the airport site is unlikely to be important habitat for these species, and as such, the proposed airport is unlikely to have a significant impact on any of these species. No assessments of significance have been prepared.

Other migratory species

Other migratory species recorded at the airport site included the Great Egret (*Ardea alba*); Cattle Egret (*Ardea ibis*); Rufous Fantail (*Rhipidura rufifrons*); Rainbow Bee-eater (*Merops ornatus*) and White-throated Needletail (*Hirundapus caudacutus*). The Stage 1 development would remove 28.6 hectares of artificial wetlands (habitat for the Great Egret and Cattle Egret), 141.8 hectares of woodland and forest vegetation (habitat for the Rufous Fantail and Rainbow Bee-eater), and 663.2 hectares of exotic grassland (habitat for the Cattle Egret). No habitat for the White-throated Needletail would be removed as this species forages in the air well above the ground. While birds are likely to be struck by aircraft on occasion, management measures (see Section 9.2) would minimise the risk of this occurring, and as such the viability of populations in the local area are not likely to be threatened.

As described in Section 4.5.4, the airport site is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DEWHA 2009b). This is due to the fact that the habitat in the airport site would not support an ecologically significant proportion of the population of these species, is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining. No assessments of significance have been prepared for these species. Based on the above considerations the airport is unlikely to impose a significant effect on these migratory fauna species.

8.2.5 Impacts on the Greater Blue Mountains World Heritage Area

The Referral determination

The project was referred to the Department of the Environment in 2014 (DIRD 2014) and was determined to be a controlled action. The Department of the Environment determined the proposal had the potential to have a significant impact on the Greater Blue Mountains World Heritage Area (GBMWHA).

Background

The statement of outstanding universal value for the GBMWHA identifies two criteria for which the property is listed on the World Heritage register:

- outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; and
- important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Other important values of the GBMWHA include its:

- geodiversity (including bisected sandstone plateaux, karst landscapes, basalt capped peaks and quaternary alluvial deposits);
- water catchments (including wild rivers, pristine and relatively undisturbed catchment areas and substantial contribution to maintaining high water quality);
- wilderness (including extensive natural areas, absence of significant human interference, opportunity to maintain integrity, gradients and mosaics of ecological processes, opportunities for solitude and self-reliant recreation, and aesthetic, spiritual and intrinsic value);
- indigenous heritage values;
- historic heritage values;
- recreation and tourism;
- research and education; and
- scenic and aesthetic.

The GBMWHA consists of 1.03 million hectares of sandstone plateaux, escarpments and gorges dominated by temperate eucalypt forest. It is noted for the diversity of eucalypts associated with its wide range of habitats as well as significant numbers of rare or threatened species, including endemic and evolutionary relict species (such as the Wollemi Pine). A significant proportion of the Australian continent's biodiversity occur in the area (UNESCO 2015). The GBMWHA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas (DECC 2009b).

Threats to the GBMWHA identified in the Strategic Plan for the GBMWHA (DECC 2009b) and the Plan of Management (NPWS 2001) include:

- invasion by pest species including weeds and feral animals;
- loss of biodiversity and geodiversity at all levels; and
- impacts of human-enhanced climate change.

Following on from these, the key management objectives relevant to this impact assessment identified by the Strategic Plan (DECC 2009b) include:

- to maintain, and wherever possible, improve the current and future integrity of the GBMWHA;
- to reduce the potential for major impacts to adversely affect the integrity of the GBMWHA;
- to conserve the GBMWHA's biodiversity and ensure the ecological viability and capacity for ongoing evolution of its World Heritage and other natural values is maintained;
- to maintain and improve the water quality and water catchment values of the GBMWHA; and
- to protect the landscape, natural beauty and aesthetic values of the GBMWHA.

This report focuses on impacts the proposed airport may have on biodiversity values of the GBMWHA.

Assessment of potential construction impacts

Construction of the proposed airport is unlikely to have any impact on the biodiversity values of the GBMWHA. Construction of the proposed airport could result in reduced water quality as a result of erosion, sedimentation and introduction of pollutants into waterways that drain to the Nepean River. Given the distance between the proposed airport and the area of the GBMWHA that is located adjacent to the Nepean River, and the design of the proposed airport, any impacts would likely have dissipated by the time the water reaches the GBMWHA. Mitigation measures are included to minimise the risk of sediments and pollutants entering local waterways (see Section 9.2).

Assessment of potential operation impacts

Operation of the proposed airport may have an impact on the biodiversity values of the GBMWHA resulting from changes to surface water quality, noise, the potential for fuel jettisoning, reduced air quality, greenhouse gas emissions, and the potential for aircraft crashes.

Noise

For most of the GBMWHA near the proposed airport, anthropogenic noise would currently be minimal. Most noise would currently be generated from existing roads and residential areas (eg the Great Western Highway and adjacent suburbs). Small amounts of localised noise are generated from smaller roads, such as trails leading to camping grounds (e.g Euroka Clearing), lookouts (e.g Nepean Lookout) and general fire trails. Some localised noise is also generated by boats operating along the Nepean River. Occasional light aircraft (e.g sight-seeing flights) and helicopters also operate above the GBMWHA, and commercial flights operate high above the area. As such, most resident fauna species in the GBMWHA would currently be subject to some low levels of anthropogenic noise, at least on occasion.

Aircraft operations over the GBMWHA following construction of the proposed airport would increase noise levels for resident fauna species that reside under the proposed flight paths. As described in Section 6.1.3, aircraft may approach the proposed airport from the south-west and take off to the south-west depending on meteorological conditions. Based on the preliminary airspace design for the proposed airport, aircraft passing over locations within the GBMWHA are generally expected to be at an altitude greater than 5,000 feet above sea level and most would be more than 10,000 feet above sea level. Indicative flight tracks at altitudes of less than 5,000 feet above sea level are limited to the eastern boundary of the Blue Mountains National Park, which is predicted to experience 50 to 100 flights per day in 2030. Maximum noise levels may occasionally reach 60 dBA at some points, but levels directly under a flight path would typically be below 55 dBA, and often much lower (Wilkinson Murray 2015b). In the locations where these occur, the character of the area could be altered, even though the noise levels associated with the overflights would be low and comparable with other noise heard in the area. The fact that the overflights are concentrated on specific flight paths means that other parts of the GBMWHA will be relatively unaffected (Wilkinson Murray 2015b).

Flights would occur both during the day and the night, impacting both diurnal and nocturnal fauna. In the early stages of operation, this would create a novel impact on fauna species, particularly in the areas of the GBMWHA under the main flight paths. Increased noise levels can substantially reduce the distance and area over which acoustic signals can be sensed by an animal receiver. Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences (refer to Section 6.1.3). Low-flying aircraft can cause flight response in some species, causing them to abandon nests, and other species are known to avoid higher elevation areas where noise levels are higher, potentially resulting in fragmentation of habitat (Ellis, Ellis, & Mindell, 1991; Landon et al 2003). Most of these impacts occur when noise levels are high (greater than 65 dB), and given the height at which flights are likely to be, these impacts are unlikely.

While background noise would increase under the flight paths, fauna are likely to become habituated to the elevated noise levels in the long term (Anderson et al 1996; Conomy et al 1998) as aircraft would not be flying at low altitudes over the GBMWHA. Operation of aircraft is highly unlikely to permanently alter foraging or breeding behaviour of any fauna species. Any impacts would be localised, with impacts occurring under the main flight paths. The majority of fauna within the vast GBMWHA would not be impacted by aircraft noise. Noise would not result in a loss of biodiversity and would not interfere with the ecological viability and capacity for ongoing evolution of species within the GBMWHA.

Surface water and hydrology

A portion of the GBMWHA fronts the Nepean River downstream of its confluence with Duncans Creek. Changes to water quality and hydrology have a very low potential to impact water quality in this portion of the GBMWHA given the airport design and recommended mitigation.

Construction of the proposed airport has the potential to release sediments and pollutants into local waterways. With the appropriate management plans in place, construction is not expected to have any significant impact on existing water quality concentrations in the receiving waters downstream of the site. Any exceedances would likely be localised and short term (GHD 2016c). As such the Stage 1 development is not likely to affect water quality of downstream aquatic habitats including key fish habitat.

Bio-retention basins would be installed to treat surface runoff before it leaves site. The bio-retention basins would not be able to satisfy WSUD targets and the ANZECC water quality objectives, however with the implementation of additional mitigation measures, it is expected that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c).

A portion of the airport site draining to Badgerys Creek would be diverted to Duncans Creek. Changes to water quantity and flooding as a result of construction have the potential to affect the physical condition of this water course. Potential impacts would be mitigated through further refinement of the surface water drainage system (GHD 2016b).

Impacts on aquatic habitat and key fish habitat may thus occur as a result of changed hydrology. Given the generally poor quality of aquatic habitats in and downstream of the airport site, the proposed airport is unlikely to have a substantial impact on fish habitat in downstream areas. These impacts are likely to be generally restricted to reaches close to the airport site. Further downstream, inflow from other creeks will dissipate these changes, and any such impacts would be dissipated through distance by the time the water reaches the GBMWHA.

The GBMWHA is located about 8 kilometres downstream of the airport site. Given the above considerations, and the distance of the GBMWHA from the airport site, the construction and operation of the proposed airport would have no adverse impact on downstream key fish habitat and other aquatic habitat located within the GBMWHA.

Fuel jettisoning

The operation of the proposed airport would result in a low risk of fuel jettisoning from aircraft. As described in Section 6.1.9, fuel jettisoning is extremely rare and fuel jettisoning is required to occur at an altitude that ensures all fuel is vaporised before reaching the ground. The effects of fuel jettisoning on local air quality would be limited due to the inability of many aircraft to perform jettison fuel, the rapid vaporisation and dispersion of jettisoned fuel and the strict regulations on fuel jettisoning altitudes and locations. Based on this information, fuel jettisoning over the GBMWHA would be extremely rare. Fuel jettisoning is therefore very unlikely to interfere with any ecosystem processes, result in the substantial degradation of habitat, or reduce the viability of any flora or fauna species.

Air quality

Aircraft traffic in particular would increase emissions of NO_2, PM_{10}, $PM_{2.5}$, CO, SO_2, and air toxics, could potentially reduce the air quality of the GBMWHA. The highest off-site concentrations of the air quality metrics evaluated were generally predicted to occur to the north and north-east of the proposed airport due to the prevalence of south-westerly winds (GHD 2016d). As such, these emissions are generally unlikely to affect air quality over the GBMWHA, as it is located to the west of the airport site. Any changes to air quality would be temporary and localised. Occasional changes to air quality as a result of wind changes are not likely to impact biodiversity values in the GBMWHA.

Greenhouse gas emissions

Human activities including energy use, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste cause greenhouse gas emissions leading to climate change. The distribution of many species, populations and communities is determined by climate. Australia's biodiversity is at risk from even moderate climate change and already under stress, for example from habitat degradation, changed fire regimes and invasive species. Climate change is likely to exacerbate these existing stressors and add additional stresses (Steffen et al 2009). In particular, climate change may result in changes to regional temperatures, rainfall, fire frequency and intensity. These changes in turn can result in changes to the distribution of species and communities, shifts in genetic composition and altered life cycles, among other impacts (Steffen et al 2009).

The construction and operation of the proposed airport will increase the emission of greenhouse gasses. The two main sources of greenhouse gas emissions during construction would be from the operation of construction equipment and from vegetation clearing. The main source of greenhouse gas emissions during operation would be from jet fuel from departing planes (GHD 2016c). The proposed airport is located in western Sydney, a region undergoing substantial urban development. All development in the region would contribute to the increase in greenhouse gas emissions, further increasing the risks associated with climate change. Climate change in general is likely to impact biodiversity values within the GBMWHA, potentially changing the species composition and distribution in the long-term. The emissions from the construction and operation of the proposed airport itself, however, are not likely to have a significant impact on the GBMWHA, as it is only a minor part of a much larger and more wide-spread issue.

Aircraft crashes

Although very unlikely, operation of the proposed airport could result in an aircraft crashing within the GBMWHA. An aircraft crash could result in felling of trees, mortality of plants and animals, potential bush fire, introduction of pollutants (fuel) and debris within the GBMWHA. The likelihood of aircraft crashes is low, however over the lifespan of the proposed airport are a possibility. An aircraft crash would mainly cause localised damage to a relatively small area of the GBMWHA. A resulting bush fire, however, could potentially impact a much larger area. Similarly, if pollutants enter waterways, a much larger area could be impacted as the pollutants are transported downstream to other areas. Despite these potential impacts, aircraft crashes are unlikely to be of a scale that would cause a substantial change in biodiversity values in the GBMWHA. The GBMWHA is regularly subject to wide-spread wildfires that result in the death of many plants and animals. There is an extremely low risk that an aircraft crash could impact a site for a rare and locally endemic species, such as the Wollemi Pine. The diversity of eucalypts and other flora and fauna, for which the GBMWHA was listed, is unlikely to be reduced.

Significance of impacts on the GBMWHA

An assessment of the likely significance of potential impacts on the GBMWHA focussing on biodiversity values has been prepared with respect to the significant impact guidelines 1.1 (DoE 2013a) and is included in Section Appendix D. Chapter 26 of the EIS provides more detail on impacts on other values, for example cultural heritage. The project is unlikely to have a significant impact on the biodiversity values of the GBMWHA given:

- There would be no direct impact on the GBMWHA.
- The construction and operation of the proposed airport is unlikely to result in the loss of biological diversity or biological processes within the GBMWHA.
- Potential impacts on fauna within the GBMWHA as a result of noise are unlikely to result in changes to species breeding or habitat use.
- Potential impacts on the GBMWHA as a result of changes to air quality are likely to be negligible given the distance to the GBMWHA and prevailing wind conditions.
- The proposed airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site.
- While greenhouse gas emissions will increase as a result of the construction and operation of the proposed airport, this is unlikely to directly result in the loss of biological diversity or biological processes within the GBMWHA.

8.3 Impacts on plants, animals and their habitat

The significant impact guidelines for actions on or impacting upon Commonwealth land and actions by Commonwealth agencies, are set out in the Significant impact guidelines 1.2 (DoE 2013b). The Significant impact guidelines 1.2 identify the elements of the environment that require specific consideration and criteria to help determine whether or not an action is likely to result in a significant impact. The elements of the environment that are relevant to this biodiversity assessment are plants, animals and their habitat. The likely significance of impacts of the proposed airport on these elements are assessed in Table 66 and Table 67. The Significant impact guidelines 1.2 require particular consideration of those elements of the environment which are sensitive or valuable, including vegetation containing a listed threatened plant species and habitat for listed threatened fauna species. The significance of impacts on NSW-listed biota, as particularly sensitive elements of the environment, is assessed in Section 8.3.3. The significance of impacts on EPBC Act-listed biota are assessed separately in Section 8.2.1 to 8.2.4 above. Impacts on other elements of the environment are discussed in the EIS.

8.3.1 Plants

Table 66 Likely significance of impacts on plants

Significance criteria	Assessment of impacts
Is there a real chance or possibility that the action will:	
• involve medium or large-scale native vegetation clearance	Construction of the Stage 1 development would result in direct impacts within a 1153.8 hectare disturbance footprint, including 318.5 hectares of native vegetation as shown on Figure 4. The extent of clearing of vegetation and habitats within the Stage 1 construction impact zone is summarised in Table 58. The majority of the Stage 1 construction impact zone is cleared land, cropland or exotic grassland (around 74%). Native vegetation removal at the airport site comprises land clearance as defined under the EPBC Act. The 318.5 hectares of native vegetation clearance would comprise ‘large-scale native vegetation clearance’.
• involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species	The Stage 1 construction impact zone includes at least four individuals comprising a local population of *Pultenaea parviflora*. Construction of the proposed airport would remove this local population as well as occupied and potential habitat. The population of *P. parviflora* at the site is not an ‘important population’ as defined in the significant impact criteria for vulnerable species (DoE 2013a). Therefore the proposed airport would not result in any direct impacts on an important population of *P. parviflora* and is not likely to threaten the recovery of the species or the viability of the western Sydney regional population. The Stage 1 construction impact zone contains at least 142 stems of *Marsdenia viridiflora* subsp. *viridiflora* (see Table 66). These plants comprise part of the *M. viridiflora viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas which is listed as an endangered population under the TSC Act. The proposed airport would result in a significant impact on the local population of *M. viridiflora viridiflora* and given the quantum of impacts may threaten the viability of the endangered population. The species occupies a broad range in northern NSW and southern Queensland (OEH 2015b) and so the proposed airport would not threaten the viability of the species as a whole. Impacts may be partially mitigated by implementation of a translocation programme and the retention of some potential habitat in the environmental

Significance criteria	Assessment of impacts
	conservation zone (see Section 8). Translocation may not provide assurance of survival and so the impact assessment and offset calculations assume the removal of all individuals in the construction impact zone. It should be possible to retain the genetic material of at least some of this local population of *M. viridiflora viridiflora* and potentially also to create a viable local population of translocated plants within or in the vicinity of the airport site. No other threatened flora species or populations have been recorded at the airport site.
• introduce potentially invasive species	Construction of the proposed airport would involve a substantial area of vegetation removal and would create some new edges on vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles. Recommendations have been made in Section 8 to minimise the potential spread of weeds from the airport site. Measures to manage weeds and to reduce the risk of spreading weeds off site in soil or water would be implemented during construction. The proposed airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site. The proposed environmental conservation zone would provide a buffer between the proposed airport and adjoining areas of native vegetation along its eastern, southern and western boundaries including the riparian corridors of Badgerys Creek and Duncans Creek. The extent of native vegetation cover would be increased in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site. The proposed airport would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations (see Section 5.1.7). Operation of the proposed airport poses a biosecurity risk. There is the potential for the introduction of new species as a result of the transport of goods on aircraft. For example, the one record of Yellow Crazy Ants from New Zealand is likely to have been a transit passenger (on taro in air baggage) (Biosecurity New Zealand, undated). Invasion of Yellow Crazy Ants is listed as a key threatening process under the TSC Act (see Section 8.1). Any escaped novel species could potentially establish in nearby vegetated areas, or be transported to other areas of native vegetation with cargo, and impact the local native flora and fauna. As with all international airports, Australian Government border control and biosecurity risk management measures will be applicable at the proposed airport.
• involve the use of chemicals which substantially stunt the growth of native vegetation, or	Construction vehicles and equipment would cause a minor localized increase in the risk of hydrocarbon contamination or other pollutants. Measures to manage harmful substances and to avoid impacts on vegetation, soil or water and specifically to prevent discharge of harmful substances off site would be implemented during the construction and operation of the

Significance criteria	Assessment of impacts
	proposed airport. Any accidental mobilisation of harmful substances during construction would not be 'regular' (if at all) and are unlikely substantially to stunt the growth of native vegetation. The operation of the proposed airport and associated transport and commercial activities would involve bulk fuel storage and is likely to include transport of harmful substances. Open space within the Stage 1 airport would be actively managed, which may include use of fertilisers and herbicides. Any such use, storage or transport of potential pollutants would be conducted under appropriate controls and with reference to relevant environmental legislation including the Airports (Environment Protection) Regulations 1997. Any inappropriate or illegal activities or accidental mobilisation of contaminants would not be 'regular' (if at all) and are unlikely to substantially stunt the growth of native vegetation. The proposed environmental conservation zone would provide a buffer between the proposed airport and adjoining areas of native vegetation along its eastern, southern and western boundaries including the riparian corridors of Badgerys Creek and Duncans Creek. The environmental conservation zone increases the distance between potential sources of contamination such as runways, storage areas and parking areas and these sensitive receptors. The proposed airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site which would further reduce the risk of transfer of contaminants off site. These measures would help to mitigate the risk of any impacts on native vegetation outside of the airport site. Mitigation measures are recommended in Section 9.2 to minimise the risk of impact from chemicals.
• involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species?	The proposed airport would not result in large-scale controlled burning or any controlled burning in areas containing listed threatened plant species. Burns may occur in areas of listed threatened ecological communities; however as described below fire is a natural part of the ecology of these communities and is unlikely to have significant adverse effects. It is expected that the airport would implement specific measures to manage the risk of fire at the airport which would also reduce the risk of off-site impacts. This may include controlled burning to manage fuel loads. Any controlled burning would be purposefully undertaken with reference to a bushfire management plan and would be undertaken in cells to limit the extent or frequency of burns. There is no rainforest or other particularly sensitive areas at the site. The majority of native vegetation at the site is grassy woodland or open forest. Fire is accepted as a positive component of the ecology of these vegetation communities (DEC 2005; DEWHA 2010c). The bushfire management plan would consider the presence of threatened plant species (which may include translocated threatened plants in the environmental conservation zone) in planning the layout of cells and/or the timing of controlled burns.

8.3.2 Animals

Table 67 Likely significance of impacts on animals

Significance criteria	Assessment of impacts
Is there a real chance or possibility that the action will:	
• cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals	As described in Section 5.1, the proposed airport has the potential to cause the long-term decrease or extinction of populations of small, less mobile animals such as frogs, reptiles and the threatened Cumberland Plain Land Snail. The removal of a large area of foraging habitat is likely to have a significant impact on the Grey-headed Flying-fox (see Section 8.2.3). The loss of foraging habitat and many hollow-bearing trees may also have a significant impact on threatened microchiropteran bats (see Section 8.3.3). Other common fauna such as birds, bats and larger mammals would be more able to move to adjacent areas, or would be part of a larger local population. Some less mobile individuals of these populations (e.g. nestlings, animals denning or roosting in tree hollows) may be subject to death or injury during clearing operations. The loss of these individuals is not likely to threaten the viability of the population.
• displace or substantially limit the movement or dispersal of native animal populations	As described in Section 5.1, the proposed airport would cause displacement of fauna and/or mortality of less mobile fauna that are within the proposed airport area at the time of construction activities. Some fauna may be able to seek refuge and persist in alternative habitat outside the airport site. Construction of Stage 1 would create a gap in habitat that is around 1150 hectares in area and about 2 kilometres wide from north to south and almost 4 kilometres long from east to west. This area would be mostly inhospitable to fauna and would be a barrier to ecological processes such as dispersal. Mobile, aerial fauna species that comprise part of the ecological community may continue to occur in areas of open space at the airport site and move around or through it. Native species are likely to suffer increased risk or energy costs as a result of moving around an obstacle of this size. The proposed runway, terminals, carpark and other built features would comprise a significant barrier to the majority of fauna species particularly in combination with security fences. Light, noise, aircraft and vehicle movement may further deter fauna species from crossing these gaps in habitat. Many generalist species of open country that currently occur at the airport site would not be able to move over or through the proposed airport. Overall, despite the current patchy and fragmented distribution of vegetation at the airport site and in the locality, construction of Stage 1 would comprise a significant decrease in the degree of available habitat for native species.
• substantially reduce or fragment available habitat for native species	The proposed airport would be located in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More

Significance criteria	Assessment of impacts
	mobile species, such as birds and bats, can more readily traverse this landscape. Construction would require the permanent removal of a maximum of 141.8 hectares of woodland and forest habitat, 811.2 hectares of native and exotic grassland, and 28.6 hectares of artificial wetlands. The proposed airport would cause displacement or mortality of less mobile fauna that are within the area to be cleared for the proposed airport at the time of construction activities. Given the size of the airport site, entire populations of some small animals (e.g skinks, snails) could be destroyed. The viability of most species would not be threatened, as similar habitat is found in surrounding areas. More mobile fauna, such as birds and bats would be displaced rather than killed. Some mortality of less mobile individuals, such as nestlings, old or sick animals may occur. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows). This may result in impacts beyond the disturbance area by favouring aggressive or generalist species. The viability of these species would not be threatened, as similar habitat is found in surrounding areas, and most species that occur at the airport site have large distributions that cover a range of habitats.
• reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species	Patches of native vegetation in the airport site are already highly fragmented. Construction of Stage 1 of the proposed airport would contribute to fragmentation at a local and regional scale by removing patches of habitat, severing vegetated corridors and by creating an extensive, permanent footprint that would comprise a significant barrier to movement of some species. Construction of the proposed airport would increase existing fragmentation of foraging habitat for the Grey-headed Flying-fox in a mainly agricultural landscape by impacting on patches of native vegetation but would not create a barrier to the species' existing ability to move through the area. While the proposed airport represents a risk of aircraft strike of individuals, it would not be an impermeable barrier to their movement. Highly mobile species such as the Grey-headed Flying-fox are expected to be less impacted by fragmentation and this species is well-adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. This species' typically exhibits very large home ranges and Grey-headed Flying-foxes are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby 1996). The Cumberland Plain Land Snail was generally recorded during recent surveys in larger patches of woodland and forest. Given the sedentary nature of the species and limited ability to colonise new areas, fragmentation would further limit the ability of this species to move through the landscape. The removal of good quality occupied patches of vegetation would remove entire local populations/subpopulations, further reduce the species' ability to disperse between patches, and would reduce genetic diversity of the species in the locality of the airport site. The loss of habitat at the airport site would have a significant impact on this species.

Significance criteria	Assessment of impacts
	All other threatened species recorded or likely to occur at the airport site are highly mobile species, or are species that mainly use the Badgerys Creek corridor to move through the area. As such, fragmentation as a result of construction of the proposed airport is unlikely to result in a long-term decline in these populations, or threaten the viability of the species (see Section 8.3.3)
• introduce exotic species which will substantially reduce habitat or resources for native species, or	Construction of the proposed airport is unlikely to introduce new exotic species to the airport site or surrounding habitats. The proposed airport has the potential to introduce exotic species imported accidentally via airlines (see 6.1.11). Species such as the Yellow Crazy Ant could substantially reduce habitat or resources for native species if introduced. There would be management controls in place throughout the construction and operation of the proposed airport to mitigate the risk of introduction of exotic species (see Section 9).
• undertake large-scale controlled burning or any controlled burning in areas containing listed threatened species?	The proposed airport would not result in large-scale controlled burning. The final Airport Plan for Stage 1 and then for long term development at the airport site would include specific measures to manage the risk of uncontrolled wildfire at the proposed airport and to reduce the risk of off-site impacts. This may include controlled burning to manage fuel loads. Any controlled burning would be purposefully undertaken with reference to a bushfire management plan and would be undertaken in cells to limit the extent or frequency of burns. The bushfire management plan would consider the presence of threatened fauna or their habitats in planning the layout of cells and/or the timing of controlled burns.

8.3.3 NSW-listed biota

Threatened ecological communities

All of the native woodland and forest vegetation at the airport site, including derived native grasslands, comprise local occurrences of TECs listed under the TSC Act (see Figure 6). Impacts on these TECs are summarised in Table 68 and discussed further below.

Table 68 Extent of impacts of Stage 1 on TECs listed under the TSC Act

TEC Name	TSC Act Status	Risk of impact	Extent of good condition vegetation (hectares)	Extent of poor condition vegetation (hectares)	Total (hectares)	Significance of impacts
Cumberland Plain Woodland	CEEC	Known. Construction would reduce the extent of a local occurrence.	102.7	140.1	242.8	Likely
River-flat Eucalypt Forest	EEC	Known. Construction would reduce the extent of a local occurrence.	34.2	7.9	42.1	Likely
Shale-Gravel Transition Forest	EEC	Known. Construction would reduce the extent of a local occurrence.	4.4	0.6	5.0	Likely

Construction of Stage 1 would result in substantial impacts on a local occurrence of Cumberland Plain Woodland. The larger and better condition patches of this vegetation at the airport site comprise the Cumberland Plain Woodland CEEC as defined under the EPBC Act and associated policy. Impacts on the EPBC Act-listed form of Cumberland Plain Woodland are assessed in detail in Section 8.2.1. The outcome of this assessment is that Stage 1 of the proposed airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland through a substantial reduction in the extent of the community and increase in the degree of fragmentation which would in turn result in a substantial negative effect on the potential for recovery of the community. Impacts on the broader TSC Act form of Cumberland Plain Woodland at the airport site include the removal of a further 140.1 hectares of woodland in patches <0.5 hectares in area and derived grassland or scrub with <10% canopy cover that do not meet the condition criteria for the EPBC Act Cumberland Plain Woodland CEEC (TSSC 2008). Construction of Stage 1 of the proposed airport would remove the majority of the local occurrence of Cumberland Plain Woodland and would result in a significant impact on the community as listed under the TSC Act.

Construction of Stage 1 would remove 34.2 hectares of good condition vegetation in riparian corridors and a further 7.9 hectares of derived grassland or scrub on flats within a local occurrence of River-flat Eucalypt Forest EEC. This is around 30% of the extent of the community at the airport site, though the local occurrence extends off site to the north and west in the riparian corridors of Badgerys, Duncans and Oaky creeks. Impacts would be partially mitigated by the retention of the environmental conservation zone. The conservation zone is around 117.1 hectares in area, including around 44.7 hectares of River-flat Eucalypt Forest. Up to 60.3 hectares would be revegetated. Operational impacts of the proposed airport such as increased noise, light spill and vehicle traffic may reduce the quality of habitat at the airport site and surrounding areas. These operational impacts may alter the species composition of the community if some more susceptible species cease using this habitat.

Construction of Stage 1 would create a gap in habitat that is around 1150 hectares in area and about 1.5 kilometres wide from north to south and almost 7 kilometres long from east to west. The area affected currently contains patchy and fragmented habitat however this would still comprise a substantial reduction in the overall extent of habitat and a substantial increase in the distance between patches. This area would be mostly inhospitable to fauna and would be a barrier to ecological processes such as dispersal, pollination and seed fall. Connectivity of habitat would be partially retained in the proposed environmental conservation zone, including a continuous riparian corridor along Badgerys Creek and links to the riparian corridor of Duncans Creek. The upper reaches of Oaky Creek would be completely removed and continuity with related communities at higher elevations would be severely reduced. This will reduce the ability of component species in the community to move across the landscape and interrupt ecological processes such as pollination, seed fall and dispersal. Overall, despite the retention of some vegetated corridors and the current patchy and fragmented distribution of vegetation in the locality, construction of Stage 1 would comprise a significant reduction in extent and increase the degree of fragmentation of River-flat Eucalypt Forest. Construction of Stage 1 of the proposed airport would therefore be likely to result in a significant impact on the local occurrence of River-flat Eucalypt Forest.

The local occurrence of Shale-Gravel Transition Forest is restricted to a single patch of 10.6 hectares of woodland and derived scrub in the north-east of the airport site. Construction of the proposed airport would reduce the extent of this local occurrence by 5.0 hectares and significantly reduce connectivity with related Cumberland Plain Woodland communities to the west. The majority of the local occurrence would be maintained in the environmental conservation zone and a small area would be revegetated. Continuity would be maintained with around 100 hectares of vegetation in the riparian corridor of Badgerys Creek. As described for River-flat Eucalypt Forest above, operational impacts of the proposed airport may affect the species composition of the community if some more susceptible species cease using this habitat. Overall, given a reduction in extent of around 25% and imposition of operational impacts on a very small, localised occurrence, Stage 1 of the proposed airport is likely to result in a significant impact on Shale-Gravel Transition Forest. This quantum of impacts is also likely to be significant when considered as part of the overarching ecological community ‘Cumberland Plain Woodland and Shale-Gravel Transition Forest’ as defined under the EPBC Act (see Section 8.2.1).

Long term development at the airport site would further reduce the extent of the Cumberland Plain Woodland and River-flat Eucalypt Forest, fragment habitat and interfere with the recovery of these TECs. Long term development at the airport site would further increase the significance of impacts of Stage 1 and would comprise a significant impact on these TECS in its own right.

Based on the revised draft Airport Plan, long term development at the airport site would not result in any direct impacts on Shale-Gravel Transition Forest and would result in relatively minor cumulative indirect impacts on the community in the context of the significant impacts arising from Stage 1. Any future changes to the Airport Plan (within its 5 year period) and long term development that would result in direct impacts on Shale-Gravel Transition Forest would need to be assessed as part of consideration of a major development plan under the Airports Act.

Offsets for threatened ecological communities listed under the TSC Act have been calculated using the BioBanking methodology for a major project as part of the assessment of offsets for impacts on the environment (see Section 9.3).

Threatened flora species and populations

The majority of the flora species listed as a threatened under the TSC Act that may occur at the airport site are also listed as threatened species under the EPBC Act. Impacts on these species have been assessed in accordance with the EPBC Act and associated policies (see Section 8.2.2). These species are not considered further in this section.

No other threatened flora species listed under the TSC Act have been recorded at the airport site. There is potential habitat at the airport site for two additional threatened plant species listed under the TSC Act: *Dillwynia tenuifolia* and *Grevillea juniperina* subsp*. juniperina*. The *Dillwynia tenuifolia* population at Kemps Creek is also listed as an endangered population however the plants at the airport site do not comprise part of this population. The quantum of potential impacts on these threatened species is summarised in Table 69.

Table 69 Extent of impacts of Stage 1 on threatened flora species and endangered populations listed under the TSC Act

Species	TSC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Marsdenia viridiflora subsp. *viridiflora*	Endangered population	Present. 142 individuals were recorded at the airport site.	Certain. All individuals recorded and a large area of potential habitat in shale woodlands would be removed.	At least 142 individuals and up to 107.1 hectares of better quality potential habitat and a further 148.6 hectares of poor quality potential habitat.[1]	Likely
Grevillea juniperina subsp. *juniperina*	Vulnerable	Possible. The species has been recorded in the locality and there is potential habitat at the airport site.	Moderate. Construction would remove a large area of potential habitat in shale woodlands and derived grassland and scrub.	Up to 107.1 hectares of better quality potential habitat and a further 148.6 hectares of poor quality potential habitat.[1]	Unlikely
Dillwynia tenuifolia	Vulnerable	Possible. The species has been recorded in the locality and there is potential habitat at the airport site.	Moderate. Construction would remove a small area of potential habitat in Shale-Gravel Transition Forest and derived scrub.	Up to 4.4 hectares of better quality potential habitat and a further 0.6 hectares of poor quality potential habitat.[2]	Unlikely

Notes: 1) Comprising the areas of Good and poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529), Forest Red Gum - Rough-barked Apple grassy woodland (HN526) and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

2) Comprising the areas of Good and poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 58.

There is no evidence of a viable local population of *Grevillea juniperina* subsp*. juniperina* or *Dillwynia tenuifolia* at the airport site or in adjoining vegetation despite many weeks of targeted survey effort in multiple seasons (Biosis 1999; SMEC 2014; OEH 2015a). There is a chance that these species may be present at the airport site in low numbers such as in areas of habitat that were not directly observed or in the soil seed bank. There is also a chance that these species could colonise this habitat at some point in the future. As such there is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site.

Construction of Stage 1 of the proposed airport would remove up to 289.8 hectares of potential habitat for *Grevillea juniperina juniperina*. There is no evidence that this habitat is of particular value or significance to the species and there are around 10,014 hectares of similar shale woodland habitat (NPWS 2006; Tozer 2010) and relatively abundant populations in the locality (OEH 2015a). Construction of Stage 1 of the proposed airport would remove up to 5.0 hectares of potential habitat for *Dillwynia tenuifolia* which is likely to have minor value compared to the relatively extensive areas of shale/gravel transition and alluvial habitat supporting thousands of individuals at Kemps Creek, around three kilometres to the east (OEH 2015b). The proposed airport is therefore not likely to result in a significant impact on a local population of these threatened plant species (if present).

One endangered population *M. viridiflora viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local a government area which is listed as an endangered population under the TSC Act was recorded at the airport site. At least 142 stems of *Marsdenia viridiflora* subsp. *viridiflora* were recorded at the airport site (see Figure 6).).

Construction of Stage 1 of the proposed airport would completely remove the known local population of *M. viridiflora viridiflora* and its occupied and potential habitat. No stems of *M. viridiflora viridiflora* were recorded in the environmental conservation zone or in the long term development area. The closest known records of the species are each around five kilometres away near Bringelly and Mulgoa (OEH 2015a). The proposed airport would result in a significant impact on the local population of *M. viridiflora viridiflora*. The quantum of potential impacts on this endangered population is summarised in Table 69.

Impacts may be partially mitigated through the implementation of a translocation programme and the retention of some potential habitat in the environmental conservation zone (see Section 9.2). It should be possible to retain the genetic material of this local population of *M. viridiflora viridiflora* and potentially also to create a viable local population of translocated plants within or in the vicinity of the airport site. *M. viridiflora viridiflora* features an underground tuber up to 20 cm in diameter (RBGT 2015). Plants with large underground tubers use them as a store of resources to produce above ground tissue in response to events such as bushfire, dry periods or herbivory. This means that plants with large underground tubers can generally be successfully transplanted and so the proposed translocation programme should be able to salvage many of the *M. viridiflora viridiflora* individuals at the airport site. Translocation may not provide assurance of survival and so a conservative approach has been adopted and the impact assessment and offset calculations assume the removal of all individuals in the construction impact zone.

Changes to water quality or hydrology are unlikely to impact threatened flora habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c).

Offsets for threatened flora listed under the TSC Act have been calculated using the BioBanking methodology for a major project as part of the assessment of offsets for impacts on the environment (see Section 9.3).

Threatened fauna species

The two threatened fauna species discussed in Section 8.2.3, the Grey-headed Flying-fox and the Swift Parrot, are also listed under the TSC Act. Potential impacts on these species are not discussed further in this Section.

Threatened fauna listed under the TSC Act that were recorded at the airport site included the Cumberland Plain Land Snail, various small woodland bird species, the Black Bittern, the Little Eagle and various microchiropteran bat species. A number of additional bird species are also likely to occur and be impacted by the proposed airport. Impacts on these NSW-listed threatened fauna species are summarised in Table 70 and discussed further below.

Table 70 Extent of impacts of Stage 1 on threatened fauna species listed under the TSC Act

Common Name	TSC Act Status	Likelihood of occurrence	Risk of impact	Habitat to be removed (hectares)	Significance of impacts
Grey-headed Flying-fox	Vulnerable	Present. Would forage throughout the airport site. No roost camps present at the airport site.	Definite. Construction would remove known habitat.	141.8[1]	Likely
Swift Parrot	Critically endangered	Likely. May forage on occasion in the airport site during winter migration.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Barking Owl	Vulnerable	Possible. May forage in the airport site. Limited, generally only marginally suitable breeding habitat present. Few local records.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Black Bittern		Present. Observed at the northern end of Badgerys Creek.	Definite. Construction would remove potential habitat. Habitat in the Badgerys Creek riparian corridor would be retained in the environmental conservation zone.	62.7[2]	Unlikely
Black-chinned Honeyeater (eastern subspecies)	Vulnerable	Possible. May occur on occasion in larger patches in the airport site.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Blue-billed Duck	Vulnerable	Present. Vagrants may occur at larger dams on occasion. Species breeds in inland swamps of NSW.	Definite. Proposal would remove known and potential habitat.	28.6	Unlikely
Diamond Firetail	Vulnerable	Likely. Suitable woodland and grassland habitat present.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely

Common Name	TSC Act Status	Likelihood of occurrence	Risk of impact	Habitat to be removed (hectares)	Significance of impacts
Gang-gang Cockatoo	Vulnerable	Possible. May occur during winter months. Unlikely to breed in the airport site.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Little Eagle	Vulnerable	Present. Individuals observed, mainly on the western side of the airport site.	Definite. Proposal would remove known habitat.	981.6[4]	Unlikely
Little Lorikeet	Vulnerable	Present. Some suitable potential habitat present.	Definite. Proposal would remove known habitat.	141.8[1]	Unlikely
Masked Owl	Vulnerable	Likely. May forage in the airport site. Limited, generally only marginally suitable breeding habitat present.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Powerful Owl	Vulnerable	Likely. May forage in the airport site. Limited, generally only marginally suitable breeding habitat present.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Scarlet Robin	Vulnerable	Present. Recorded in the riparian corridor along Badgerys Creek.	Definite. Construction would remove known habitat.	141.8[1]	Unlikely
Speckled Warbler	Vulnerable	Possible. Some suitable potential habitat present, however may not be of appropriate patch size. No individuals recorded during surveys.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Varied Sittella	Vulnerable	Present. Recorded in the riparian corridor along Badgerys Creek.	Definite. Construction would remove known habitat adjoining the Badgerys Creek riparian corridor.	141.8[1]	Unlikely
Eastern Bentwing-bat	Vulnerable	Possibly recorded (Anabat). May forage throughout the airport site. Could roost under bridges and in buildings.	High. Construction would remove habitat in which this species has possibly been recorded.	1010.2[3]	Unlikely
Eastern Cave Bat	Vulnerable	Possibly recorded (Anabat). May forage throughout the airport site.	Moderate. Construction would remove potential habitat.	141.8[1]	Unlikely
Eastern False Pipistrelle	Vulnerable	Previously recorded. Would forage in woodland habitat. May roost in hollow-bearing trees and bridges, culverts etc at the airport site.	High. Construction would remove habitat in which this species has previously been recorded.	141.8[1]	Likely

Common Name	TSC Act Status	Likelihood of occurrence	Risk of impact	Habitat to be removed (hectares)	Significance of impacts
Eastern Freetail-bat	Vulnerable	Present. Most common bat species recorded. May roost in hollow-bearing trees and bridges, culverts etc at the airport site.	Definite. Construction would remove known habitat.	141.8[1]	Likely
Greater Broad-nosed Bat	Vulnerable	Likely. Would forage throughout the airport site. May roost in hollow-bearing trees and bridges, culverts etc at the airport site.	High. Construction would remove habitat in which this species has possibly been recorded.	1010.2[3]	Likely
Large-footed Myotis	Vulnerable	Probably recorded. Likely to forage along creeks and above dams. May roost under bridges and in tree hollows at the airport site.	Definite. Construction would remove known habitat.	62.7[2]	Possible
Yellow-bellied Sheathtail-bat	Vulnerable	Possible. Suitable foraging and roosting habitat present. Few local records.	Moderate. Construction would remove potential habitat.	1010.2[3]	Likely
Cumberland Plain Land Snail	Endangered	Present. Occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	Definite. Construction would remove known habitat.	141.8[1]	Likely

Notes: 1) based on all areas of good quality native vegetation as detailed in Table 58.
2) based on the area of artificial wetlands and good quality riparian vegetation as detailed in Table 58.
3) based on all areas of native vegetation, grassland and artificial wetlands as detailed in Table 58.
4) based on all areas of native vegetation and grassland as detailed in Table 58.

The Cumberland Plain Land Snail was generally recorded during recent surveys in larger patches of woodland and forest that were subject to less grazing pressure, however in some locations grazing was occurring. Previous surveys for the earlier 1997-1999 EIS also generally recorded the species in the larger woodland and forest patches, and also within linear vegetation along Longleys Road. Vegetation types included Cumberland Plain Woodland, Shale-gravel Transition Forest and River-flat Eucalypt Forest, and included good quality and poor quality vegetation as identified by vegetation surveys. Based on a conservative estimate and assuming all woodland and forest vegetation is potential habitat for the species, the proposed airport would remove a total of 141.8 hectares of occupied and potential habitat. Given the sedentary nature of the species and limited ability to colonise new areas, only part of this habitat is likely to be occupied by the species. Some occupied and potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site, although much of the riparian vegetation is not suitable habitat for this species, which is more likely to occur in Cumberland Plain Woodland or at the intergrade of River-flat Eucalypt Forest and Cumberland Plain Woodland.

Few woodland patches that would be impacted by the airport development extend across the boundary of the airport site, with only some vegetation in the west of the airport site extending across the site boundary. As this vegetation is adjacent to mostly cleared agricultural land, it has already been subject to fragmentation. The project would result in the further fragmentation of a small number of small stands of woodland at the western boundary of the airport site.

The loss of habitat at the airport site would have a significant impact on the Cumberland Plain Land Snail. The removal of good quality occupied patches of vegetation would remove entire local populations/subpopulations and would reduce genetic diversity of the species in the locality of the airport site.

Small woodland birds recorded in the study area included the Scarlet Robin and the Varied Sittella. The Scarlet Robin and the Varied Sittella were both recorded along the Badgerys Creek riparian corridor, but could occur in any of the woodland and forest patches. A number of additional small woodland birds may also occur, but were not recorded during surveys (Table 28). The proposal would remove about 141.8 hectares of woodland and forest vegetation for threatened woodland birds. However, around 46.8 hectares of occupied and potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. The loss of this vegetation would reduce the total area of habitat for these threatened woodland bird species in the locality. Many of these species require large patches of intact vegetation for their survival, and may only occur at the airport site on a transient basis, if at all, and are highly unlikely to breed at the site. Given that these species are likely to mainly occur along the riparian corridor which would be protected as an environmental conservation zone, the impacts of the proposal would be limited, and it is unlikely to result in a significant impact on these species.

The Little Eagle was recorded regularly soaring above the airport site. No nests were observed at the site, however the species may nest in tall trees present in some stands. The airport site may support a number of breeding pairs. Good quality foraging habitat for the Little Eagle is provided by the high numbers of rabbits and hares observed at the site. Similar foraging habitat is likely to be present throughout agricultural areas within the locality. The construction and operation of the proposed airport would remove 981.6 hectares of potential foraging and breeding habitat for the Little Eagle. The species may continue to forage above the southern portion of the site prior to this area being developed. Soaring individuals are at risk of mortality from aircraft strike. The proposed airport would reduce the area of available habitat for the species in the locality. Given the large home ranges, and large area of potential habitat present in the locality, this is unlikely to be a significant impact on the species.

Three Blue-billed Ducks were observed at a large artificial dam in the Stage 1 construction impact zone footprint. In NSW, this species occurs mainly in the Murray-Darling Basin and breeds in NSW inland swamps. It is generally only during summer or in drier years that this species is found in coastal areas. The Blue-Billed Duck would be a rare visitor to the airport site, and would not breed at the airport site. The construction and operation of the proposed airport would remove 28.6 hectares of artificial wetlands that would provide only occasional foraging habitat for a few individuals. No breeding habitat would be removed. There is a very low risk of mortality from aircraft strike give the low numbers of individuals that may occur in the area. Changes to water quality or hydrology are unlikely to impact Blue-billed Duck habitat that may occur downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c). Given these points, the proposed airport is unlikely to have a significant impact on this species.

No threatened owls were recorded at the airport site, however local records exist for the Powerful Owl, Masked Owl and Barking Owl. Most local records of these species are associated with well vegetated areas such as the Blue Mountains National Park, Warragamba area, Bents Basin State Conservation Area and Mulgoa Nature Reserve. A range of prey species, including possums, rabbits and birds were recorded at the site. These owl species could potentially forage at the site on occasion, however given the large areas of cleared land in the area, the airport site is not likely to be core habitat for these species. Large, hollow-bearing trees are present that are theoretically suitable for breeding. As per the previous point, however, given the lack of good quality foraging habitat, breeding is unlikely to occur in the airport site. The proposed airport would remove up to 141.8 hectares of woodland and forest habitat. However, around 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. Strike risk for most birds during operation is considered to be low (Avisure 2015). Given the lack of evidence of these species at the site, and the patchy nature of the vegetation to be removed, the proposed airport is unlikely to have a significant impact on these species.

The Gang-gang Cockatoo was not recorded during targeted surveys, but may forage at the airport site during cooler months. Most local records of this species are associated with well vegetated areas such as the Blue Mountains. This species often moves to lower altitudes during autumn and winter, occurring in drier more open eucalypt forests and woodlands, and is often recorded in urban areas. During spring and summer it moves to tall mountain forests and woodlands for breeding. As such, the Gang-gang Cockatoo is unlikely to breed at the airport site. The proposed airport would remove up to 141.8 hectares of woodland and forest, which is potential foraging habitat for the species. However, around 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. Strike risk for most birds during operation is considered to be low (Avisure 2015). Given the lack of evidence of this species at the site, the patchy nature of the vegetation to be removed, and that breeding at the site is unlikely, the proposed airport is unlikely to have a significant impact on this species.

The Little Lorikeet was recorded flying over woodland in the airport site. This species tends to occur in large remnants, with most breeding records from west of the Great Dividing Range. The airport site is likely to provide foraging habitat for occasional transient visitors. Given the patchy nature of the vegetation, low density of hollow-bearing trees, and the fact that most breeding occurs west of the Great Dividing Range, this species is unlikely to breed at the site. The proposed airport would remove up to 141.8 hectares of woodland and forest, which is potential foraging habitat for the species. However, around 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. Strike risk for most birds during operation is considered to be low (Avisure 2015). Given the lack of evidence of this species at the site, the patchy nature of the vegetation to be removed, and that breeding at the site is unlikely, the proposed airport is unlikely to have a significant impact on this species.

The Black Bittern was recorded within the Badgerys Creek riparian corridor near Elizabeth Drive. Preferred habitat for this species at the airport site is mainly located along this riparian corridor, which will mostly be retained within the environmental conservation zone. It could also occur at wetlands on the airport site where there is suitable cover and the riparian corridors of Duncans Creek and Oaky Creek. A total of about 62.7 hectares of wetland and riparian vegetation would be removed for the Stage 1 development. Not all of this area would be suitable for the species, as it requires dense vegetation for cover. Changes to water quality or hydrology are unlikely to impact Black Bittern habitat that may occur downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c). However, around 46.8 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. Given the protection of the Badgerys Creek corridor and the large numbers of artificial wetlands present in the locality, the proposed airport is unlikely to have a significant impact on this species.

A number of threatened microchiropteran bat species were recorded at the airport site during recent and previous surveys. Additional threatened bat species may also occur (see Table 70). The Stage 1 development would remove 141.8 hectares of forest and woodland foraging habitat for bats, 811.2 hectares of native and exotic grassland (foraging habitat for open country species such as the Eastern Bentwing Bat), and 28.6 hectares of wetland habitat (foraging habitat for the Large-footed Myotis and other bat species). 107.9 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek and in the western portion of the airport site. There are relatively extensive areas of similar foraging habitat in the locality including around 17,393 hectares of woody native vegetation interspersed with open country (see Figure 7).

No breeding habitat is present for the cave-breeding species such as the Eastern Bentwing Bat though they may occupy diurnal roosts in bridges or culverts. The Eastern Bentwing Bat will forage in open country and females may travel hundreds of kilometres to the nearest maternity colony (Churchill 2008). The proposed airport is unlikely to have a significant impact on the Eastern Bentwing Bat

The Large-footed Myotis is mainly known to breed in caves and other man-made structures, however there is evidence it may also breed in tree hollows (Campbell 2009). The colony of bats (probably Large-footed Myotis) observed roosting under the bridge over Badgerys Creek on Badgerys Creek Road may include breeding individuals. This bridge would not be removed during construction of the airport. There are regular vehicle movements over this bridge currently, causing associated noise and vibration. Additional vehicular movements due to construction of the airport are likely to increase the noise and vibration at this location, which may potentially disturb roosting bats if present.

The species is also known to roost in buildings and in hollow-bearing trees. Few buildings remain at the airport site. Removal of any remaining buildings may result in the loss of breeding habitat for bats. The removal of tree hollows may also reduce breeding habitat for this species in the locality. There are large areas of potential breeding habitat in the locality for this species, including around 17,393 hectares of woody native vegetation that would contain tree hollows as well as buildings, bridges and culverts. The Large-footed Myotis would forage along rivers and above dams throughout the locality. Changes to water quality or hydrology are unlikely to impact Large-footed Myotis habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the proposed airport would have no adverse impact on downstream water quality (GHD 2016c). The proposed airport may have a significant impact on this species if it uses tree hollows in the airport site for breeding. Significant impacts on the foraging habitat are unlikely given the wide-ranging nature of this species.

Hollow-bearing trees may provide roosting and breeding habitat for the threatened bat species listed in Table 70 and in particular the Eastern Freetail Bat, which was the most common bat species recorded during the recent surveys. Occasional hollow paddock trees are present, and some larger, more intact patches of native vegetation contain occasional hollow-bearing trees.

The construction of the proposed airport and other associated infrastructure would result in the loss of hollow-bearing trees. Given the historical clearing that has occurred at the airport site and surrounding areas, hollow-bearing trees occur in generally low densities. As such, hollows present at the airport site are likely to be important for maintaining breeding populations of local populations of bats. A proportion of the hollow-bearing trees at the airport site would be protected along the Badgerys Creek riparian corridor and the rest of the environmental conservation zone.

Given the large scale of the Stage 1 construction impact zone a relatively large number of individual microbats may be harmed and the habitat resources to be removed may be significant to local populations of these threatened bats. Bat populations at the airport site would experience additional risk and energy costs associated with travelling to occupy alternative habitat. There is also likely to be competition with resident bats in these alternative habitats, particularly for comparatively scarce resources such as hollow-bearing trees, which may lead to an overall decline in population sizes. Further development of the locality would follow as a result of construction, resulting in additional clearing of foraging and roosting habitat for microbat species. Based on the considerations above, the construction of the proposed airport is likely to result in a significant impact on the threatened obligate hollow-breeding microbat species Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat, and Yellow-bellied Sheathtail-bat through direct impacts on individual bats and removal of a substantial area of foraging and roosting habitat.

As discussed in Section 6.1.1, while individuals of these fauna species may be at risk of mortality from aircraft strike during operation, this is unlikely to substantially impact any populations as a whole. Operation of the proposed airport would increase general traffic in the area surrounding the airport site, and could result in increased risk of fauna mortality on surrounding roads. In the context of the current level of development and volume of traffic in the locality these additional impacts are unlikely to substantially impact any populations as a whole.

Offsets for threatened fauna listed under the TSC Act have been calculated using the BioBanking methodology for a major project (see Section 9.3).

8.3.4 Conclusions of assessment of significance

Based on the above considerations of the Significant impact guidelines 1.2, the proposed airport is likely to have a significant impact on the environment. The proposed airport would result in:

- large-scale vegetation clearing in an area of Commonwealth Land;
- permanent removal of the 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the EPBC Act form of the CEEC as described above and an additional 142.9 hectares that comprises the TSC Act-listed form of the CEEC or the closely related endangered ecological community (EEC) Shale-gravel Transition Forest;
- permanent removal of 42.1 hectares of River-flat Eucalypt Forest, which is listed as an EEC under the TSC Act;
- removal of 142 *Marsdenia viridiflora* subsp. *viridiflora* stems that are part of an endangered population listed under the TSC Act as well as up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat;
- the long-term decrease or extinction of populations of small, less mobile animals such as frogs, reptiles and the Cumberland Plain Land Snail (*Meridolum corneovirens*);
- removal of up to 141.8 hectares of suitable potential foraging habitat for the Grey-headed Flying-fox (*Pteropus poliocephalus*);
- removal and fragmentation of known and potential habitat for a range of threatened woodland birds and microchiropteran bat species listed under the TSC Act.

9. Recommended management measures

Recommended measures to mitigate biodiversity loss arising from the construction and operation of the proposed WSA are presented in this section according to the hierarchy of avoidance, mitigation and offsetting of impacts.

9.1 Avoidance of impacts

The airport site was selected based on criteria such as site topography, surrounding topography, proximity to infrastructure, and the need to minimise potential environmental and social impacts. Given this range of selection criteria, the size of site required and the constraints associated with the safe operation of an airport it would not have been possible to completely avoid impacts on biodiversity values. The airport site that has been selected is rural and residential land that has been extensively modified by clearing for agriculture, dwellings and industry. Impacts on native flora and fauna, while significant, are substantially less than would be associated with an undisturbed 'green field' site. Construction of the Stage 1 development would result in direct impacts within a 1153.8 hectare disturbance footprint of which 318.5 hectares is native vegetation.

The portion of the Badgerys Creek corridor within the airport site would be protected as part of the 117.1 hectares of land in the environmental conservation zone (see Figure 2). The environmental conservation zone includes around 56.8 hectares of native vegetation and representative areas of each of the vegetation types at the airport site (see Table 58). This report assumes that the 60.3 hectares of land within the conservation zone that does not currently contain native vegetation would be revegetated. Around 2.1 hectares of surface water management features such as detention ponds fall within the environmental conservation zone. This area would require initial vegetation removal and earthworks and so has been included in the impact calculations. It would be allowed to regenerate and will support native vegetation and provide fauna habitat resources and so it has also been included in the total area of the environmental conservation zone. The environmental conservation zone is well placed around the perimeter of the airport site to maintain vegetation connectivity and to provide opportunity for fauna movement and other ecological processes that are necessary to maintain biodiversity values.

The opportunity to further modify the extent or layout of the proposed airport is limited by constraints such as the length and position of the runway, size of terminal and parking required, access, security and the obstacle limitation surface that is required to ensure safe operation of the proposed airport. As such, there is little opportunity to further avoid impacts on biodiversity values at the airport site.

It is expected that the long term development area outside the Stage 1 construction impact zone would not be cleared and grubbed until required for construction of the second runway or other developments that would be the subject of separate approvals. This approach means that longer term impacts on biodiversity values outside the Stage 1 construction impact zone would be avoided for as long as is practicable. As such, it is expected that native vegetation and habitat in the areas outside the Stage 1 construction impact zone would help to maintain biodiversity values in the locality for up to 20 years or more after the Stage 1 construction impacts. Biodiversity values would be maintained in the long term development area through:

- retention of native vegetation and flora and fauna populations in areas not subject to development for up to 20 years. This would help maintain the viability of populations outside the airport site by providing source populations for ecological processes such as pollination, reproduction and recruitment as well as helping to maintain genetic variability;

- retention of habitat resources, including potential refuge habitat and resources such as tree hollows, in areas not subject to development for up to 20 years for fauna displaced by clearing for Stage 1; and
- maintenance of habitat connectivity, including locally important vegetated corridors linking larger patches of Cumberland Plain Woodland at the airport site with riparian corridors extending away from the site.

A staged vegetation clearing process would be implemented during construction of Stage 1. This would provide opportunity for fauna that are resident in the Stage 1 construction impact zone to seek refuge in alternative habitat in the environmental conservation zone, long term development impact zone or outside the airport site. Clearing would commence in the north east of the site and proceed south and west. The clearing will be undertaken before the construction of the Southern perimeter fence to allow fauna to relocate towards the environmental conservation zone and off site. This approach will be taken to maximise the opportunity for resident fauna to vacate the clearing footprint via vegetated remnants and move toward alternative habitat.

9.2 Recommended mitigation of impacts

In order to address the potential impacts of the proposed airport on biodiversity values as discussed in Sections 5, 6 and 8, the recommended mitigation and management measures outlined in Table 71 should be implemented. The recommended mitigation and management measures have been presented according to the specific environmental issue which they are intended to address and split into ‘Design’, ‘Pre-construction’ ‘Construction’ and ‘Operation’ stages of the proposed airport. An assessment of the likely effectiveness and justification for identified mitigation and management measures is included. Many of the mitigation measures are best practice environmental management measures used on construction projects. Impact mitigation and management measures for threatened biota recommended in recovery plans or in the recovery strategies referred to in the threatened species profiles (OEH 2015b) have been identified where relevant.

A Construction and Environmental Management Plan (CEMP) would be prepared that would identify the specific measures for the ‘Pre-construction’ and ‘Construction’ stages and would include work methods, contingencies, roles and responsibilities. The CEMP would specify, as a minimum, industry-standard measures for the management of environmental hazards and risks prepared with reference to the outline in Table 71. Sub-plans, as detailed in Chapter 28 of the EIS, would be prepared with additional detail relating to specific environmental factors.

It should be noted that a precautionary approach has been adopted in the biodiversity assessment and that the assessment of residual impacts on biodiversity values at the airport site does not rely on the effectiveness of mitigation measures. For instance residual impacts and biodiversity offsets have been calculated based on the removal of all threatened plants in the Stage 1 construction impact zone whereas it is likely that a proportion of the resident populations would survive the proposed translocation programme.

Table 71 Mitigation measures, likely effectiveness and timing of implementation

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Pre-construction stage				
Fauna hazard	Develop a Wildlife Hazard Management Plan to include: • conduct of additional surveys to confirm the findings of the preliminary risk study and monitor for changes in species and movement patterns; • review of detailed design documentation to identify potential to identify potential bird and bat attractants; and • review of plans for proposed developments within 13 kilometres of the airport site that are likely to increase the bird and bat strike risk. Design of the proposed airport to minimise its attractiveness to fauna and thus minimise bird and bat strike risk and terrestrial fauna strike risk. Measures to include: • design and build drains, water basins and the airfield to reduce the availability of water; • the design should have an appropriate fence to restrict terrestrial animal access to the airfield; and • the design should have airside access roads to facilitate active wildlife management.	Effective	Measures meet best practice management of fauna at airports.	Design

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Hydrology	Design of the surface water management system at the airport site to minimise the potential for adverse impacts on downstream environments involving measures to: • separate ‘clean’ and ‘dirty’ water and retain and treat any surface water generated on hard stand areas on site before discharge from the airport site; and • avoid substantial alteration of surface water drainage patterns and the volume of downstream flows.	Effective	Measures meet best practice management of water quality.	Design
Waterway-crossings	Location and design of new waterway crossings or upgrades of existing crossing (if required on the airport site) to minimise impacts on riparian and aquatic habitats. Crossings should be designed to minimise potential impacts on watercourse functionality, in particular impacts on aquatic and riparian habitats and fish passage, in accordance with DPI (2013).	Effective	Crossings would be designed according to best practice management of fish passage (DPI 2013).	Design
Lighting	Design of airport lighting to minimise unnecessary light spill into adjoining areas of retained vegetation (such as in the conservation areas).	Effective	Measures meet best practice management of fauna at airports. Proposed measures are in line with the recovery actions for the Eastern Freetail Bat (OEH 2015b): ‘encourage reduction or modification of light impacting on known habitat to reduce levels of disturbance’.	Design
Environmental management	A Construction and Environmental Management Plan (CEMP) will be prepared, including the specific mitigation/management measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation/management measures included in the CEMP and sub-plans would be implemented during pre-construction and construction stages.	Effective	Measures meet best practice management of construction projects	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Worker inductions	All workers are to be provided with an environmental induction prior to starting construction activities on site. This would include information on the ecological values of the airport site and protection measures to be implemented to protect biodiversity during construction.	Effective	Measures meet best practice management of construction projects	Pre-construction
Erosion and sediment	Erosion and sediment control plans will be prepared in accordance with Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC 2008f). The erosion and sediment control plans would be established prior to the commencement of construction and be updated and managed throughout as relevant to the activities during the construction phase to minimise the potential for adverse impacts on adjoining conservation areas, watercourses and downstream environments.	Effective	Measures meet best practice management of erosion and sedimentation on construction projects	Pre-construction
Dust	Specific measures will be incorporated into the CEMP to minimise the generation of dust and associated impacts on natural environments adjacent and downstream of the airport site. These should include: • rapid stabilisation of disturbed soil surfaces following clearing and earthworks; • setting maximum speed limits for construction and operational traffic within the airport site to limit dust generation; • use of a water tanker or similar to spray unpaved roads during construction where required; • application of dust suppressants or covers on soil stockpiles; and • immediate removal off site of excavated fill materials not required for backfilling or other onsite uses.	Effective	Measures meet best practice management of dust on construction projects.	Construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Contaminants	Specific measures should be incorporated into the CEMP to minimise the potential for chemical spills and associated impacts on natural environments adjacent to and downstream of the airport site. These should include: • storage of chemicals in clearly marked and bunded areas; • management of sewage storage tanks, including regular emptying and disposal off site; • regular inspection of vehicles and mechanical plant for leakage of fuel or oil; • no refuelling of vehicles, vehicle maintenance or washing of vehicles within 20m of waterways; and • an emergency plan for spills, to minimise the risk of impacts on retained vegetation and downstream habitats.	Effective	Measures meet best practice management of contaminants on construction projects.	Pre-construction
Vegetation clearance and habitat loss	Disturbance and removal of some areas of native vegetation and habitat will be unavoidable during the construction phase. To reduce the potential for adverse impacts on ecologically sensitive areas the following measures should be implemented: • deferral of vegetation removal until necessary; • locating site offices and stockpiles in already cleared and disturbed areas to avoid further unnecessary removal or disturbance of native vegetation and hollow-bearing trees; • provision of maps to construction staff clearly showing vegetation clearing boundaries and exclusion/no-go zones; and • a suitably qualified ecologist or environmental officer would be engaged prior to any clearing works to clearly demarcate vegetation protection areas.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Disease management	Management of plant and animal disease (such as Phytophthora, Myrtle Rust and Chytrid fungus) would be a principal consideration in the development of the construction environmental management plan, with particular regard to protection of environmental conservation zones.	Effective	Measures meet best practice management of vegetation diseases on construction projects. 'Prevention of pathogen spread' is an objective of the chytrid fungus threat abatement plan (DEH 2006).	Pre-construction
Threatened fauna management plans	Threatened fauna species management plans should be prepared to reduce the potential for impacts on relevant species. These should include: • maps identifying locations of threatened species; • scope and requirements for targeted surveys, pre-clearing surveys; • unexpected finds protocol, including for occurrences of threatened species previously recorded in the broader area, but not previously recorded at a specific location; • salvage and translocation of threatened species as per the measures recommended below; • clearing protocols; and • reporting and adaptive management measures.	Effective	Measures meet best practice management of threatened species on construction projects.	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Threatened flora translocation plan	A threatened flora salvage and/or translocation sub plan to the CEMP will be prepared in consultation with the Australian Botanic Gardens, Mount Annan and with consideration of the Guidelines for the Translocation of Threatened Plants (Vallee et al 2004). It is recommended that this include consideration of the salvage and propagation or transplanting of the known local populations of *Pultenaea parviflora* and *Marsdenia viridiflora* subsp. *viridiflora* and any other threatened plants detected at the airport site. The plan should consider the suitability of sites within the environmental conservation zone and within the vicinity of the airport site in order to maintain populations of these species as close to their original location as is possible.	Potentially effective. May not provide assurance of survival and so the impact assessment and offset calculations assume the removal of all individuals in the construction impact zone.	Seed and cutting collections were made from the *Pultenaea parviflora* population by the Royal Botanic Gardens Trust on a number of occasions in 1990 and 1991 (RBGS 1992). The following priority actions are included in the conservation advice for *Pultenaea parviflora* (DEH 2008): • Implement national translocation protocols (Vallee et al 2004) if establishing additional populations is considered necessary and feasible. • Undertake appropriate seed collection and storage. • Undertake seed germination and/or vegetative propagation trials to determine the requirements for successful establishment. Translocation of *Marsdenia longiloba* has been successfully carried out on a number of road projects (Benwell 2014). Translocation of plants would be conducted in accordance with Vallee et al (2004).	Pre-construction
Pre-clearance surveys for threatened species	Pre-clearance surveys should be undertaken by a qualified ecologist and the required methodology will be developed for target species as part of the CEMP. Specific management plans should be prepared as sub-plans to the CEMP to manage impacts on threatened flora and fauna species as outlined above. Surveys should include: • additional targeted searches of the airport site for the Green and Golden Bell Frog in optimal conditions to confirm that they are no present at the site (surveys for the species were conducted at the end of the survey season and were subject to access	Likely to be effective	Measures meet best practice management of flora and fauna on construction projects. Targeted searches for the Green and Golden Bell Frog would be conducted with regard to the survey methodology outlined in the Environmental Impact Assessment Guidelines for the species (Appendix 2 of the draft recovery plan (DEC 2005)) and the Commonwealth survey guidelines for frogs (DEWHA 2010).	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
	constraints as discussed in Section 3.4.3). A management plan should be prepared as a sub plan to the CEMP to provide more detail on Green and Golden Bell Frog relocation and habitat management should this species be located during targeted surveys. Frog collection and relocation would need to be conducted by appropriately experienced ecologists; • targeted searches of the airport site for the Cumberland Plain Land Snail (in suitable conditions) and salvage and relocation of any snails and/or suitable shelter sites that are detected. A management plan should be prepared as a sub plan to the CEMP to provide more detail on Cumberland Plain Land Snail relocation and habitat management. Snails and/or suitable shelter sites would be relocated to appropriate habitat near the airport site. Snail collection and relocation would need to be conducted by appropriately experienced ecologists. Discussion would occur with OEH about the location of the receiver sites. • survey of any bridges, culverts or buildings that need removal to search for roosting bats; • pre-clearing surveys for larger birds' nests, particularly the White-bellied Sea-Eagle and Little Eagle; and • targeted searches for threatened flora species in areas of appropriate habitat with particular attention to the vicinity of known populations of *Marsdenia virdiflora* subsp. *viridiflora and Pultenaea parviflora*. Any unexpected finds would be communicated to the Department and addressed in the translocation plan and/or offset delivery plan as appropriate.		Proposed measures are in line with recovery actions for these threatened species, including: • Green and Golden Bell Frog: 'Undertake survey work in suitable habitat and potential habitat to locate any additional populations/ occurrences/ remnants' (DoE 2014c). • Cumberland Plain Land Snail: 'Undertake monitoring and evaluation of the success (or otherwise) and impacts on individuals, of projects that involve translocation new habitat sites as part of development offset or population enhancement actions' (OEH 2015b).	

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Habitat clearing and fauna management protocol	Measures for the management of impacts on fauna species during clearing activities should be developed and incorporated into the CEMP, including the following measures: • preparation of a nest box strategy including provisions for: – installation of nest-boxes within conservation areas prior to clearing areas of native vegetation on the airport site to provide a safe location for hollow-dwelling fauna to be transferred to during clearing operations; – reuse of hollows and fallen debri within conservation areas; and – salvage of native fauna from existing nest boxes on the airport site prior to their removal and translocation of fauna to newly established nest box sites. • pre-clearing surveys undertaken by a suitably qualified ecologist to mark and map hollow-bearing trees, logs and existing nest boxes that would require fauna management during removal; • establishing protocols for the staged clearing vegetation and safe tree felling and log remove to reduce the risk of fauna mortality; • protocols for the capture and relocation of less mobile fauna (such as nestling birds and nocturnal fauna) by a trained fauna handler; and • protocols for the appropriate management of injured or deceased individuals.	Effective	Measures meet best practice management of flora and fauna on construction projects. Proposed measures are in line with the recovery actions for the following threatened species: • Large-footed Myotis (OEH 2015b): ‘Promote roosting habitat in new artificial structures within the species' range’. • Little Lorikeet: ‘Identify sites where tree hollows are limiting and develop and implement a nest box strategy that has clear objectives and includes monitoring, maintenance, and evaluation of success’.	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Weeds	A weed management plan should be prepared as part of the CEMP and should include: • implementing soil erosion and sediment control measures; • mapping of weed infestations; • removal and control of noxious weed species. In particular, the Alligator Weed infestation on the dam at the quarry should be eradicated prior to any works in the vicinity; • appropriate disposal of weeds and weed-infested soils; • stabilisation of disturbed areas following clearing to prevent weed spread; • monitoring and adaptive management of weeds; and • reporting on the extent, composition and severity of weed infestations and adaptive management measures.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Pre-construction
Unexpected finds	An unexpected finds protocol should be prepared to detail measures to be undertaken if threatened flora and fauna not previously recorded on site are detected during clearing or construction activities, or if additional occurrences of threatened species previously recorded in the broader area, but not previously recorded at a specific location, are recorded during clearing or construction activities.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Dam decommissioning	A protocol for the decommissioning of dams should be developed in consultation with relevant agencies, and should include, but not be restricted to, the actions described below: • dam removal should follow any requirements of a Green and Golden Bell Frog management plan if one has been prepared (see above); • the Alligator Weed infestation on the dam at the quarry should be eradicated prior to any works in the vicinity; • existing dams within the footprint should be progressively emptied over a number of days to allow fauna to relocate as the water is removed. Smaller dams should be emptied by water carts directly pumping the water into their tanks, larger dams will have a standpipe installed; • dam removal should not be conducted during the nesting season of waterbirds. A pre-removal survey should be conducted to ensure no birds are breeding; • salvage and relocation of aquatic vertebrate fauna, including frogs, turtles and eels, to areas of suitable habitat retained on the airport site or adjoining habitats should be undertaken, with regard to numbers and identification of suitable release sites; • Eastern Gambusia (*Gambusia holbrooki*) and other noxious fish should not be released into local waterways as a result of draining of farm dams. Eastern Gambusia should be eradicated from dams using humane methods; and • protocols for the humane euthanasia of aquatic fauna, including fish, should be specified and implemented.	Effective	Measures meet best practice management of flora and fauna on construction projects. 'Minimising human dispersal of gambusia' is an objective of the threat abatement plan for the Green and Golden Bell Frog (NPWS 2003).	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Fire	A Bushfire Management Plan should be prepared to minimise the risk of bushfire and associated impacts on adjoining areas of native vegetation, including the proposed conservation areas. This should include the following: • a requirement for relevant permits to be obtained for all activities likely to generate sparks. Restrictions contained within these permits should be based on the forecast fire danger; • preparation of pre-planned fire response action plans in accordance with the nationally endorsed 'Prepare, Act, Survive' format. The action plans should be issued as part of the site induction for all site personnel; • development of limitations on relevant construction procedures which should be applied during the fire season based on specific fire danger ratings. An example of such restrictions would include the halting of all construction works during extreme or catastrophic fire danger days; • management of the airport site to maintain a low overall fuel hazard. Measures to achieve this should include a combination of herbicide application (applied according to relevant State Catchment Authority (SCA) and label standards), slashing/ trittering, low intensity prescribed burning and hand removal; and • fuel-reduction measures should be appropriate to biodiversity values in each area (e.g. low intensity prescribed burns rather than slashing should be used in native woodland and forest).	Effective	Measures meet best practice management of bushfire on construction projects.	Pre-construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Construction stage				
Water quality	All water discharge into creeks should be guided by the ANZECC Water Quality Guidelines (2000). Measures to manage erosion and sediments and contaminants as detailed in GHD (2016a, b) should be implemented to minimise impacts on surface water quality.	Effective	Measures meet best practice management of water quality on construction projects.	Construction
Groundwater	Any groundwater seepage in excavations should be characterised and treated as appropriate for any observed water quality issues prior to discharge off site. Measures to manage erosion and sediments and contaminants as detailed in GHD (2016a, b) should be implemented to minimise impacts on groundwater quality. Undertake baseline and ongoing monitoring as detailed in GHD (2016e)	Effective	Measures meet best practice management of groundwater on construction projects.	Construction
Lighting	Steps should be taken to minimise unnecessary light spill into adjoining areas of retained vegetation (such as in the conservation areas).	Effective	Measures meet best practice management of erosion and sedimentation on construction projects.	Construction
Erosion and sediment	Erosion and sediment control measures should be implemented in accordance with plans. Environmental controls should be inspected and maintained and should be adapted as required in response to weather conditions.	Effective	Measures meet best practice management of contaminants on construction projects.	Construction
Contaminants	Specific measures in the CEMP to minimise the potential for chemical spills and associated impacts should be implemented.	Effective	Measures meet best practice management of weeds on construction projects.	Construction
Weeds	Specific measures to minimise the potential for the spread of weeds contained in the weed management sub plan of the CEMP should be implemented.	Effective	Measures meet best practice management of water quality on construction projects.	Construction

Fauna management	Subject to safety and security, measures for the management of impacts on fauna species during clearing activities should be implemented, including in particular the matters outlined below: • A plan for a progressive vegetation clearing process should be implemented. This should provide opportunity for fauna that are resident in the Stage 1 construction impact zone to seek refuge in alternative habitat in the environmental conservation zone, long term development impact zone or outside the airport site. Clearing should commence in the northeast of the site and proceed south and west. The clearing should be undertaken before the construction of the southern perimeter fence to allow fauna to relocate offsite and towards the environmental conservation zone. This approach has been identified to maximise the opportunity for resident fauna to vacate the clearing footprint via vegetated remnants and move toward alternative habitat. • Prior to the commencement of clearing a fauna spotter should undertake an assessment to identify potential habitat trees and logs. These should be clearly identified with spray paint. A dozer should then clear the undergrowth and trees not identified as potential habitat trees. An excavator should follow several days behind the dozer to give resident fauna the opportunity to vacate habitat trees. The excavator should drop trees in a manner to increase the likelihood of survival of any fauna present. • An experienced fauna spotter-catcher, licensed wildlife carer or ecologist should be present to supervise native vegetation clearing or removal/disturbance of other habitat features (e.g. culverts), and to capture and relocate fauna if required. Any injured native fauna should be transferred to the care of a licenced wildlife carer.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Construction

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Threatened species management	Measures contained within the threatened species management plans should be implemented (as relevant) to minimise potential impacts on threatened flora and fauna species at the airport site.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Construction
Dam decommissioning	Specific dam decommissioning protocols contained in the CEMP should be implemented.	Effective	Measures meet best practice management of flora and fauna on construction projects.	Construction
Operation stage				
Airport environmental management	Environmental management plans would be prepared and approved prior to the commencement of operations and implemented, including the specific management measures relating to the protection and management of biodiversity values as outlined below.	Effective	Measures meet best practice management of flora and fauna.	Pre-operation
Vegetation	Engage an ecologist to prepare a vegetation management plan (VMP). The VMP should apply to open space within the airport site and the environmental conservation zone and should include: • retention of native vegetation and/or supplementary replanting with indigenous native species of local provenance; • slashing of grassland to manage fuel loads and bushfire risk; • identification of threatened flora populations and measures to avoid impacts from activities such as weed control or bushfire hazard reduction; • measures for the management of weeds; • planting schedules; • monitoring of the success of revegetation, weed control and adaptive management; and • reporting.	Effective	Measures meet best practice management of flora and fauna on construction projects. The Cumberland Plain Recovery Plan (DECCW 2011) notes that 'smaller remnants and corridors outside the priority conservation lands (PLCs) are important and may play a role in linking the PCLs and/or supporting biodiversity in the PCLs'. Recovery Objective 2 of the Cumberland Plain Recovery Plan (DECCW 2011) is 'To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation'.	Operation

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
			Proposed measures are in line with the recovery actions for the following threatened species: • Grey-headed Flying-fox: ‘Enhance winter and spring foraging habitat for Grey-headed Flying-foxes’ (DECCW 2009). • Eastern Bentwing Bat: ‘Undertake revegetation, using a diverse mix of locally appropriate native species. Revegetation should focus on areas of good moisture and fertility, particularly riparian areas and wetlands. Priority should be given to expanding existing small habitat patches’ (OEH 2015b). • Black Bittern: ‘Implement riparian restoration activities in areas where the species is known to occur and in habitat where it is likely to breed’ and ‘Encourage landholders to enter land management agreements that promote the maintenance of riparian vegetation and habitat’. • Varied Sittella: ‘Undertake revegetation, using a diverse mix of locally appropriate native	

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
			species, focussing on expanding areas of existing habitat, connecting isolated habitat patches (either through corridor or stepping stone plantings) or establishing additional habitat patches in landscapes with already existing, although insufficient, patches of suitable habitat. Areas with access to water, especially riparian areas, are particularly important, although care should be taken to ensure that riparian revegetation programmes are sufficiently wide (minimum 50m wide)'. 'Target removal of weeds significantly compromising habitat values (e.g. invasive perennial grasses) and restore native vegetation. Care should be taken to avoid widespread removal of beneficial exotic woody vegetation without replacement and avoid non-target impacts of herbicides'.	
Biosecurity	Due to existing requirements for airlines and airports to comply with biosecurity requirements under the Quarantine Act 1908 (Cth) and other relevant legislation, no specific mitigation measures are proposed	NA		Operation

Issue	Mitigation/management measure	Likely effectiveness	Justification for likely effectiveness	Recommended timing of implementation
Fauna strike	Due to existing requirements for airports to comply with wildlife strike management requirements under the Civil Aviation Safety Regulations 1998 (Cth) and other relevant legislation, no specific management measures are proposed	NA		Operation
Fire	A Bushfire Management Plan would be implemented. Fire-fighting vehicles and staff would be located at the proposed airport to minimise the risk of impact of fire on adjacent native vegetation.	Effective	Meets best practice management of fire at airports.	Operation
Contaminants	Implementation of measures to manage the risk of contaminants polluting surface water and other sensitive receptors adjoining the airport site, including: • maintenance of sewerage systems; • appropriate fencing, bunding and management of chemicals and fuel storage areas to prevent spills; • appropriate storage and management of pesticides and herbicides to prevent entry into local waterways; and • emergency response protocols to contain and clean-up accidental spills.	Effective	Measures meet best practice management of contaminants at sites.	Operation
Water quality	Appropriate management of stormwater to maintain aquatic habitat values downstream, having regard to relevant regulatory standards and guidelines.	Effective	Measures meet best practice management of stormwater at sites.	Operation

9.3 Offsetting of impacts

The EIS guidelines state that the EIS must include details of an offset package to be implemented to compensate for residual significant impacts associated with the project, as well as an analysis of how the offset meets the requirements of the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012* (EPBC Act Offsets Policy) (DSEWPaC 2012a).

Biodiversity offsets would be required to compensate for significant residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox and plants, animals and their habitat in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012a). The EPBC Act Offsets Policy requires offsets for significant impacts on threatened species and communities listed under the EPBC Act, calculated using the 'offsets assessment guide' spreadsheet. Consultation with DoEE has confirmed that the FBA is their preferred approach for estimating offsets for the significant residual impacts on plants, animals and their habitat, including threatened biota listed under the NSW TSC Act. The biodiversity offset package for the proposed airport has been prepared in accordance with the EPBC Act Offsets Policy and will conserve habitat for the affected matters in suitable offset sites (see Appendix K2 of the EIS).

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the proposed airport, it will not be possible to identify and secure all of the proposed biodiversity offsets as part of this final EIS. A staged approach will assist in resolving the challenges and realising the opportunities associated with delivering biodiversity offsets. The process of identifying and securing suitable biodiversity offsets will continue after the Infrastructure Minister'sdetermination of the Airport Plan for the proposed airport and will comprise the following main stages:

- This biodiversity offset package report included as Appendix K2 of the EIS, which outlines the approach to the delivery of biodiversity offsets for the proposed airport, comprising an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.
- The biodiversity offset delivery plan which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in the biodiversity offset package.
- The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring

At this stage of the planning and assessment for the proposed airport, the intent is to deliver most biodiversity offsets through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on the title of the relevant sites. The number and type of biodiversity credits would be purchased and retired from offset sites to match the proposed airport's impacts on affected EPBC Act-listed biota as calculated by the offsets assessment guide. Additional biodiversity credits would be purchased to offset impacts on plants, animals and their habitat. The purchase of credits would secure the conservation covenant over the area of land that is linked to the biodiversity credits and provide funds for management in perpetuity.

Suitable offset sites have been identified that contain Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat and biodiversity credits appropriate to match the proposed airport's impacts on plants, animals and their habitat. Potential offset sites are shown on Figure 8, along with the airport site, regional biodiversity corridors and priority conservation lands. The potential offset sites include established biobank sites with suitable biodiversity credits for sale and proposed biobank sites that are at various stages of the assessment and approval process for obtaining a BioBanking agreement. Portions of four of these potential offset sites are located in Cumberland Plain Priority Conservation Lands identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). Twelve out of fourteen potential offset sites are located in regional wildlife corridors and priority biodiversity investment areas identified in the *Biodiversity Investment Opportunities Map - Mapping Priority Investment Areas for the Cumberland Subregion* (OEH 2015d). Conservation of the potential offset sites would ensure the protection and management of core areas of habitat within recognised regional wildlife corridors as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

There are a variety of alternative offsetting conservation mechanisms to BioBanking which may also be utilised in the biodiversity offset delivery plan as other compensatory measures to meet offset requirements. Biodiversity offsets using these alternative mechanisms may be delivered through a variety of existing and future programmes, projects, and policies that may be appropriate under certain circumstances. This is particularly the case where such alternative options may be more practical, or achieve greater strategic benefits for biodiversity conservation in the region.

As a coordinated approach to consulting on the development of alternative conservation mechanisms, the Department of Infrastructure and Regional Development will establish an Experts Group, including DoEE, other relevant NSW authorities, organisations and stakeholder groups as determined by the Department. Key considerations, with reference to the EPBC Act Offsets Policy, will include that any offsets must directly benefit the protected matter to be affected, must be based on sound ecological survey and assessment, and must be additional to any existing funding for conservation programmes.

Offset assessment guide calculations were performed for the affected protected matters listed under the EPBC Act based on the following:

- removal of 104.9 hectares of Cumberland Plain Woodland;
- removal of 141.8 hectares of habitat for the Grey-headed Flying-fox; and
- the conservation and management of offset sites to achieve increased site quality.

The ‘area of offset’ has been treated as a variable in these preliminary offset assessment guide calculations to estimate the total area of habitat at offset sites that would be required to directly offset 100% of the proposed airport’s impacts. The calculator inputs associated with the other attributes of the offset areas is an aggregate based on the assessment of all potential offset sites identified in the offset package. This approach has been used to demonstrate that suitable offset areas are available having regard to the EPBC Act Offset Policy and that these potential offset areas would substantially meet the offset requirements for the proposed airport as direct offsets.

The outcome of these preliminary offsets assessment guide calculations is that:

- Removal of 104.9 hectares of EPBC Act Cumberland Plain Woodland at the airport site would require an offset area of around 355 hectares to offset 100 per cent of the proposed airport's impacts on the community. There are 207.9 hectares of EPBC Act-listed form of Cumberland Plain Woodland in the proposed offset areas. There are a further 135 hectares of poorer quality Cumberland Plain Woodland that would be actively managed so that it would reach the same site quality as the airport site and comprise a functioning occurrence of the EPBC Act-listed form of the community over the medium-term.

- Removal of 141.8 hectares of habitat for the Grey-headed Flying-fox at the airport site would require an offset area of around 410 hectares to offset 100 per cent of the proposed airport's impacts on this vulnerable species. There are up to 451 hectares of Grey-headed Flying-fox habitat in the proposed offset areas.

The DoEE is expected to confirm the specific offset requirements for residual impacts arising from the Stage 1 development. Offset calculations would be finalised with additional site specific information such as proposed management, current risk of development and the security of title proposed for individual offset sites. This additional data would be entered in the offsets assessment guide by specialists within DoEE to confirm the quantum of offsets that would be delivered for threatened biota listed under the EPBC Act in the biodiversity offset delivery plan.

Based on preliminary calculations in this report, the currently identified potential offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland will be identified and considered through the development of a biodiversity offset delivery plan, with this work to commence after the Infrastructure Minister's determination of the Airport Plan for the proposed airport.

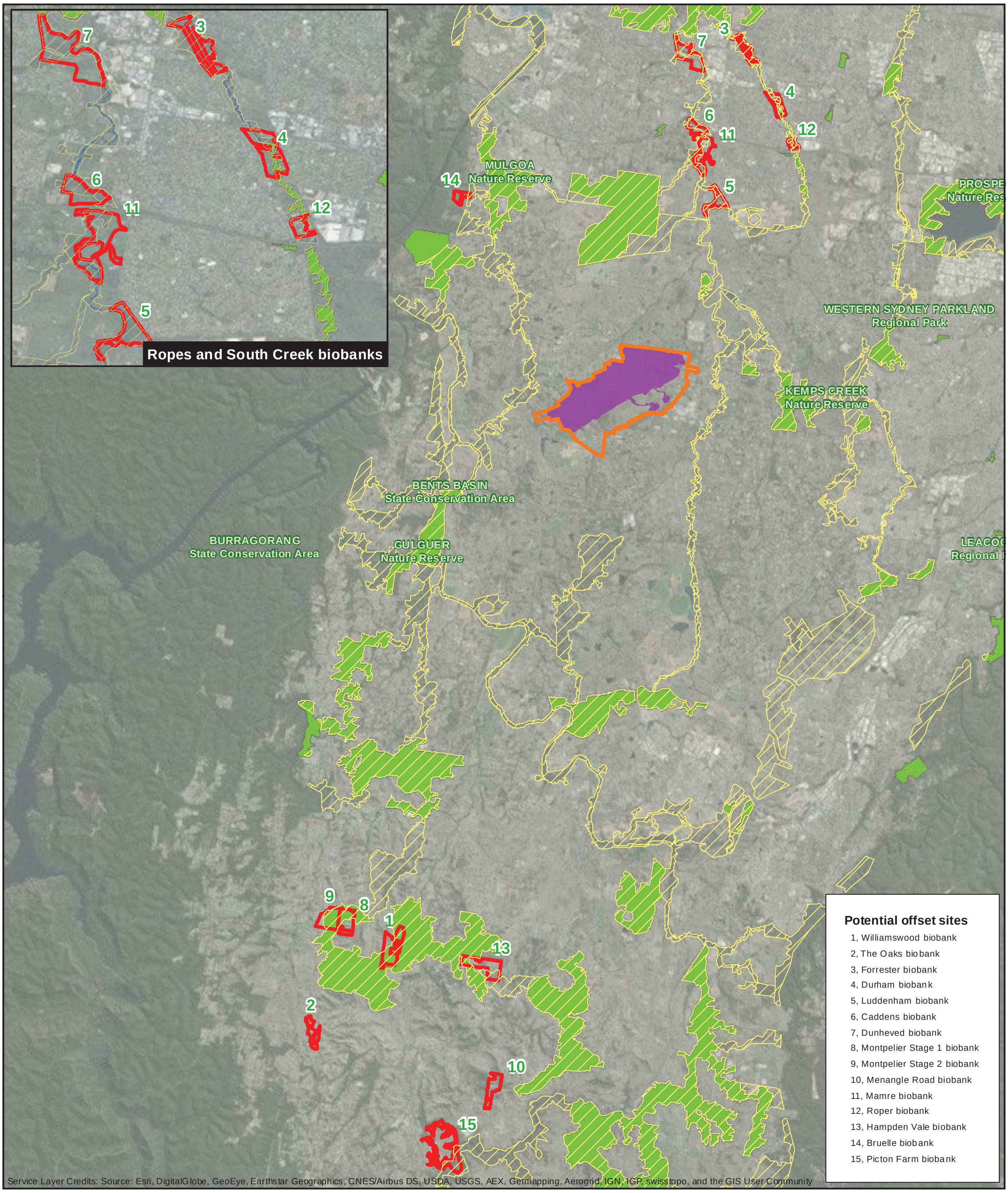
BioBanking credit calculations using the FBA methodology have been used to estimate offsets for impacts on plants, animals and their habitat, including threatened species, populations and communities listed under NSW legislation. The estimated offset requirement for impacts on these other plants, animals and their habitat substantially overlaps with that required for affected EPBC Act-listed biota but involves a considerably greater quantum because of the inclusion of additional matters that are not protected under the EPBC Act. Notably, offsets would be required for poorer condition vegetation that does not comprise EPBC Act-listed Cumberland Plain Woodland. The quantum of offsets required for impacts on plants, animals and their habitat would be determined by DoEE based on the FBA calculations included in this offset package.

A preliminary costing for the offset package has been undertaken using the assumption that all offsets would be secured through BioBanking, as this provides a useful benchmark for overall pricing of offsets that would be included in the biodiversity offset delivery plan. Based on the FBA and BioBanking credit calculations included in this offset package and recent biodiversity credit sales for equivalent vegetation types and species in the Western Sydney region on the 'market', it is estimated that it would cost between $123,000,000 and $157,000,000 (ex GST) to deliver biodiversity offsets for the Stage 1 development. GHD recommends a 20% contingency to allow for potential credit price rises during the time it will take to secure all offsets. Based on the upper limit of the credit value range of $157,000,000, this equates to $31,400,000. The 'upper limiting cost', which includes the contingency, would be approximately $188,400,000 (ex GST).

The offset package included as Appendix K2 of the EIS outlines the approach for the delivery of biodiversity offsets for the proposed airport, including:

- an estimate of the quantum of offsets that may be required for the significant residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox and on plants, animals and their habitat that are likely to arise from the proposed airport;
- evidence that access is possible to offset sites that could substantially meet this offsetting requirement and that are aligned with conservation priorities for the affected protected matters;
- an approach to delivering the remaining offset requirement; and
- a commitment to deliver an approved biodiversity offset delivery plan prior to the commencement of Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

When implemented, the biodiversity offset delivery plan would improve or maintain the viability of the protected matters that would be affected by the proposed airport.



LEGEND

- Airport site
- Stage 1 construction impact zone
- Potential offset sites
- Cumberland plain priority conservation lands
- Regional biodiversity corridors

Paper Size A4

0 1,750 3,500 7,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Western Sydney Unit, Department of Infrastructure and Regional Development
Western Sydney Airport
Biodiversity Assessment

Job Number	21-24265
Revision	A
Date	12 Aug 2016

The airport site and potential offset sites

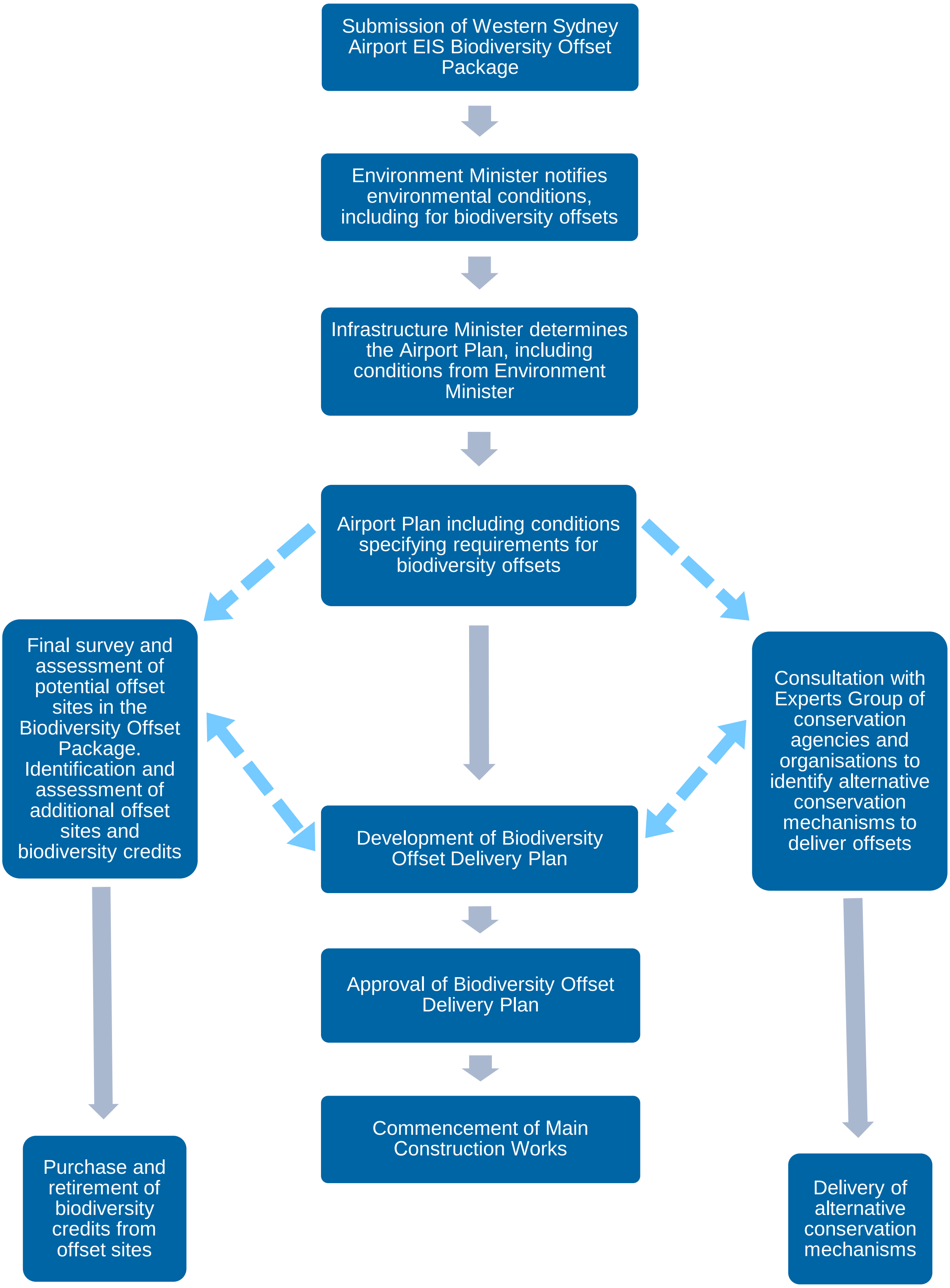
Figure 8

G:\21\24265\GIS\Maps\Deliverables\21-24265-Z082_AirportSiteAndOffsetSites.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial Imagery: ESRI, 2015. Offset sites: GHD, 2015. Cumberland Plain Conservation: DECCW, 2011 Created by:mweerakoon

Figure 9 Stages in the delivery of offsets for the proposed airport



10. Conclusion

This biodiversity assessment has been prepared to describe the biodiversity values present at the airport site, assess impacts of the proposed airport, and recommend appropriate management measures and offset requirements for the proposed airport.

The airport site comprises gently undulating, low hills on shale and broad flats on alluvium on the Cumberland Plain. It features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural residential development.

The condition of native vegetation and habitat across the airport site varies as a result of previous land uses and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. There is moderate to severe weed infestation throughout, with linear remnants along roads and isolated patches in agricultural land the most severely affected. Notwithstanding the generally poor condition of the airport site it has high conservation significance as a result of the presence of threatened species and ecological communities and the generally limited extent and quality of similar environments in the Western Sydney region.

Construction of the Stage 1 development at the airport site would result in direct impacts within a 1153.8 hectare disturbance footprint, including 318.5 hectares of native vegetation. The majority of impacts for the Stage 1 development would be in areas that have previously been cleared for agricultural purposes. The Stage 1 construction impact zone would be completely developed and converted to airport infrastructure or managed open space with minimal native vegetation cover. Native vegetation removal in the Stage 1 construction impact zone would comprise land clearance as defined under the EPBC Act and would constitute a substantial increase in the operation of this Key Threatening Process in the locality and region. Impacts as a result of clearing of this vegetation would be permanent and irreversible.

Construction and operation of Stage 1 of the proposed airport would create a gap in habitat that is around 1150 hectares in area and about 2 kilometres wide from north to south and almost 4 kilometres long from east to west. This area would be mostly inhospitable to native species given the presence of cleared areas, fences, infrastructure, lights and aviation-related activities. The gap would create a barrier to ecological processes such as dispersal, pollination and seed fall. The proposed airport would result in a substantial increase in the degree of habitat fragmentation in the locality and region.

Other direct and indirect impacts arising from the proposed construction and operation of the airport would include harm to plants and animals during construction, substantial alteration of the land surface and hydrology, the risk of bird and bat strike by aircraft and the potential for alteration of flows and water quality downstream.

The Stage 1 development would result in the following impacts on threatened biota and other biodiversity matters listed under the EPBC Act:

- permanent removal of 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the EPBC Act form of the critically endangered ecological community (CEEC);
- removal of a local population of *Pultenaea parviflora*, comprising four individuals and up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat;

- removal of a maximum of 141.8 hectares of better quality potential habitat and a up to a further 148.6 hectares of poor quality potential habitat for the threatened flora species White-flowered Wax Plant (*Cynanchum elegans)*, Spiked Rice-flower (*Pimelea spicata)* and Downy Wattle (*Acacia pubescens*), which are listed as endangered species and Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*) and Austral Toadflax (*Thesium australe*), which are listed as vulnerable species under the EPBC Act. The scale of impacts on these threatened plants varies depending on their specific habitat requirements;
- removal of up to 141.8 hectares of suitable potential foraging habitat for the Grey-headed Flying-fox (*Pteropus poliocephalus*), which is listed as a vulnerable species under the EPBC Act and which has been observed flying over the airport site;
- removal of up to 141.8 hectares of potential winter foraging habitat for the Swift Parrot (*Lathamus discolor*), which is listed as a critically endangered species under the EPBC Act and which may occur at the airport site during annual migrations on an opportunistic basis;
- removal and fragmentation of habitat for migratory bird species;
- large-scale vegetation clearing and other impacts on plants in an area of Commonwealth Land;
- the long-term decrease or extinction of populations of small, less mobile animals such as frogs, reptiles and the Cumberland Plain Land Snail (*Meridolum corneovirens*) and other impacts on fauna in an area of Commonwealth Land;
- operational impacts on the matters listed above such as increased noise, light or traffic and the potential for bird and bat strike by aircraft; and
- substantial cumulative and facilitated impacts on the matters listed above such as additional removal of native vegetation and habitat resources as a result of other planned and potential infrastructure developments linked to the proposed airport. Construction of the proposed airport is also likely to provide a stimulus to economic activity in the locality and result in commercial developments in the surrounding area.

The Stage 1 development would result in impacts on threatened biota listed under the NSW TSC Act, as part of the impacts on the environment generally, comprising:

- permanent removal of the 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the EPBC Act form of the CEEC as described above and an additional 142.9 hectares that comprises the TSC Act-listed form of the CEEC or the closely related endangered ecological community (EEC) Shale-gravel Transition Forest;
- permanent removal of 42.1 hectares of River-flat Eucalypt Forest, which is listed as an EEC under the TSC Act;
- removal of 142 *Marsdenia viridiflora* subsp. *viridiflora* stems that are part of an endangered population listed under the TSC Act as well as up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat;
- the impacts on threatened plants listed under the EPBC Act described above, as each of these species are also listed as threatened species under the TSC Act. Removal of up to 107.1 hectares of better quality potential habitat and a further 148.6 hectares of poor quality potential habitat for two additional plant species, *Dillwynia tenuifolia* and *Grevillea juniperina* subsp*. juniperina*, which are listed as vulnerable species under the TSC Act*;*
- the impacts on threatened fauna listed under the EPBC Act described above, as each of these species are also listed as threatened species under the TSC Act;

- removal of 141.8 hectares of known and potential habitat for the Cumberland Plain Land Snail, which is listed as an endangered species under the TSC Act; and
- removal and fragmentation of known and potential habitat for a range of threatened woodland birds and microchiropteran bat species listed under the TSC Act.

Assessments of significance have been prepared in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013a) for impacts on threatened biota and other MNES and the *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies* (DoE 2013b) for impacts on the natural environment (for the purposes of this report comprising plants, animals and their habitats).

The outcome of these assessments is that the proposal is likely to have a significant impact on the following protected matters:

- Cumberland Plain Woodland CEEC;
- the vulnerable Grey-headed Flying-fox; and
- plants, animals and their habitats, including a number of species and populations listed as threatened under the TSC Act, as part of the impacts on the environment generally.

Operation of the proposed airport has the potential to impact the biodiversity values of the Greater Blue Mountains World Heritage Area (GBMWHA). Potential indirect impacts on World Heritage and National Heritage values from the operation of the airport were assessed having regard to the attributes identified in the Statement of Outstanding Universal Value for the GBMWHA and the complementary values of the area as defined in the GBMWHA Strategic Plan. The assessment considered noise, air quality and visual amenity impacts from aircraft overflights, lighting and traffic. An assessment of the likely significance of impacts on the GBMWHA has been prepared with respect to the significant impact guidelines 1.1 (DoE 2013a). The project would be unlikely to have a significant impact on the biodiversity values of the GBMWHA given:

- There would be no direct impact on the GBMWHA
- Indirect impacts associated with the proposed construction and operation of the airport would be unlikely to result in the loss or significant modification of biological diversity or biological processes within the GBMWHA, given:
  - Potential impacts on fauna within the GBMWHA as a result of noise are unlikely to result in changes to species behaviour or habitat use
  - Potential impacts on the GBMWHA as a result of changes to air quality are likely to be negligible given the distance to the GBMWHA and prevailing wind conditions
  - The draft airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns and water quality outside of the airport site.
  - While greenhouse gas emissions will increase as a result of the proposed construction and operation of the airport, this is unlikely to directly result in the loss of biological diversity or biological processes within the GBMWHA.

The airport site was selected based on criteria such as site topography, surrounding topography, proximity to infrastructure and the need to minimise potential environmental and social impacts. Given this range of selection criteria, the size of site required and the constraints associated with the safe operation of an airport it would not have been possible to completely avoid impacts on biodiversity values. The long term development area would not be cleared and grubbed until required for construction of the second runway and other longer term infrastructure. This approach means that impacts on biodiversity values would be avoided for as long as is practicable.

Specific mitigation and management measures are recommended to address the potential impacts on biodiversity values described above. Recommended measures that are likely to substantially reduce the risk or consequence of impacts include:

- protection of the portion of the Badgerys Creek corridor within the airport site along with around 117.1 hectares of land in an environmental conservation zone that includes around 56.8 hectares of native vegetation and 60.3 hectares of land that would be revegetated;
- designing the surface water management system in order to retain any potentially contaminated surface water generated on site and maintain the volume and potentially improve the quality of downstream flows;
- staged vegetation removal during construction, pre-clearing surveys and measures for the salvage of resident fauna and habitat resources;
- translocation programmes for the Cumberland Land Snail and for threatened plant species and populations; and
- designing the proposed airport to minimise its attractiveness to fauna and thus minimise bird and bat strike and terrestrial fauna strike.

Biodiversity offsets would be required to compensate for significant residual impacts arising from the proposed airport in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC 2012). An offset package has been prepared to compensate for the following significant impacts on protected matters listed under the EPBC Act:

- removal of 90 hectares of vegetation within the local occurrence of Cumberland Plain Woodland;
- removal of 120 hectares of foraging habitat for the Grey-headed Flying-fox; and
- other plants, animals and their habitats, including several species and communities listed under NSW legislation in an area of Commonwealth Land.

The quantum of biodiversity offsets required has been calculated in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012) and includes offsets assessment guide calculations for impacts on EPBC Act-listed species and communities and FBA credit calculations for impacts on plants, animals and their habitats. The biodiversity offset package sets out the overarching framework and strategy for how biodiversity offsets will be identified and secured for the proposed airport. Offsets for the proposed airport would comprise the conservation of habitat for the affected protected matters in suitable offset sites and other appropriate offsetting mechanisms. Offset sites would mainly be secured by the relevant site owners obtaining a BioBanking agreement that would ensure that they would be securely titled and managed for conservation as a Biobank in perpetuity.

The process of identifying and securing suitable biodiversity offsets will continue after the Infrastructure Minister's determination of the Airport Plan for the proposed airport. A biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the proposed airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

Long term development at the airport site would require separate assessment of impacts and calculation of additional biodiversity offsets. Other major developments in the locality subject to State approval processes would need to deliver biodiversity offsets in accordance with the NSW Framework for Biodiversity Assessment and/or the EPBC Act Offsets Policy. The cumulative benefits of biodiversity offsets should help to compensate for the cumulative impacts of the various developments.

11. References

Allen, G.R., Midgley, S.H. and Allen, M., 2002, Field Guide to the Freshwater Fishes of Australia, *Western Australian Museum*

Andersen D. E..; Rongstad O. J.;and Mytton W. R.., 1986, Response of Nesting Red-Tailed Hawks to Helicopter Overflights. *Condor*. 91: 296-299.

Andrews, A. 1990, Fragmentation of habitat by roads and utility corridors: a review. *Australian Zoologist,* vol. 26, pp. 130-142.

ANZECC & ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council.

ASTB 2010, *Australian Aviation Wildlife Strike Statistics: Bird and animal strikes 2002 to 2009. Australian Transport Safety Bureau*. Accessed at http://www.atsb.gov.au/media/1574235/ar2009064.pdf

ATRP 2010, *Streblus pendulinus*, Australian Tropical Rainforest Plants. Accessed at http://keys.trin.org.au:8080/key-server/data/0e0f0504-0103-430d-8004-060d07080d04/media/Html/taxon/Streblus_pendulinus.htm.

Augee, M.L. and Ford, D. 1999, Radio-tracking studies of Grey-headed Flying-foxes, *Pteropus poliocephalus*, from the Gordon colony, Sydney. *Proceedings of the Linnaean Society of New South Wales,* vol. 121, pp.61-70.

Avisure 2015, *Western Sydney Airport Bird and Bat Strike Risk Assessment*. Report prepared for Department of Infrastructure and Regional Development, Western Sydney Unit.

AWS 2015, *An national strategy for weed management in Australia*. Commonwealth of Australia, Australian Weeds Committee.

Backhouse, G., J. Lyon & B. Cant 2008, *Background and Implementation Information for the Murrray Hardyhead Craterocephalus fluviatilis National Recovery Plan*. Melbourne, Victoria: Department of Sustainability and Environment.

Backhouse, G., Jackson, J. and O'Connor, J. 2008. Background and Implementation Information for the Australian Grayling *Prototroctes maraena* National Recovery Plan. Department of Sustainability and Environment, Melbourne.

Bali, R, 2005, Discussion paper – *Compensating for Edge Effects*, Ecosense for the Roads and Bannerman S.M. and Hazelton P.A., 1990, Soil Landscapes of the Penrith 1:100,000 Sheet map and report, Soil Conservation Service of NSW, Sydney.

Barber, J.R., Fristrup, K. M., Brown, C. L., Hardy, A. R., Angeloni, L. M. and Crooks, K. R. 2009. Conserving the wild life therein--Protecting park fauna from anthropogenic noise. *Park Science* 26 (3).

Bee, M. A., and E. M. Swanson. 2007. Auditory masking of anuran advertisement calls by road traffic noise. *Animal Behaviour* 74:1765–1776.

Benwell, A. (2014). *Warrell Creek to Urunga Upgrade of the Pacific Highway Threatened Flora Management Plan*. www.rms.nsw.gov.au/.../warrell-creek.../management-plan-threatened-flora

Biosecurity New Zealand (undated). Invasive Ant Risk Assessment. Accessed at http://www.biosecurity.govt.nz/files/pests/invasive-ants/yellow-crazy-ants/yellow-crazy-ant-risk-assessment.pdf

Biosis Research 1999, Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area Technical Paper 8: Flora and Fauna. Report prepared for PPK.

Birdlife Australia 2015a, The website for the atlas of Australian Birds. Accessed at http://birdlife.org.au/projects/atlas-and-birdata/data-extractions-atl

Birdlife Australia 2015b, Find a bird; Australian Painted Snipe. Accessed at http://www.birdlife.org.au/all-about-birds/australias-birds/find-a-bird/

Birdline NSW 2015, Birdline NSW recent sightings. http://www.eremaea.com/BirdlineRecentSightings.aspx?Birdline=2

Birds Australia 2008, Birds in Backyards Factsheet: Rufous Fantail. Accessed at http://birdsinbackyards.net/species/Rhipidura-rufifrons.

BOM (2015c). *Atlas of Groundwater Dependent Ecosystems*, Bureau of Meteorology. http://www.bom.gov.au/water/groundwater/gde/map.shtml

BOM 2015a, Climate Data Online. Sydney Olympic Park weather station (66212), Bureau of Meteorology. Accessed at http://www.bom.gov.au/climate/data/?ref=ftr

BOM 2015b, Sydney in autumn 2015: Wettest autumn since 2003, Bureau of Meteorology. Accessed at http://www.bom.gov.au/climate/current/season/nsw/archive/201505.sydney.shtml

Campbell, S. 2009, So long as it’s near water: variable roosting behaviour of the large-footed myotis (*Myotis macropus*). *Australian Journal of Zoology* 57: 89-98.

Campbell, S. 2011, Ecological specialisation and conservation of Australia's large-footed myotis: a review of trawling bat behaviour. In *'The Biology and Conservation of Australasian Bats*' (eds B. Law, P. Eby, D. Lunney and L. Lumsden). Royal Zoological Society of NSW, pp. 72-85

Chessman, B.C. 2003, SIGNAL 2 – *A Scoring System for Macro-invertebrate* (‘*Water Bugs’*) *in Australian Rivers*. *Monitoring River Heath Initiative Technical Report no 31*, Commonwealth of Australia, Canberra.

Churchill, S 2008, *Australian Bats*, Allen and Unwin, Australia.

Conomy, JT; Dubovsky, JA; Collazo, JA; Fleming, WJ, 1998, Do black ducks and wood ducks habituate to aircraft disturbance. *Journal of Wildlife Management* 62: 1135-1142.

Commonwealth Consolidated Regulations. *The Airports (Environment Protection) Regulations 1997. http://www.austlii.edu.au/cgi-bin/download.cgi/au/legis/cth/consol_reg/apr1997501, accessed 19th November 2014.* Department of Primary industries (2013).

Corben C 2015, *AnalookW* software, version 4.1t.

DEC 2004a, *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. Department of Environment and Conservation.

DEC 2004b, *Wildlife corridors*. Department of Environment and Conservation. Accessed at http://www.environment.nsw.gov.au/resources/nature/landholderNotes15WildlifeCorridors.pdf

DEC 2005, Pimelea spicata *R*. Br. *Recovery Plan*. Department of Environment and Conservation.

DEC 2005, *Recovering bushland on the Cumberland Plain: best practice guidelines for the management and restoration of bushland,* New South Wales Department of Environment and Conservation. Accessed at http://www.environment.nsw.gov.au/threatenedspecies/CumberlandPlainManagementGuidelines.htm

DEC 2006a, *NSW Recovery Plan for the Large Forest Owls: Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae)* Department of Environment and Conservation.

DEC 2006b, *NSW Recovery Plan for the Bush Stone-curlew (*Burhinus grallarius). Department of Environment and Conservation, Sydney. Accessed at http://www.environment.nsw.gov.au/resources/nature/TSRecoveryPlanForestOwls.pdf

DECC 2007, *Terrestrial vertebrate fauna of the Greater Southern Sydney region: Volume 2 Species of conservation concern and priority pest species*. A joint project between the Sydney Catchment Authority and the Parks and Wildlife Division of the Department of Environment and Climate Change by the Information and Assessment Section, Metropolitan Branch, Climate Change and Environment Protection Group, Department of Environment and Climate Change (NSW). http://www.environment.nsw.gov.au/threatenedspecies/faunasouthsydney.htm

DECC 2008a, *NSW (Mitchell) Landscapes*, *Version 3*. Department of Environment and Climate Change.

DECC 2008b, *Descriptions for NSW (Mitchell) Landscapes*. Department of Environment and Climate Change.

DECC 2008c, *Recovery plan for the Koala* (Phascolarctos cinereus). Department of Environment and Climate Change. Accessed at http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf

DECC 2008d, *Hygiene protocol for the control of disease in frogs*. Department of Environment and Climate Change, NSW, Sydney South.

DECC 2008e, *Identification Guidelines for Endangered Ecological Communities Freshwater Wetlands on Coastal Floodplains (Freshwater Wetlands)*, Department of Environment and Climate Change, Hurstville, NSW.

DECC 2008f, *Managing Urban Stormwater; Soils and Construction, Volume 2D, Department of Environment and Climate Change, Sydney*, (NSW).

DECC 2009a, *Biobanking Assessment Methodology and Credit calculator operational manual. Department of Environment and Climate Change*, Sydney, (NSW).

DECC 2009b, *Greater Blue Mountains World Heritage Area Strategic Plan. Department of Environment and Climate Change*. Accessed at http://www.environment.nsw.gov.au/resources/parks/stategicplannpws.pdf

DECCW 2009, *National Recovery Plan for Grey-headed Flying-fox* (Pteropus poliocephalus), Department of Environment, Climate Change and Water (NSW), Hurstville.

DECCW 2010, *Cumberland Plain Recovery Plan*, Department of Environment, Climate Change and Water (NSW), Sydney.

DEH 2006, *Threat Abatement Plan: infection of frogs with chytrid fungus resulting in chytridiomycosis*. Department of Environment and Heritage. Accessed at http://www.environment.gov.au/biodiversity/threatened/publications/tap/infection-amphibians-chytrid-fungus-resulting-chytridiomycosis

DEH 2008, *Approved conservation advice for* Pultenaea parviflora. Department of Environment and Heritage. Available at http://www.environment.gov.au/cgi-bin/sprat/public/conservationadvice.pl

Department of Infrastructure and Transport 2012, *Joint Study on Aviation Capacity in the Sydney Region.*

Department of Infrastructure and Transport 2013, *A Study of Wilton and RAAF Base Richmond for civil aviation operations.*

DERM 2011, *National recovery plan for the large-eared pied bat* Chalinolobus dwyeri. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Department of Environment and Resource Management. Accessed at http://www.environment.gov.au/system/files/resources/9e59696a-f72f-4332-8eda-25eeb4460349/files/large-eared-pied-bat.pdf

DEWHA 2009a, *Significant impact guidelines for the vulnerable green and golden bell frog* Litoria aurea. Department of Environment, Water, Heritage and the Arts. Accessed at http://www.environment.gov.au/resource/significant-impact-guidelines-vulnerable-green-and-golden-bell-frog-litoria-aurea

DEWHA 2009b, *Draft significant impact guidelines for 36 migratory shorebird species*. Department of Environment, Water, Heritage and the Arts. Accessed at http://www.environment.gov.au/resource/draft-significant-impact-guidelines-36-migratory-shorebird-species-migratory-species-epbc

DEWHA 2010a, *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act*. Department of Environment, Water, Heritage and the Arts. Accessed at http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-frogs-guidelines-detecting-frogs-listed-threatened

DEWHA 2010b, *Survey guidelines for Australia's threatened birds. : Guidelines for detecting birds listed as threatened under the EPBC Ac*t. Department of Environment, Water, Heritage and the Arts. Accessed at http://www.environment.gov.au/system/files/resources/107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds.pdf

DEWHA 2010c. *Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act*. Department of the Environment, Water, Heritage and the Arts. Accessed at: http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-bats-guidelines-detecting-bats-listed-threatened

DEWHA 2010d, *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest A guide to identifying and protecting the nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999 Policy Statement 3.31*. Department of Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra, ACT.

DEWHA 2010e. *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act*. Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-mammals-guidelines-detecting-mammals-listed

DIRD 2014, *Western Sydney Airport referral of proposal action*. Department of Infrastructure and Regional Development.

DoE 2011. Approved Conservation Advice for Botaurus poiciloptilus (*Australasian Bittern*). http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-conservation-advice.pdf

DoE 2013a, *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment.

DoE 2013b, *Significant impact guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies*. Department of the Environment.

DoE 2014a, *EPBC Act referral guidelines for the vulnerable Koala*. Department of the Environment. Accessed at http://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-vulnerable-koala

DoE 2014b, *Threat abatement plan for disease in natural ecosystems caused by* Phytophthora cinnamomi*.* Department of the Environment. Accessed at http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-disease-natural-ecosystems-caused-phytophthora-cinnamomi

DoE 2014c, *Approved conservation advice for Litoria aurea* (green and golden bell frog). Department of the Environment. Accessed at http://www.environment.gov.au/cgi-bin/sprat/public/conservationadvice.pl

DoE 2014d, *Approved conservation advice for* Heleioporus australiacus (giant burrowing frog). Accessed at http://www.environment.gov.au/cgi-bin/sprat/public/conservationadvice.pl

DoE 2015a, *Protected Matters Search Tool*. Department of the Environment. Accessed at http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst.jsf

DoE 2015b, *Species profiles and threats database (SPRAT*). Department of the Environment. Accessed at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DoE 2015c, *Assessment Process Notice*. Department of the Environment. Accessed at http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=referral_detail&proposal_id=7391

DoE 2015d, *Key threatening processes under the EPBC Act*. Department of the Environment. Accessed at http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes

DoE 2015e, *Independent review of the Environment Protection and Biodiversity Conservation Act 1999. Fact Sheet 5 Climate Change.* Department of the Environment. Accessed at http://www.environment.gov.au/system/files/resources/5f3fdad6-30ba-48f7-ab17-c99e8bcc8d78/files/fact-sheet-5-climate-change.pdf

DoE 2015f, *Guidelines for a draft Environmental Impact Statement for Western Sydney Airport*. Department of the Environment.

DoE 2015g, *Interactive Flying Fox Web Viewer*: http://www.environment.gov.au/biodiversity/threatened/species/flying-fox monitoring.

DoP 2016, *Sydney Growth Centres Strategic Assessment - Program Report*. New South Wales Department of Planning

DPI 2007, *Key Fish Habitat maps.* http://www.dpi.nsw.gov.au/fisheries/habitat/publications/protection/key-fish-habitat-maps

DPI 2011, *Myrtle Rust factsheet*, Department of Primary Industries. Accessed at http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust

DPI 2013, *Policy and guidelines for fish habitat conservation and management (update 2013*) Accessed at http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation

DPI 2015a, *Profiles for species, populations and ecological communitie*s. Department of Primary Industries. Accessed at http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current

DPI 2015b, *Weeds declared in the Local Control Authority area of Liverpool City Council*. Department of Primary Industries. Accessed by http://weeds.dpi.nsw.gov.au/WeedDeclarations/Results?RegionId=70

Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) 2011, *Interim Biogeographic Regionalisation for Australia (IBRA), Version 6.1* DSEWPaC, Canberra, ACT.

DSEWPaC 2012, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Duffy, A.M., Lumsden, L.F., Caddle, C.R., Chick, R.R. & Newell, G.R. 2000, The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, *Acta Chiropterologica, vol* 2, pp. 127-144.

Eby P. 1991, Seasonal Movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropopididae), from Two Maternity Camps in Northern New South Wales, *Wildlife Research*, vol. 18, pp 547-59.

Eby P. 1996, *Interactions between the grey-headed flying-fox* Pteropus poliocephalus *and its diet plants*, University of New England, Lismore.

Eby, P. and Law, B. 2008, *Ranking the feeding habitats of Grey-headed flying foxes for conservation management*. A report for The Department of Environment and Climate Change (NSW) & the Department of Environment, Water, Heritage and the Arts.

Ecological Australia 2012, *Liverpool Biodiversity Management Plan*. Report prepared for Liverpool City Council.

Ecosure 2009, *Sydney Basin Australian White Ibis Regional Management Plan*. West Burleigh, Queensland.

Ellis, D. H., Ellis, C. H., & Mindell, D. P. 1991, Raptor responses to low-level jet aircraft and sonic booms. *Environmental Pollution*, 74(1), 53–83.

Fly By Night Bat Surveys Pty Ltd. 2004. *Monitoring of the Bat Fauna of Ulan Underground Coal Mine Lease and Rehabilitation Areas of Ulan Open Cut Coal Mine during 2004*. Report to Mount King Ecological Surveys.

Forman, R. T. T. 2000, Estimate of the area affected ecologically by the road system in the United States. Conservation Biology, Vol. 14, pp 31–35.

GHD 2016a, *Western Sydney Airport, Biodiversity Offset Package*. Report prepared for Department of Infrastructure and Regional Development.

GHD 2016b, *Western Sydney Airport Environmental Impact Statement; Surface Water Hydrology and Geomorphology*. Report prepared for Department of Infrastructure and Regional Development.

GHD 2016c, *Western Sydney Airport Environmental Impact Statement; Surface Water Quality Assessment.* Report prepared for Department of Infrastructure and Regional Development.

GHD 2016d, *Western Sydney Airport Environmental Impact Statement; Air Quality*. Report prepared for Department of Infrastructure and Regional Development.

GHD 2016e, *Western Sydney Airport Environmental Impact Statement; Groundwater*. Report prepared for Department of Infrastructure and Regional Development.

Gibbons, P; Lindenmayer, D.B.; Barry, S.C. and Tanton, M.T. 2000, Hollow formation in eucalypts from temperate forests in south-eastern Australia. *Pacific Conservation Biology, vol.* 6, pp 218-228.

Gomon, M. F. 2011, Firetail Gudgeon, *Hypseleotris galii*, in Fishes of Australia. Accessed 23/6/2015. http://www.fishesofaustralia.net.au/home/species/4146

Hart, B.T., Bailey, P., Edwards, R., Hortle, K., James, K., Mcmahon, A., Meredith, C. & Swadling, K. 1991, A review of the salt sensitivity of the Australian freshwater biota. *Hydrobiologia,* **210,** 105-144.

Higgins, P.J. (ed.) 1999, *Handbook of Australian, New Zealand and Antarctic Birds*. *Volume 4: Parrots to Dollarbird.* Oxford University Press.

http://pas.dpi.nsw.gov.au/Species/Species_Profile.aspx?SpeciesListingID=15

http://www.environment.gov.au/system/files/resources/2ec924dc-c627-4288-81f5-51025ef2e166/files/pomaderris-brunnea-recovery-plan.pdf

Jessup, L.W. 2003, *Flora of South-eastern Queensland: Volume 1: Changes to names or status of taxa*. Queensland Herbarium, Toowong, Queensland. Accessed by http://www.derm.qld.gov.au/register/p00721aa.pdf.

Kuginis L., Byrne G., Serov P, Williams J.P., June 2012, *Risk assessment guidelines for groundwater dependent ecosystems, Volume 3 – Identification of high probability groundwater dependent ecosystems on the coastal plains of NSW and their ecological value, NSW* Department of Primary Industries, Office of Water, Sydney. Accessed at http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems

Landon, D. M., P. R. Krausman, K. K. G. Koenen, and L. K. Harris. 2003, Pronghorn use of areas with varying sound pressure levels. *Southwestern Naturalist* 48:725–728.

Law, B.S., Herr, A. and Phillips, W. 2008, Eastern False Pipistrelle *Falsistrellus tasmaniensis*. In S. Van Dyke and R. Strahan (eds), *'The Mammals of Australia' 3rd edition*. Reed New Holland, Chatswood.

Lemckert, F. 1999, *Green and Golden Bell Frog Survey Report*. Appendix F5 Environmental Impact Statement: Second Sydney Airport Proposal.

Lengagne, T. 2008, Traffic noise affects communication behaviour in a breeding anuran, *Hyla arborea*. *Biological Conservation* 141:2023–2031.

Lintermans, M. (2007), *Fishes of the Murray-Darling Basin: An Introductory Guide*. Murray-Darling Basin Authority, Canberra.

Lock, M.L. and Wilson, B.A. 1999, The distribution of the New Holland mouse (*Pseudomys novaehollandiae*) with respect to vegetation near Anglesea, Victoria. *Wildlife Research* vol. 26, pp 565-577.

Mills, D.J., Norton, T.W., Parnaby, H.E., Cunningham, R.B. & Nix, HA 1996, Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. *Forest Ecology and Management* 85(1-3):149-161.

NPWS 1997, *Western Sydney Urban Bushland Biodiversity Survey*. NSW National Parks and Wildlife Service, Hurstville.

NPWS 2000, *Environmental impact assessment guidelines: Cumberland Plain Large Land Snail*. National Parks and Wildlife Service. Accessed at http://www.environment.nsw.gov.au/resources/nature/McorneovirensEia0500.pdf

NPWS 2001, *Blue Mountains National Park Plan of Management*. National Parks and Wildlife Service. Accessed at http://www.environment.nsw.gov.au/resources/parks/pomfinalbluemountains.pdf

NPWS 2002, *Environmental impact assessment guidelines: Cynanchum elegans*. NSW National Parks and Wildlife Service. Accessed at http://www.environment.nsw.gov.au/resources/nature/CelegansEia1202.pdf

NPWS 2002, *Environmental impact assessment guidelines:* Dillwynia tenuifolia. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/DtenuifoliaEia0502.pdf

NPWS 2002, *Environmental impact assessment guidelines:* Grevillea juniperina subsp. juniperina. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/GjuniperinaEia0502.pdf

NPWS 2002, *Environmental impact assessment guidelines:* Pultenaea parviflora. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/PparvifloraEia0502.pdf

NPWS 2002, *Environmental impact assessment guidelines:* Grevillea parviflora subsp. parviflora. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/GparvifloraEia0802.pdf

NPWS 2002a, *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney*, Final Edition. New South Wales National Parks and Wildlife Service, Hurstville.

NPWS 2003, *Environmental impact assessment guidelines:* Acacia pubescens. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/ApubescensEia0103.pdf

NPWS 2003, *Environmental impact assessment guidelines:* Pimelea spicata. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/resources/nature/PimeleaSpicata0805EIA.pdf

NPWS (2003). *Predation by Gambusia holbrooki – the Plague Minnow. Approved NSW Threat Abatement Plan*. NSW National Parks and Wildlife Service http://www.environment.nsw.gov.au/pestsweeds/TAPPlagueMinnow.htm

NPWS 2006, *Native Vegetation of the Cumberland Plain, Western Sydney.*

NSW Scientific committee 2009, *Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing NSW Scientific Committee - Final determination*. Accessed at http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm

O'Gara E., K. Howard, B. Wilson and GEStJ. Hardy 2005, *Management of* Phytophthora cinnamomi *for Biodiversity Conservation in Australia: Part 2- National best practice guidelines*. Accessed at http://www.environment.gov.au/system/files/resources/23925ac2-8fda-4036-aa56-5451f5d8b06d/files/part2.pdf

OEH 2014a, *Framework for Biodiversity Assessment – NSW Biodiversity Offsets policy for Major projects*. Office of Environment and Heritage. Accessed at: http://www.environment.nsw.gov.au/biodivoffsets/1482fba.htm

OEH 2014b, *NSW vegetation types database*. Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm

OEH 2015a, *NSW Bionet. The website for the atlas of NSW wildlife*, Office of Environment and Heritage. Accessed at http://www.bionet.nsw.gov.au/

OEH 2015b, *Threatened Species Profiles*. Office of Environment and Heritage. Accessed at http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx.

OEH 2015c, *VIS Classification 2.1- Community Identification.* Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/NSWVCA20PRapp/search/keysearch.aspx

OEH 2015d, *Key threatening processes*, Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/threatenedspecies/KeyThreateningProcessesByDoctype.htm

OEH 2015e, *OEH principles for the use of biodiversity offsets in NSW.* Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm

OEH 2016, Credit Calculator for Major Projects and Biobanking - Operation Manual. Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/resources/biobanking/160096BBCC.pdf

Parsons, J.G., Blair, D., Luly, J. and Robson, S.K.A. 2009, Bat strikes in the Australian aviation industry. *Journal of Wildlife Management*, Vol. 73, pp. 526-529.

Pennay, M, Law, B, Reinhold, L 2004, *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*, NSW Department of Environment and Climate Change, Hurstville.

Pennay, M., Law, B., and Lunney, D. 2011, Review of the Distribution and status of the bat fauna of NSW and the ACT. pp. 226-256 in *The Biology and Conservation of Australian Bats,* edited by Law., B Eby., P, Lunney., D.

PPK Environment and Infrastructure 1999, *Second Sydney Airport Draft Environmental Impact Assessment*. Report prepared for the Commonwealth Department of Transport and Regional Development.

Reijnen, R., Foppen, R., Braak, C. Ter, & Thissen, J. 1995, The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads. *Journal of Applied Ecology*, 187–202.

RBGS 1992, *Further progress report on the ex-situ conservation at the Mt Annan Botanic Garden of the Badgerys Creek population of* Pultenaea parviflora. Royal Botanic Gardens Sydney letter dated 20 February 1992 to Infrastructure Planning Group, Department of Transport and Communications.

RBGT 2015, *PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust,* The Royal Botanic Gardens and Domain Trust *Sydney, Australia. Accessed* by: http://plantnet.rbgsyd.nsw.gov.au

Saunders, D.L. and Tzaros, C.L. 2011, *National Recovery Plan for the Swift Parrot* Lathamus discolor*.* Birds Australia. Accessed at http://www.environment.gov.au/system/files/resources/c3e20a20-8122-4a9c-bd06-455ea7620380/files/lathamus-discolor-swift-parrot.pdf

Schaub, A., Ostwald, J., & Siemers, B. M. 2008, Foraging bats avoid noise. *Journal of Experimental Biology*, 211: 3174–3180.

SMEC 2014, *Environmental field survey of Commonwealth land at Badgerys Creek*. Report prepared for Western Sydney Unit Department of Infrastructure and Regional Development.

Spencer HJ, C Palmer and K Parry-Jones 1991, Movement of fruit-bats in eastern Australia, determined by radio-tracking, *Journal of Wildlife Research* Vol 18, pp. 463-467.

Stauber, A. G. (2006). *Habitat requirements and habitat use of the red-crowned toadlet Pseudophryne australis and the giant burrowing frog* Heleioporus australiacus *in the Sydney basin*. PhD thesis University of Technology, Sydney.

Steffen, W., Burbidge, A.A., Hughes, L., Kitching, R., Lindenmayer, D., Musgrave, W., Stafford-Smith, M. and Werner, P.A. 2009, *Australia’s biodiversity and climate change: a strategic* *assessment of the vulnerability of Australia's biodiversity to climate change*. A report to the Natural Resource Management Ministerial Council commissioned by the Australian Government. CSIRO Publishing. Accessed at http://www.environment.gov.au/climate-change/adaptation/publications/australias-biodiversity-climate-change

Sutter G 2011, *National Recovery Plan for the Rufous Pomaderris* (*Pomaderris brunnea).* Department of Sustainability, Water, Population and Communities. Accessed at

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*. Department of Primary Industries, Water and Environment, Hobart. Accessed by http://www.environment.gov.au/system/files/resources/a1580450-35ba-4f52-bf50-ad1e36ae2272/files/swift-parrot.pdf

Thackway, R. and Cresswell, I.D. 1995. *An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0*. Australian Nature Conservation Agency, Canberra.

Theischinger, G., & Hawking, J.H. (2006). *The complete field guide to dragonflies of Australia*. Collingwood, Vic. CSIRO.

Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, P., & Cox S. 2010, Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11: 359–406.

TSSC 2001, *Land clearance*, Threatened Species Scientific Committee Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed at http://www.environment.gov.au/node/14579

TSSC 2008, *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.* Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-listing-advice.pdf.

TSSC 2013, *Commonwealth Listing Advice on Western Sydney Dry Rainforest and Moist Woodland on Shale*. Threatened Species Scientific Committee Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed by http://www.environment.gov.au/biodiversity/threatened/communities/pubs/106-listing-advice.pdf

Turak, E., Waddell, N. & Johnstone, G. (2004) *New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual*. Department of Environment and Conservation (NSW), Sydney.

UNESCO 2015, *Greater Blue Mountains Area*. United Nations Educational, Scientific and Cultural Organisation. Accessed at http://whc.unesco.org/en/list/917

Vallee, L., T. Hogbin, L. Monks, B. Makinson, M. Matthes & M. Rossetto 2004, *Guidelines for the translocation of threatened plants in Australia - Second Edition*. Canberra, ACT: Australian Network for Plant Conservation.

Van Dyck, S and Strahan R. 2008. *The mammals of Australia, 3rd edition*, Sydney, New Holland Publishers.

Webb N.J. and Tidemann C.R. 1996. Mobility of Australian flying-foxes, *Pteropus* spp. (Megachiroptera): evidence from genetic variation. *Proceeding of the Royal Society London Series B* 263, 497–502.

White AW and Pyke GH 2008, Green and Golden Bell Frogs in New South Wales: current and future prospects. *Australian Zoologist*, Vol. 34, pp 319-333.

Wilkinson Murray 2015a, *Western Sydney Airport EIS: Assessment of Ground-based Noise*. Report prepared for GHD.

Wilkinson Murray 2015b, Western Sydney Airport EIS: Aircraft Overflight Noise. Report prepared for GHD.

Wilson, B.A. and Bradtke, E. 1999, The diet of the New Holland mouse, *Pseudomys novaehollandiae* (Waterhouse) in Victoria. *Wildlife Research, Vol.* 26, pp. 439-451.

Appendices

Appendix A – Assessment of likelihood of occurrence of threatened and migratory species at the airport site

Likelihood of occurrence classes

Likelihood of occurrence	Definition
Present	Biota confirmed as present within the study area either from previous records or field survey results.
Likely	Species previously recorded within the locality and/or; suitable habitat occurs within the study area. These species are likely to occur in the study area and the airport may result in direct or indirect impacts on these species, including through the removal of habitat resources that may be relied upon by local populations of these species.
Possible	Species known or predicted to occur within the locality and potentially suitable habitat occurs within the study area. These species may occur in the study area on a transitory, seasonal or opportunistic basis. The project may result in direct or indirect impacts on these species, but would not remove any habitat resources that are relied upon by local populations of these species for their ongoing survival in the locality.
Unlikely	Species not previously recorded within the locality; study area is outside of the biota's known distribution and/or; suitable habitat not present within the study area. The project would not result in any direct or indirect impacts on these species or their habitats.

Codes

CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; C - CAMBA, J-JAMBA- R-ROKAMBA ;CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community; VEEC -Vulnerable Endangered Ecological Community M - Migratory.

Other notes

Marine/pelagic/estuarine species, including seabirds, shorebirds, sandpipers, turtles, whales, sharks, appearing in database search results are not considered in the assessment given the inland location of the site.

All habitat information in this table is taken from NSW OEH and Commonwealth Threatened Species profiles (OEH 2015, DoE 2015) unless otherwise stated.

Appendix Table 1 Threatened flora recorded within 10 kilometres of the study area

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Acacia bynoeana	Bynoe's Wattle	E	V	Endemic to central eastern NSW, currently known from only 34 locations, many of only 1-5 plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No sandy soils present at the site.	Unlikely	Low
Acacia pubescens	Downy Wattle	V	V	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	16 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Potential habitat present in shale woodlands and Shale-Gravel Transition Forest.	Possible	Moderate risk of removal of potential habitat.
Allocasuarina glareicola		E	E	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No tertiary alluvial gravels or Castlereagh woodland at the site.	Unlikely	Low
Asterolasia elegans		E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Species or species' habitat may occur within 10km (DoE 2015a)	No sandstone habitat present. Outside of species' known range.	Nil	Nil

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with *Cryptostylis subulata* and the *Cryptostylis erecta*. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Species or species' habitat may occur within 10km (DoE 2015a)	Marginal habitat present. Not previously recorded in the locality.	Unlikely	Nil
Cynanchum elegans	White-flowered Wax Plant	E	E	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	5 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Potential habitat present in forest and woodland.	Possible	Moderate risk of removal of potential habitat.
Dillwynia tenuifolia	*Dillwynia tenuifolia,* Kemps Creek	EP		Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. This population occurs on a small outlier of the Berkshire Park Soil Landscape; the site supports a transition from Castlereagh	26 records within 10km (OEH 2015a)	The Kemps Creek endangered population is located around three kilometres to the east of the airport site (OEH, 2015b). Any *Dillwynia tenuifolia* individuals or habitat at the airport site would not be part of this endangered population.	Nil	Nil
Dillwynia tenuifolia		V		Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	41 records within 10km (OEH 2015a)	Potential habitat present in Shale-Gravel Transition Forest.	Possible	Moderate risk of removal of potential habitat.

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Eucalyptus benthamii	Camden White Gum	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). 2 major subpopulations: in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep.	24 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Broadly suitable habitat present but not recorded despite targetted survey for this large, conspicuous species.	Unlikely	Minor risk of removal of potential habitat.
Eucalyptus scoparia	Wallangarra White Gum	E	V	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	1 record within 10km (OEH 2015a)	No suitable habitat. Outside of species' known distribution.	Nil	Nil
Genoplesium baueri	Yellow Gnat-orchid	E	E	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Species or species' habitat may occur within 10km (DoE 2015a)	No suitable sandstone habitat.	Unlikely	Nil
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V		Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale-Gravel Transition Forests.	87 records within 10km (OEH 2015a)	Potential habitat present in shale woodlands and Shale-Gravel Transition Forest.	Possible	Moderate risk of removal of potential habitat.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	11 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	Potential habitat present in Shale-Gravel Transition Forest.	Possible	Moderate risk of removal of potential habitat.

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Haloragis exalata subsp. exalata	Wingless Raspwort	V	V	Occurs in 4 widely scattered localities in eastern NSW, in the central coast, south coast and north-western slopes. Requires protected and shaded damp situations in riparian habitats.	Species or species' habitat may occur within 10km (DoE 2015a)	Marginal habitat. Outside of species' known distribution.	Nil	Nil
Hypsela sessiliflora syn. Isotoma sessiliflora		E	X	Currently known from a single location less than 10x15m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as *Cynodon dactylon*.	7 records within 10km (OEH 2015a)	Potential habitat present in wetlands and adjoining moist grassland.	Unlikely	Low. Outside of the species known, limited distribution. Considered extinct under the EPBC Act and may not be a valid taxon (Leonard, G. pers. comm.).
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	22 records within 10km (OEH 2015a)	Occupied habitat present in shale woodlands and Shale-Gravel Transition Forest.	Present	Removal of around 142 stems and of occupied habitat.

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Melaleuca deanei	Deane's Melaleuca	V	V	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	Species or species' habitat may occur within 10km (DoE 2015a)	No suitable sandy soils.	Unlikely	Nil
Pelargonium sp. Striatellum	Omeo Stork's-bill	E	E	Omeo Storksbill Pelargonium sp. (G.W. Carr 10345), syn. P. striatellum, is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No suitable habitat. Outside of species' known distribution.	Nil	Nil
Persoonia acerosa	Needle Geebung	V	V	Recorded on central coast and in Blue Mountains, from Mt Tomah to Hill Top (though now believed extinct in Hill Top). Mainly in Katoomba, Wentworth Falls and Springwood areas. Inhabits dry sclerophyll forest, scrubby low woodland and heath on sandstone. Occurs in well-drained soils including sands, laterite and gravels between 550- 1000m asl. May occur in disturbed areas eg roadsides.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No suitable habitat. Outside of species' known distribution.	Nil	Nil
Persoonia nutans	Nodding Geebung	E	E	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	8 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Marginal habitat present in Shale-gravel Transition Forest.	Unlikely	Low
Pimelea curviflora var. curviflora		V	V	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Species or species' habitat may occur within 10km (DoE 2015a)	No sandstone-transition habitat present. No records in the locality.	Unlikely	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Pimelea spicata	Spiked Rice-flower	E	E	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	8 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	Potential habitat present in shale woodland and forest.	Possible	Moderate risk of removal of potential habitat.
Pomaderris brunnea	Rufous Pomaderris	V	V	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by E. amplifolia with Allocasuarina sp. and Bursaria sp. understorey, or on alluvial flats with eucalypts including *E. elata*, *E. piperita* and *E. punctata* (Sutter 2011).	Species or species' habitat likely to occur within 10km (DoE 2015a)	Potential habitat present in alluvial woodland and forest. Outside of species' known distribution.	Unlikely	Moderate risk of removal of potential habitat.
Pterostylis gibbosa	Illawarra Greenhood	E	E	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Eucalyptus tereticornis, *E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata*, *E.tereticornis* and *E. paniculata*. In the Hunter region, the species grows in open woodland dominat*ed by E. crebra, E.tereticornis and Callitris* endlicheri.	Species or species' habitat may occur within 10km (DoE 2015a)	Marginal habitat present. Not previously recorded in the locality.	Unlikely	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Species or species' habitat likely to occur within 10km (DoE 2015a)	Marginal habitat present. Not previously recorded in the locality.	Unlikely	Low
Pultenaea glabra	Smooth Bush-pea	V	V	In NSW restricted to higher Blue Mountains in the Katoomba-Hazelbrook and Mt Victoria areas. Unconfirmed sightings in Mt Wilson and Mt Irvine areas. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No sandstone habitat present. Outside of species' known range.	Nil	Nil
Pultenaea parviflora		E	V	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	89 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Occupied habitat present in shale woodland.	Present	Removal of four individuals and of occupied habitat.
Streblus pendulinus	Siah's Backbone		E	Siah's Backbone occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island (ATRP 2010; Jessup 2003; The Royal Botanic Gardens and Domain Trust 2011). Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010).	Species or species' habitat known to occur within 10km (DoE 2015a)	Marginal habitat in sheltered pockets of shale woodland. No moist woodland or dry rainforest.	Unlikely	Low
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Species or species' habitat may occur within 10km (DoE 2015a)	No suitable habitat. Outside of species' known distribution.	Nil	Nil

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact
Thesium australe	Austral Toadflax	V	V	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass (*Themeda australis*).	Species or species' habitat may occur within 10km (DoE 2015a)	Potential habitat present in woodland and derived grassland.	Possible	Moderate risk of removal of potential habitat.

Appendix Table 2 Threatened fauna recorded within 10km of the study area

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Frogs										
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Has a strong geological association with Hawkesbury Sandstone and occupies upper topographic areas with ephemeral watercourses of gentle gradients. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	4 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	No sandstone habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low
Litoria aurea	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing Cumbungi (*Typha spp*.) or spike rushes (*Eleocharis spp*.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	1 record within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a)	Numerous dams with emergent vegetation present. Mosquitofish common.	Unlikely. Appropriate habitat present, however no individuals recorded despite targeted surveys during March 2015 and October 1998. No previous records at the airport site.	Low	Unlikely. Suitable habitat not likely to be present.	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Species or species' habitat may occur within 10km (DoE 2015a)	No appropriate rocky stream habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low
Pseudophryne australis	Red-crowned Toadlet	V		Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	2 records within 10km (OEH 2015a)	No sandstone habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low
Birds										

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Anthochaera phrygia	Regent Honeyeater	CE	E	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	3 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	No Spotted Gum or Swamp Mahogany forest present.	Unlikely. No suitable foraging habitat present. Not known to breed in the area.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low
Botaurus poiciloptilus	Australasian Bittern	E	E	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp. and Eleocharis spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Species or species' habitat known to occur within 10km (DoE 2015a)	Farm dams and creeks with emergent vegetation present.	Possible. May occur at farm dams and creeks. No local records. Not recorded during surveys.	Low	May occur in the GBMWHA. No records in the area to the west of the airport site (OEH 2015b).	Low
Burhinus grallarius	Bush Stone-curlew	E		Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006b).	2 records within 10km (OEH 2015a)	Small patches of grassy woodland present. Some fallen timber. Mainly grazed.	Unlikely. Limited suitable habitat present.	Low	Not known or predicted to occur in the GMBWHA (OEH 2015b)	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	7 records within 10km (OEH 2015a)	Open woodland, including riparian woodland present.	Possible. May occur during winter months. Unlikely to breed in the airport site.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	18 records within 10km (OEH 2015a)	Small patches of woodland with Allocasuarina species present. Some hollows-bearing trees along present.	Possible. No large expanses of Allocasuarina-dominated woodland present. May forage on occasion in the airport site.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Chthonicola sagittata	Speckled Warbler	V		Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	16 records within 10km (OEH 2015a)	Grassy and shrubby woodland patches present. Few large, undisturbed patches present.	Possible. Some suitable potential habitat present, however may not be of appropriate patch size. No individuals recorded during surveys.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	36 records within 10km (OEH 2015a)	Eucalypt woodland present.	Present. A small group recorded foraging in Badgerys Creek riparian corridor. May breed at the airport site.	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Dasyornis brachypterus	Eastern Bristlebird	E	E	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Species or species' habitat may occur within 10km (DoE 2015a)	No heathy habitat present.	Nil	Nil	Not known or predicted to occur in the GBMWHA (OEH 2015b)	Nil
Ephippiorhynchus asiaticus	Black-necked Stork	E		In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	1 record within 10km, last recorded 1994 (OEH 2015a)	Farm dams present.	Unlikely. Outside usual range.	Low	Known to occur in the northern portion of the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts. Most breeding records are from the western slopes.	3 records within 10km (OEH 2015a)	Eucalypt woodland with areas of shrubs and logs present. Few large patches.	Present. Some suitable potential habitat present, however may not be of appropriate patch size. Few local records.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Hieraaetus morphnoides	Little Eagle	V		Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Also occurs in open country. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	6 records within 10km (OEH 2015a)	Woodland and open country present. Abundance of prey (rabbits etc).	Present. Individuals observed across most of the airport site. Likely to part of the home range for a breeding pair.	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low

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Ixobrychus flavicollis	Black Bittern	V		Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	1 record within 10km (OEH 2015a)	Vegetated creeks and dams with emergent vegetation present.	Present. Observed at the northern end of Badgerys Creek.	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low
Lathamus discolor	Swift Parrot	E	CE	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. *Eucalyptus robusta*, *Corymbia maculata*, C. gummifera and *E. tereticornis* dominated coastal forests are also important habitat.	8 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Eucalyptus tereticornis dominates much of the native vegetation in the study area.	Likely. May forage on occasion in the airport site.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low

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Limosa limosa	Black-tailed Godwit	V	C,J,K	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	1 record within 10km, last recorded 1982 (OEH 2015a)	No preferred habitat present. May occur at farm dams on occasion.	Unlikely. Limited suitable habitat present.	Low	Not known or predicted to occur in the GBMWHA (OEH 2015b)	Nil

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Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km2.	3 records within 10km (OEH 2015a)	Woodland and timbered water courses present.	Possible. Suitable potential habitat present.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.	3 records within 10km (OEH 2015a)	Lightly wooded and open areas present. Few large patches present.	Possible. Some suitable potential habitat present, however may not be of appropriate patch size. Few local records. Not recorded during surveys.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 hectares. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	1 record within 10km (OEH 2015a)	Dry open woodland, including woodland dominated by Grey Box present. Few large patches present.	Possible. May occur on occasion in larger patches in the airport site. Not recorded during surveys.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Ninox connivens	Barking Owl	V		Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including *Eucalyptus camaldulensis*, *Eucalyptus albens*, *Eucalyptus polyanthemos* and *Eucalyptus blakelyi*. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	1 record within 10km (OEH 2015a)	Eucalypt woodland present.	Possible. May forage and breed in the airport site. Few local records. Not recorded during surveys.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low

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Ninox strenua	Powerful Owl	V		Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 hectares. Forages within open and closed woodlands as well as open areas.	17 records within 10km (OEH 2015a)	Woodland and open country present.	Likely. Suitable foraging and breeding habitat present. Not recorded during surveys.	High	Known to occur in the GBMWHA (OEH 2015b).	Low
Oxyura australis	Blue-billed Duck	V	-	Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.		Freshwater wetland habitat present.	Present. Recorded in a wetland at the site. Vagrants likely to occur in small numbers on occasion (eg during periods of drought).	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low

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Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	3 records within 10km (OEH 2015a)	Woodland with woody debris present.	Present. Recorded in woodland alongside Badgerys Creek. Likely to be a non-breeding winter migrant to the airport site.	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low
Petroica phoenicea	Flame Robin	V		Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	4 records within 10km (OEH 2015a)	Woodland with woody debris present.	Likely. Areas of suitable habitat present. Likely to be a non-breeding winter migrant to the airport site.	Moderat e.	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Rostratula australis	Australian Painted Snipe	E	E	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Species or species' habitat likely to occur within 10km (DoE 2015a)	Farm dams with tall reeds present.	Possible. May occur at farm dams. No local records. Not recorded during surveys.	Moderate	Not known or predicted to occur in the GBMWHA (OEH 2015b)	Low
Stagonopleura guttata	Diamond Firetail	V		Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	4 records within 10km (OEH 2015a)	Patches of grassy woodland present, as well as riparian areas and lightly wooded farmland.	Likely. Areas of suitable habitat present.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Stictonetta naevosa	Freckled Duck	V		Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	1 record within 10km (OEH 2015a)	Farm dams and creeks with emergent vegetation present.	Possible. May occur on occasion during drought.	Low	Not known or predicted to occur in the GBMWHA (OEH 2015b)	Nil

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Tyto novaehollandiae	Masked Owl	V		Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 hectares and 1000 hectares. Prey mostly terrestrial mammals but arboreal species may also be taken.	9 records within 10km (OEH 2015a)	Woodland and open country present.	Likely. Suitable foraging and breeding habitat present. Not recorded during surveys.	High	Known to occur in the GBMWHA (OEH 2015b).	Low
Fish										
Prototroctes maraena	Australian Grayling		V	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	Species or species' habitat likely to occur within 10km (DoE 2015a)	No appropriate river habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low

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Macquaria australasica	Macquarie Perch	E (FM Act)	E	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Species or species' habitat may occur within 10km (DoE 2015a)	No appropriate river habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low
Gastropods										
Meridolum corneovirens	Cumberland Plain Land Snail	E		Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	237 records within 10km (OEH 2015a)	Cumberland Plain woodland present.	Present. Occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	Definite. Proposal would remove known habitat.	Does not occur in the GBMWHA.	Nil
Insects										
Archaeophya adamsi	Adam's emerald dragonfly	E (FM Act)		Known from the greater Sydney region. Only five adults have ever been collected. Larvae is found in small creeks with gravel or sandy bottoms, in narrow shaded riffle zones with moss and rich riparian vegetation..	Listed as found within the Sydney Metro CMA (DPI 2015a)	Some small creek habitat with sandy bottoms present.	Unlikely. Riffle zone habitat is limited and not present with other habitat features.	Low	May occur in the GBMWHA.	Low

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Austrocordulia leonardi	Sydney hawk dragonfly	E (FM Act)		Known from three locations in a small area south of Sydney, from Audley to Picton. The species is known from the Hawkesbury-Nepean, Georges River, Port Hacking and Karuah drainages. Occurs in deep and shady riverine pools with cooler water.	Listed as found within the Sydney Metro CMA (DPI 2015a)	No appropriate riverine pool present.	Nil	Nil	May occur in the GBMWHA.	Low
Mammals										

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Van Dyck. and Strahan 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. Habitat critical to the survival of the Large-eared Pied Bat includes sandstone cliffs for roosting and proximate fertile wooded valley habitat for foraging (DECC 2007). The Large-eared Pied Bat is dependent on roosts, including sandstone caves and overhangs, used for diurnal and nocturnal shelter (when not feeding) and for rearing young (DERM 2011). It appears to forage in nearby fertile valleys and plains and along watercourses rather than sandstone landscapes and nearly all records are within several kilometres of cliff lines or rocky terrain (DERM 2011). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	9 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	No sandstone habitat present.	Unlikely. Most records of the species occur within several kilometres of sandstone clifflines or rocky terrain. The airport site is likely to be too distant from sandstone escarpment country and remnant vegetation too patchy and isolated due to clearing to comprise important foraging habitat for this species. There are no roost sites at the airport site or in the immediate vicinity. Large cleared areas separate the airport site and the Blue Mountains.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Has a preference for mature wet forest habitats, particularly in areas of 600 mm rainfall per annum. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 hectares and males up to 3,500 hectares, usually traversed along densely vegetated creek lines. Radio-tracking studies have shown that the species uses gullies and riparian flats for hunting and movement.	Species or species' habitat known to occur within 10km (DoE 2015a)	Patchy woodland including riparian woodland present. Large areas of agricultural land present. Limited connectivity with larger tracts of native vegetation.	Unlikely. Narrow riparian corridor and large cleared areas present. Limited connectivity. No evidence of the species from camera surveys.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded) (Churchill 2008, Law et al 2008).	5 records within 10km (OEH 2015a)	No tall wet forest present. Few large remnants present.	Possibly recorded. Preferred foraging habitat not present. May forage on occasion in larger woodland patches. Could roost in the airport site.	High	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Miniopterus australis	Little Bentwing-bat	V		Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Van Dyck and Strahan 2008).	2 records within 10km (OEH 2015a)	No moist woodland or rainforest present. Tree hollows and empty buildings and sheds and bridges present.	Unlikely. No preferred habitat present.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	34 records within 10km (OEH 2015a)	Woodland and open areas present. Bridges, empty buildings and sheds present.	Possibly recorded (Anabat). May forage throughout the airport site. Could roost under bridges and in buildings.	High	Known to occur in the GBMWHA (OEH 2015b).	Low
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	38 records within 10km (OEH 2015a)	Woodland present. Tree hollows and empty buildings and sheds present.	Present. Most common bat species recorded. Likely to breed at the airport site.	Definite. Proposal would remove known habitat.	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Myotis macropus	Large-footed Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008)	24 records within 10km (OEH 2015a)	Creeks and dams present. Tree hollows and empty buildings and sheds and bridges present.	Probably recorded. Would forage along creeks and above dams. May roost under bridges and in tree hollows.	High	Known to occur in the GBMWHA (OEH 2015b).	Low
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	1 record within 10km, last recorded 1994 (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	No sandstone habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Phascolarctos cinereus	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	3 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	*Eucalyptus tereticornis* (primary feed tree) and *Eucalyptus mollucana* (secondary feed tree) dominate much of the native vegetation in the study area. Woodland is patchy with large cleared areas present. No direct connectivity with other local records.	Unlikely. Patchy vegetation. Local records associated with either the Blue Mountains National Park or the Western Sydney Parklands. No direct connectivity with these areas. No scats recorded.	Low	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Pseudomys novaehollandiae	New Holland Mouse		V	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Species or species' habitat likely to occur within 10km (DoE 2015a)	No heathy habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	38 records within 10km (OEH 2015a); Foraging, feeding and related behaviour known to occur within 10km (DoE 2015a)	Eucalypt woodland present.	Present. Would forage throughout the airport site when trees are in flower. No roost camps present in the airport site.	High	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrence in the GBMWHA	Risk of impact
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	1 record within 10km (OEH 2015a)	Woodland and open areas present. Tree hollows and empty buildings and sheds present.	Possible. Suitable foraging and roosting habitat present. Few local records.	Moderate	Known to occur in the GBMWHA (OEH 2015b).	Low
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Van Dyck and Strahan 2008), Churchill 2008).	15 records within 10km (OEH 2015a)	Woodland and open areas present. Tree hollows and empty buildings and sheds present.	Possibly recorded Would forage throughout the airport site. May roost in the airport site.	High	Known to occur in the GBMWHA (OEH 2015b).	Low

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence in the airport site	Risk of impact	Likelihood of occurrenc e in the GBMWHA	Risk of impact
Vespadelus troughtoni	Eastern Cave Bat	V	-	Occurs in NE NSW south to Kempsey and west to the Warrumbungles. Inhabits rainforest margins, wet and dry sclerophyll forests through to drier forests and woodlands in semi-arid environments. All records are within close proximity to sandstone or volcanic escarpments. Roosts in overhangs and caves, mines, boulder piles, abandoned Fairy Martin nests and occasionally in buildings, and regularly switches between alternate roost colonies. Forages over a small area, but are capable of flying 500 m over clear paddocks (Churchill 2008, Parnaby et al 2008).	0	Woodland and forest areas present. Bridges, culverts and empty buildings and sheds present.	Possibly recorded Would forage throughout the airport site. May roost in the airport site.	High	Known to occur in the GBMWHA (OEH 2015b).	Low
Reptiles										
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Species or species' habitat likely to occur within 10km (DoE 2015a)	No sandstone habitat present.	Nil	Nil	Known to occur in the GBMWHA (OEH 2015b).	Low

Appendix Table 3 Migratory species recorded within 10km of the study area

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence
Apus pacificus	Fork-tailed Swift		C,J,K	Recorded in all regions of NSW. Non- breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	3 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Rural area with patches of native vegetation.	Likely. May forage in the area on occasion.
Ardea alba	Great Egret		C,J	Occurs across NSW. Within NSW there are breeding colonies within the Darling Riverine Plains and Riverina regions, and minor colonies across its range including the north and north-east of the state. Reported from a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial).	8 records within 10km (OEH 2015a); Breeding known to occur within 10km (DoE 2015a)	Variety of farm dams present.	Present. Occasional individuals recorded in the study area.
Ardea ibis	Cattle Egret		C,J	Occurs across NSW. Principal breeding sites are the central east coast from Newcastle to Bundaberg. Also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes). Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Uses predominately shallow, open and fresh wetlands with low emergent vegetation and abundant aquatic flora. Sometimes observed in swamps with tall emergent vegetation and commonly use areas of tall pasture in moist, low-lying areas.	31 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a)	Variety of farm dams and grassland present.	Present. Flocks of about 40 recorded.
Gallinago hardwickii	Latham's Snipe		C,J,K	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	5 records within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a)	Farm dams with low vegetation and adjacent grassland present.	Present. One individual flushed from beside a dam surrounded by grassland.

Scientific name	Common name	TSC Status	EPBC Status	Habitat association	Source	Habitat present in the study area	Likelihood of occurrence
Merops ornatus	Rainbow Bee-eater		J	Distributed across much of mainland Australia, and several near-shore islands. Occurs in a range of habitats, including open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. Nests are made in sandy banks.	3 records within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a)	Rural area with patches of native vegetation.	Present. Several individuals heard in patchy woodland remnants in the vicinity of the Badgerys Creek riparian corridor.
Hirundapus caudacutus	White-throated Needletail		C,J,K	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	1 record within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	Rural area with patches of native vegetation.	Present.
Rhipidura rufifrons	Rufous Fantail			Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	4 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a)	Eucalypt woodland present.	Present. A number of individuals recorded in various patches in the study area.

Notes: 1. Conservation status: M- Migratory species; C = China-Australia Migratory Bird Agreement (CAMBA), J = Japan-Australian Migratory Bird Agreement (JAMBA) and K = Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)

Appendix B – Survey guidelines and methodology

Appendix Table 4 Survey guidelines and methodology for threatened ecological communities known to occur at the airport site*

Scientific name	TSC Status	EPBC Status	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC	CEEC	Much of the native vegetation at the airport site is Cumberland Plain Woodland.	The key diagnostic attributes for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest are detailed in the listing advice (TSSC 2008). In addition, condition thresholds were also established for the national ecological community (TSSC 2008, DEWHA 2010d). Diagnostic attributes of the community as listed under the TSC Act are provided in the NSW VIS Classification 2.1- Community Identification (OEH 2015c), NSW vegetation types database (OEH 2014b) and threatened community profile (OEH 2015b). Vegetation mapping can be conducted using a combination of transects or traverses, plot-based surveys and random meanders (DEC 2004). The FBA details methods for determining the appropriate number of pilot-transects required for a site, and for identifying condition of each plot surveyed (OEH 2014a). The NSW VIS Classification 2.1- Community Identification (OEH 2015c) and vegetation types database provides information on each vegetation type in NSW (OEH 2014b).	Vegetation survey and assessment for the community listed under both the EPBC Act and TSC Act was carried out with reference to the FBA (OEH 2014a, 2016) in order to assess vegetation type and condition and to calculate the quantum of offsets required for the proposed airport. Diagnostic species of each plot-transect were compared with key diagnostic attributes and condition classes for the threatened ecological community detailed in the listing advice (TSSC 2008).	Surveys carried out for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest at the airport site are consistent with the various relevant guidelines.

Appendix Table 5 Survey guidelines and methodology for flora species known or considered to have a possibility of occurring at the airport site*

Scientific name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended (DEC 2004)	Survey method and timing implemented	Consistency with guidelines
Acacia pubescens	V	V	16 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a).	Potential habitat present in shale woodlands and Shale-Gravel Transition Forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Survey may be conducted at any time of the year (NPWS 2003).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.
Cynanchum elegans	E	E	5 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a).	Potential habitat present in forest and woodland.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Survey may be conducted at any time of the year (NPWS 2002a).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.
Dillwynia tenuifolia	V		41 records within 10km (OEH 2015a).	Potential habitat present in shale woodlands and Shale-Gravel Transition Forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Best surveyed during the flowering period (August to March, but especially September) (NPWS 2002), however the species can be identified outside the flowering season.	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.

Scientific name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended (DEC 2004)	Survey method and timing implemented	Consistency with guidelines
Grevillea juniperina subsp. *juniperina*	V		87 records within 10km (OEH 2015a).	Potential habitat present in shale woodlands and Shale-Gravel Transition Forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Survey may be conducted at any time of the year (NPWS 2003).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.
Grevillea parviflora subsp. *parviflora*	V	V	11 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	Potential habitat present in Shale-Gravel Transition Forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Best surveyed during the main flowering period (July to December) (NPWS 2002), however the species can be identified outside the flowering season.	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.
Hypsela sessiliflora	E	X	7 records within 10km (OEH 2015a).	Potential habitat present in wetlands and adjoining moist grassland.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Flowers in spring, or if conditions are suitable throughout the year (OEH 2015b).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders. Targeted searches carried out around dam margins.	Surveys carried out for this species at the airport site are broadly consistent with the relevant guidelines (other than timing of surveys) The species was not assumed to be present because the airport site is outside of its highly limited distribution.

Scientific name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended (DEC 2004)	Survey method and timing implemented	Consistency with guidelines
Marsdenia viridiflora subsp. *viridiflora*	EP		22 records within 10km (OEH 2015a).	Occupied habitat present in shale woodlands and Shale-Gravel Transition Forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Flowers in spring (RBGT 2015), however the species can be identified outside the flowering season.	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders. Targeted searches carried out near known records.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. The species was recorded at the airport site.
Pimelea spicata	E	E	8 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	Potential habitat present in shale woodland and forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Surveys should be undertaken when flowering, which is sporadic during the year. A nearby reference population should be used as an indicator of flowering time (NPWS 2004).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are broadly consistent with the relevant guidelines (other than confirmation of timing of surveys by checking reference populations). The species was assumed to be present and impacted based on the presence of suitable habitat.
Pomaderris brunnea	V	V	Species or species' habitat likely to occur within 10km (DoE 2015a).	Potential habitat present in alluvial woodland and forest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Scientific name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended (DEC 2004)	Survey method and timing implemented	Consistency with guidelines
Pultenaea parviflora	E	V	89 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a).	Occupied habitat present in shale woodland.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Best surveyed during the flowering period (September) (NPWS 2002), however the species can be identified outside the flowering season.	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders. Targeted searches carried out near known records.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines. This species was recorded at the airport site.
Streblus pendulinus		E	Species or species' habitat known to occur within 10km (DoE 2015a).	Marginal habitat in sheltered pockets of shale woodland. No moist woodland or dry rainforest.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Thesium australe	V	V	Species or species' habitat may occur within 10km (DoE 2015a).	Potential habitat present in woodland and derived grassland.	Combination of transect or plot surveys, opportunistic observations (eg when walking between sites), random meanders. Recommended effort for random meanders is 30 minutes for each quadrat sampled within the same stratification unit as the quadrat (DEC 2004). Flowers and fruits throughout the year (DoE 2015b).	Flora surveys conducted over 18 days between February and June 2015. Included a combination of plot/transects, opportunistic surveys and random meanders.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. The species was assumed to be present and impacted based on the presence of suitable habitat.

* no targeted surveys were conducted for species that have no habitat present or are unlikely to occur based on the assessment provided in Appendix A however the survey effort summarised above would be consistent with the survey guidelines for many of these species.

Appendix Table 6 Survey guidelines and methodology for fauna species known or considered to have a possibility of occurring at the airport site*

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Birds							
Australasian Bittern	E	E	Species or species' habitat known to occur within 10km (DoE 2015a).	Farm dams and creeks with emergent vegetation present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004). Observation of targeted foraging habitat within wetlands in the early morning or early evening. Detection by sightings and unsolicited calls (DEWHA 2010b).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.
Australian Painted Snipe	E	E	Species or species' habitat likely to occur within 10km (DoE 2015a).	Farm dams with tall reeds present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004). Diurnal area search in appropriate habitat in and around the study area, including flushing surveys (DEWHA 2010b).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Barking Owl	V		1 record within 10km (OEH 2015a).	Eucalypt woodland present with large hollow-bearing trees present.	Call playback (at least 5 visits per site which should be at least 800m apart). Daytime habitat search for pellets/ likely hollows. Stag-watching at sunset also an option. Surveys can be carried out all year (DEC 2004).	Call playback conducted on 9 nights between March and May 2015. Spotlighting conducted on 12 nights between March and May 2015. Daytime habitat searches carried out over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the size of the site and access restrictions, no stag watching was carried out. Similarly, only one site was surveyed via call playback each night, and most sites were surveyed once or twice.
Black Bittern	V		Recorded during surveys. 1 record within 10km (OEH 2015a).	Vegetated creeks and dams with emergent vegetation present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Black-chinned Honeyeater (eastern subspecies)	V		1 record within 10km (OEH 2015a).	Dry open woodland, including woodland dominated by Grey Box present. Few large patches present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Diamond Firetail	V		4 records within 10km (OEH 2015a).	Patches of grassy woodland present, as well as riparian areas and lightly wooded farmland.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Flame Robin	V		4 records within 10km (OEH 2015a).	Woodland with woody debris present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Freckled Duck	V		1 record within 10km (OEH 2015a).	Farm dams and creeks with emergent vegetation present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.
Gang-gang Cockatoo	V		7 records within 10km (OEH 2015a).	Open woodland, including Riparian forest present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings and near dams on 4 mornings between May and June 2015 by two ecologists. Opportunistic surveys carried out throughout the day over 3 days in early May 2015. Dedicated driven transects and walked transects carried out on one day in late May and one day in June 2015 by two ecologists.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Glossy Black-Cockatoo	V		18 records within 10km (OEH 2015a).	Small patches of woodland with Allocasuarina species present. Some hollows-bearing trees along present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Hooded Robin (south-eastern form)	V		3 records within 10km (OEH 2015a).	Lightly wooded and open areas present. Few large patches present.	At least 1 hour dawn or dusk survey (DEC 2004) per 100 hectares stratification unit.	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Little Eagle	V		Recorded during surveys. 6 records within 10km (OEH 2015a).	Woodland and open country present. Abundance of prey (rabbits etc).	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Little Lorikeet	V		Recorded during surveys. 3 records within 10km (OEH 2015a).	Eucalypt woodland with areas of shrubs and logs present. Few large patches.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Masked Owl	V		9 records within 10km (OEH 2015a).	Woodland and open country present. Large, hollow-bearing trees present.	Call playback (at least 8 visits per site which should be at least 800m apart). Daytime habitat search for pellets/ likely hollows. Stag-watching at sunset also an option (DEC 2004).	Call playback conducted on 9 nights between March and May 2015. Spotlighting conducted on 12 nights between March and May 2015. Daytime habitat searches carried out over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the size of the site and access restrictions, no stag watching was carried out. Similarly, only one site was surveyed via call playback each night, and most sites were surveyed once or twice.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Powerful Owl	V		17 records within 10km (OEH 2015a).	Woodland and open country present. Large, hollow-bearing trees present.	Call playback (at least 5 visits per site which should be at least 800m apart). Daytime habitat search for pellets/ likely hollows. Stag-watching at sunset also an option (DEC 2004).	Call playback conducted on 9 nights between March and May 2015. Spotlighting conducted on 12 nights between March and May 2015. Daytime habitat searches carried out over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the size of the site and access restrictions, no stag watching was carried out. Similarly, only one site was surveyed via call playback each night, and most sites were surveyed once or twice.
Scarlet Robin	V		Recorded during surveys. 3 records within 10km (OEH 2015a).	Woodland with woody debris present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Speckled Warbler	V		16 records within 10km (OEH 2015a).	Grassy and shrubby woodland patches present. Few large, undisturbed patches present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Square-tailed Kite	V		3 records within 10km (OEH 2015a).	Woodland and timbered water courses present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Swift Parrot	E	E	8 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a).	Eucalyptus tereticornis dominates much of the native vegetation in the study area.	Surveys on the mainland should be conducted between March and July. Area searches of suitable habitat, in the early morning and afternoon when birds are most active and vocal. Slow-moving vehicle transects also effective in expansive areas. Targeted surveys of patches of heavily flowering eucalypts may be useful (DEWHA 2010b).	Early morning bird surveys carried out in woodland areas on 10 mornings and near dams on 4 mornings between May and June 2015 by two ecologists. Opportunistic surveys carried out throughout the day over 3 days in May 2015. Dedicated driven transects and walked transects carried out on one day in late May and one day in June 2015 by two ecologists. All surveys carried out once Swift Parrots were confirmed within NSW (Birdline NSW). General bird surveys were carried out in March and April however these were prior to the species being recorded in NSW.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Varied Sittella	V		Recorded during surveys. 36 records within 10km (OEH 2015a).	Eucalypt woodland present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Mammals							
Grey-headed Flying-fox	V	V	Recorded during surveys. 38 records within 10km (OEH 2015a); Foraging, feeding and related behaviour known to occur within 10km (DoE 2015a).	Eucalypt woodland present.	Spotlight observations and roost surveys (1 hour of spotlighting on two separate nights). Surveys can be conducted all year (DEC 2004). A review of known flying fox camps for the airport site and the wider general area. Surveys of vegetation communities and food plants. Night time surveys including walked transects for feeding and flying bats. Daytime field surveys for camps to record presence of unrecorded day roosts. Timing of surveys are dependent on availability of food resources (DEWHA 2010c).	Flying fox camps reviewed. Vegetation surveys included identification of food plants. 12 nights of nocturnal surveys by 2-3 people between March and May 2015. Diurnal surveys of riparian areas included searches for camps.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Eastern Bentwing-bat	V		34 records within 10km (OEH 2015a).	Woodland and open areas present. Bridges, empty buildings and sheds present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March. Additional methods include searching rocks, overhangs and caves/mines (DEC 2004).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015. Inspection of bridges for roosting bats.	Surveys generally consistent with relevant guidelines. Good calls of this species can be distinguished by anabat analysis, although there can also be some overlaps with other species (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Eastern False Pipistrelle	V		5 records within 10km (OEH 2015a).	No tall wet forest present. Few large remnants present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March (DEC 2004).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015. No harp nets set as few flyways present in the airport site.	Surveys generally consistent with relevant guidelines. Good calls of this species can be distinguished by anabat analysis, although there can also be some overlaps with other species (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.
Eastern Freetail-bat	V		Recorded during surveys. 38 records within 10km (OEH 2015a).	Woodland present. Tree hollows and empty buildings and sheds present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March (DEC 2004).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015. No harp nets set as few flyways present in the airport site.	Surveys generally consistent with relevant guidelines. Calls of this species can be easily distinguished by anabat analysis (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Greater Broad-nosed Bat	V		15 records within 10km (OEH 2015a).	Woodland and open areas present. Tree hollows and empty buildings and sheds present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March (DEC 2004).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015.	Surveys generally consistent with relevant guidelines. Good calls of this species can be distinguished by anabat analysis, although there can also be some overlaps with other species (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.
Southern Myotis	V		Recorded during surveys. 24 records within 10km (OEH 2015a).	Creeks and dams present. Tree hollows and empty buildings and sheds and bridges present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Spotlighting around waterbodies. Survey recommended to occur between October to March (DEC 2004).	Two Anabat units per night for X nights in March and early April 2015. Additional 3 nights in May 2015. Inspection of bridges for roosting bats. No harp nets set as few flyways present in the airport site.	Surveys generally consistent with relevant guidelines. Good calls of this species can be distinguished by anabat analysis, although there can also be some overlaps with other species (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Yellow-bellied Sheathtail-bat	V		1 record within 10km (OEH 2015a).	Woodland and open areas present. Tree hollows and empty buildings and sheds present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March (DEC 2004).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015. No harp nets set as few flyways present in the airport site.	Surveys generally consistent with relevant guidelines. Calls of this species can be easily distinguished by anabat analysis (Pennay et al 2004). Given small patches of vegetation present at the airport site and generally open nature of habitat present, harp trapping was not considered an efficient survey method.
Invertebrates							
Cumberland Plain Land Snail	E		Recorded during surveys. 237 records within 10km (OEH 2015a).	Cumberland Plain woodland present.	Searches to be conducted at any time of the year in appropriate habitat. Survey effort to be determined by size of potential habitat present (NPWS 2000).	Targeted searches in woodland patches over 11 days between March and May 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Migratory species							
Cattle Egret		C,J	Recorded during surveys. 31 records within 10km (OEH 2015a); Species or species' habitat likely to occur	Variety of farm dams and grassland present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
			within 10km (DoE 2015a).			surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	potential habitat present.
Fork-tailed Swift		C,J,K	3 records within 10km (OEH 2015a); Species or species' habitat likely to occur within 10km (DoE 2015a).	Rural area with patches of native vegetation.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Great Egret		C,J	Recorded during surveys. 8 records within 10km (OEH 2015a); Breeding known to occur within 10km (DoE 2015a).	Variety of farm dams present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Latham's Snipe		C,J,K	Recorded during surveys. 5 records within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a).	Farm dams with low vegetation and adjacent grassland present.	A 20 minute dawn or dusk census for each identified watercourse and a 1 hour dawn or dusk survey for each wetland (DEC 2004). Diurnal area search in appropriate habitat in and around the study area, including flushing surveys (DEWHA 2010b).	Early morning bird surveys specifically targeting riparian areas were conducted on 4 mornings and specifically targeting wetlands on 4 mornings between March and June 2015. These surveys tended to include a number of riparian and wetland areas. Wetlands often occurred adjacent to woodland patches, and were thus also surveyed during early morning bird surveys in woodland areas on other days. Opportunistic surveys carried out throughout the day at many wetlands and riparian areas over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the various relevant guidelines. Given the large area of the airport, not every farm dam was surveyed. Surveys focussed on those farm dams with suitable potential habitat present.
Rainbow Bee-eater		J	Recorded during surveys. 3 records within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a).	Rural area with patches of native vegetation.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Rufous Fantail			Recorded during surveys. 4 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	Eucalypt woodland present.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
White-throated Needletail		C,J,K	Recorded during surveys. 1 record within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	Rural area with patches of native vegetation.	Area search method using the species-time curve approach is recommended (DEC 2004).	Early morning bird surveys carried out in woodland areas on 10 mornings between March and June 2015. Opportunistic surveys carried out throughout the day over 18 days between February and June 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

* no surveys were conducted for species that have no habitat present or are unlikely to occur based on the assessment provided in Appendix A.

Appendix Table 7 Survey guidelines and methodology for EPBC Act–listed fauna species unlikely to occur at the airport site*

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Green and Golden Bell Frog	E	V	1 record within 10km (OEH 2015a); Species or species' habitat may occur within 10km (DoE 2015a).	No previous records at the airport site. Numerous dams with emergent vegetation present. Mosquitofish common. Appropriate habitat present, however no individuals recorded despite targeted surveys during March 2015 and October 1998.	The referral guidelines (DEWHA 2009a) recommend an initial habitat assessment followed by at least four nights of surveys between September and March, during warm and windless weather conditions following rainfall. Surveys of about an hour are recommended for wetlands up to 50 metres in width. Where possible, surveys should include use of a nearby reference site (DEWHA 2009a). The survey guidelines for threatened frogs (DEWHA 2010a) further recommend surveys be under taken within one week of heavy rainfall (i.e. greater than 50 mm in seven days) between October and February. Recommended survey methods include visual searches for basking frogs and call playback.	Habitat assessment and four nights of targeted survey conducted in March with heavy rain falling on one night. Surveys could not be conducted prior to this due to timing of project commencement and access constraints.	Surveys carried out for this species at the airport site are generally consistent with the relevant guidelines. Surveys were conducted over 4 nights in March (consistent with DEWHA (2009a)). Surveys were conducted following a wet summer with many large storms, however only one large rainfall event occurred during surveys. Given the timing of commencement of the project, surveys could not be conducted earlier in the season. Surveys conducted in October 1998 did not record any evidence of the species and Lemckert (1999) considered it likely that the Green and Golden Bell Frog does not occur at the airport site.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Regent Honeyeater	CE	E	3 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	No Spotted Gum or Swamp Mahogany forest present.	Area search method using the species-time curve approach is recommended (DEC 2004). Area searches in suitable habitat, preferable in the morning (DEWHA 2010b).	No preferred foraging habitat present. Early morning bird surveys carried out in woodland areas on 10 mornings and near dams on 4 mornings between May and June 2015 by two ecologists. Opportunistic surveys carried out throughout the day over 3 days in May 2015. Dedicated driven transects and walked transects carried out on one day in late May and one day in June 2015 by two ecologists. All surveys carried out once Swift Parrots were confirmed within NSW (Birdline NSW). General bird surveys were carried out in March and April however these were prior to the species being recorded in NSW.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Koala	V	V	3 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	*Eucalyptus tereticornis* (primary feed tree) and *Eucalyptus mollucana* (secondary feed tree) dominate much of the native vegetation in the study area. Woodland is patchy with large cleared areas present. Local records associated with either the Blue Mountains National Park or the Western Sydney Parklands. No direct connectivity with other local records.	Methods include a combination of desktop assessment of local records, vegetation composition, habitat connectivity and assessment of existing threats and recovery value. Various field survey methods can be used, including a combination of strip transects, spotlighting, call playback, remote cameras, and scat searches. Survey methods used depend on area of habitat and considerations of connectivity etc (DoE 2014). The recovery for the Koala details feed trees in various management areas (DECC 2008c).	Habitat assessments between March and June 2015, with regards to feed trees detailed in DECC (2008c). Scat searches in areas of potential habitat over 11 days (35 sites, about 25 person hours). 12 nights of nocturnal surveys by 2-3 people between March and May 2015.	Surveys carried out for this species at the airport site are consistent with the relevant guidelines.
Large-eared Pied Bat	V	V	9 records within 10km (OEH 2015a); Species or species' habitat known to occur within 10km (DoE 2015a).	No preferred sandstone habitat present. No breeding habitat present. Large cleared areas present between the airport site and the Blue Mountains where preferred foraging habitat is located. May forage on occasion in the western portion of the airport site closest to Blue Mountains National Park closer to where suitable habitat is present.	Two Anabat units left recording for the entire night for two nights. Harp trapping (4 trap nights over 2 consecutive nights). Survey recommended to occur between October to March (DEC 2004). The use of electronic bat detectors is the best means of non-invasive survey, and the most efficient in terms of data collection and area coverage. Trapping with harp traps and mistnets, and roost searches in caves, mines, rock overhangs, culverts and crevices could be undertaken to confirm presence or roosting (DEWHA 2010c).	Two Anabat units per night for 9 nights in March and early April 2015. Additional 3 nights in May 2015. No harp nets set as few flyways present in the airport site.	Surveys for this species at the airport site are consistent with relevant guidelines. The Large-eared Pied Bat can be surveyed using anabat analysis (DEWHA 2010a). Calls can easily be distinguished from other species by the combination of the low frequencies and distinct pattern of alternation present in search phase calls (Pennay et al 2004). Given the lack of roosting and breeding habitat, no harp netting was considered necessary.

Common name	TSC Status	EPBC Status	Existing records	Habitat present in the study area	Survey method and timing recommended	Survey method and timing implemented	Consistency with guidelines
Spotted-tailed Quoll	V	E	Species or species' habitat known to occur within 10km (DoE 2015a).	Limited marginal habitat present. No local records. Narrow riparian corridor and large cleared areas present. Limited connectivity.	Recommended techniques include searches for habitat resources, scats and latrines, hair sampling and remote cameras (left on site for three weeks). Cage trapping surveys are not considered necessary at the first stage of detection, provided hair funnel surveys or remote cameras are employed, as they are an appropriate and effective alternative. The optimal survey time is during the breeding season, with peak activity occurring between May and August. Surveys conducted during April to August may detect males in areas where they may not usually occur, either as they move in search of females to mate with or move away from other more competitive males (DEWHA 2010e).	Habitat assessment and searches for evidence (scats/latrines) between March and June 2015. Two infra-red cameras were placed at four separate locations in woodland or near dams (ie each camera recorded at two locations). Cameras were set for 3-4 weeks at each location. Cameras recorded between March and June.	Surveys for this species at the airport site are consistent with relevant guidelines.

Appendix C – Field survey results

Appendix Table 8 Plant species recorded in Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Acanthaceae	*Brunoniella australis*	Blue Trumpet		2	2	2	2	2	2	2	2	2	1	2
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	Rock Fern				1	1			1		1	1	2
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed							1					
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*	1			1		1				2	
Anthericaceae	*Caesia parviflora* var. *parviflora*									2				
Anthericaceae	*Caesia parviflora* var. *vittata*				x			1	1		1			2
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily										x		
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily							1			2	1	
Apiaceae	*Centella asiatica*	Indian Pennywort				1	1					2		2
Apocynaceae	*Araujia sericifera*	Moth Vine	*	1							2	1		1
Apocynaceae	*Marsdenia viridiflora* subsp. *viridiflora*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas											2	
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*	1						1	1			
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	1	2	1	1					1		1
Asteraceae	*Bidens subalternans*	Greater Beggar's Ticks	*	2	1	2			2	2		1		1
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy											1	
Asteraceae	*Cirsium vulgare*	Spear Thistle	*		1		1	2		1		1	1	1
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*		1			1	1	1		1	1	1
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear					1							
Asteraceae	*Euchiton sphaericus*	Star Cudweed			1		1		1			2		
Asteraceae	*Glossocardia bidens*	Cobbler's Tack		1										
Asteraceae	*Hypochaeris radicata*	Catsear	*											1
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood										x		

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Asteraceae	*Senecio hispidulus*	Hill Fireweed							x					
Asteraceae	*Senecio madagascariensis*	Fireweed	*	1			2	1		1		1		
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	Indian Weed						1		1	1			
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*	1	1					1		1		1
Asteraceae	*Taraxacum officinale*	Dandelion	*	1						1		1		
Asteraceae	*Vernonia cinerea*					2	1	2						
Asteraceae	*Vittadinia cuneata*	A Fuzzweed					x						1	1
Brassicaceae	*Lepidium* sp.	A Peppercress	*	1										
Brassicaceae	*Sisymbrium* sp.		*				1							
Cactaceae	*Opuntia stricta*	Common Prickly Pear, Smooth Pest Pear	*				x							
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell			1				1			2	2	
Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush											1	
Chenopodiaceae	*Chenopodium album*	Fat Hen	*		1	1	1						1	
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		2	1	1	2	3	2	2	1	1	2	
Chenopodiaceae	*Einadia nutans* subsp. *nutans*	Climbing Saltbush		2	1		1	3	2		2	1	1	1
Chenopodiaceae	*Einadia polygonoides*	Knotweed Goosefoot											1	
Chenopodiaceae	*Einadia trigonos* subsp. *Trigonos*								1	2	1		1	1
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush											1	
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush										3		
Chenopodiaceae	*Salsola kali* var. *kali*	Buckbush											1	
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		2	2	2	2		2		1			
Convolvulaceae	*Dichondra repens*	Kidney Weed		2	2	2	2	2	2	2	1			1
Crassulaceae	*Bryophyllum delagoense*	Mother of millions	*		x								3	
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Club-rush		1										
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge		1	1		1		1	1	1		1	2
Cyperaceae	*Cyperus* sp.			1								1		

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge					1		2	1		2		1
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower								2				
Ericaceae	*Lissanthe strigosa*	Peach Heath			x	1	1							
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia				x	1		1					2
Juncaceae	*Juncus subsecundus*	Finger Rush			1									
Juncaceae	*Juncus usitatus*											x		
Lamiaceae	*Ajuga australis*	Austral Bugle								1				
Lamiaceae	*Mentha satureioides*	Native Pennyroyal					1			2				2
Lobeliaceae	*Isotoma fluviatilis*	Swamp Isotome						x						
Lobeliaceae	*Pratia purpurascens*	Whiteroot												2
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*			3	2		2		2	1	1	3	2	2
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush								1		x		2
Loranthaceae	*Amyema pendulum* subsp. *pendulum*													1
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*	1										
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*	2	2	2	2		2		2	2	2	1
Myoporaceae	*Eremophila debilis*	Amulla				x	1	2		2	2			
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark									x			
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark					x				x			
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark			3						x			3
Myrtaceae	*Eucalyptus moluccana*	Grey Box		4				4	4	4	4	3	4	4
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum			4	4	4					3		3
Myrtaceae	*Melaleuca decora*								x				x	
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	*	2	2		1		2	4	3	2		1
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*		1		1	1	1					
Oxalidaceae	*Oxalis perennans*										1	1		1
Phormiaceae	*Dianella revoluta* var. *revoluta*	A Blue Flax Lily											x	

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Phyllanthaceae	*Phyllanthus similis*					1								
Phyllanthaceae	*Phyllanthus virgatus*	Wiry Spurge		1			1					1		1
Phytolaccaceae	*Phytolacca octandra*	Inkweed	*						x					
Pittosporaceae	*Bursaria spinosa* subsp. *spinosa*	Native Blackthorn			3	4	2	4	4	5	4	2	3	
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain		2			1		1					1
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	2			1							
Plantaginaceae	*Plantago varia*										x			
Poaceae	*Aristida ramosa*	Purple Wiregrass		2	3	2	2		1	2	1	3		2
Poaceae	*Aristida vagans*	Threeawn Speargrass		2	1	2			2			2	3	
Poaceae	*Austrodanthonia bipartita*	Wallaby Grass					1							
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass		2										
Poaceae	*Austrodanthonia racemosa* var. *racemosa*	Wallaby Grass							2			1		1
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass							1				2	
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*			2								
Poaceae	*Bothriochloa macra*	Red Grass		1	1		1							
Poaceae	*Briza minor*	Shivery Grass	*										1	
Poaceae	*Briza subaristata*		*				1					2		
Poaceae	*Chloris divaricata* var. *divaricata*	Slender Chloris				2	3	3	2	1	1		2	
Poaceae	*Chloris gayana*	Rhodes Grass	*	2										1
Poaceae	*Chloris* sp.		*	2										
Poaceae	*Chloris truncata*	Windmill Grass											3	
Poaceae	*Chloris ventricosa*	Tall Chloris			3									3
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass			1					1				
Poaceae	*Cynodon dactylon*	Common Couch			2								1	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass							1					
Poaceae	*Echinochloa crus-galli*	Barnyard Grass	*	1										
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass												1

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass										1		
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*	1						2				
Poaceae	*Entolasia stricta*	Wiry Panic												1
Poaceae	*Eragrostis curvula*	African Lovegrass	*	2	2									
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass		1	2	2	2		1	1	1	2	1	1
Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass									1			
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass		2	2	4	3	1				4	1	2
Poaceae	*Panicum decompositum* var. *tenuius*								1	1	1			
Poaceae	*Panicum effusum*	Hairy Panic					1							
Poaceae	*Paspalum dilatatum*	Paspalum	*	2	2	1	2							
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*										1	
Poaceae	*Setaria parviflora*		*	2	3	3	2	2	2	1	2	3	2	2
Poaceae	*Setaria pumila*	Pale Pigeon Grass	*								2			
Poaceae	*Sporobolus africanus*	Parramatta Grass	*											1
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass		2	2		1		1	1		1		
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass					1						1	
Poaceae	*Themeda australis*	Kangaroo Grass		2	2		3	2	1	1		2	1	1
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	*							1				
Portulacaceae	*Portulaca oleracea*	Pigweed											1	
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	*		1									
Rubiaceae	*Asperula conferta*	Common Woodruff		1	1		1		1			2		1
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw						1						
Rubiaceae	*Opercularia varia*	Variable Stinkweed			1	1				1				
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart											x	
Sapindaceae	*Dodonaea viscosa* subsp. *cuneata*	Wedge-leaf Hop-bush							1					
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*	1			x	2	2		1	1		1

Family	Scientific Name	Common Name	Exotic	Plot /Transect										
				2	5	6	7	10	11	12	16	22	23	25
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*	1					1	1				1
Solanaceae	*Solanum prinophyllum*	Forest Nightshade		1	1	1	1	1	1	1	1	1		
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*	1	1	1		2	1			1		
Solanaceae	*Solanum sisymbriifolium*		*	1						1		1	2	1
Solanaceae	*Solanum* sp.		*		2	1		1	1					
Stackhousiaceae	*Stackhousia* sp.											1		
Sterculiaceae	*Brachychiton populneus*	Kurrajong							x					
Verbenaceae	*Lantana camara*	Lantana	*							x				
Verbenaceae	*Verbena bonariensis*	Purpletop	*		1				1					
Fabaceae	*Acacia decurrens*	Black Wattle										1		3
Fabaceae	*Acacia falcata*													2
Fabaceae	*Acacia floribunda*	White Sally										x		
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea							1					
Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil				1				2				
Fabaceae	*Desmodium varians*	Slender Tick-trefoil		2			1			1				1
Fabaceae	*Dillwynia sieberi*				x	1			2					1
Fabaceae	*Glycine microphylla*	Small-leaf Glycine				2	2	2	2	1		1		1
Fabaceae	*Glycine tabacina*	Variable Glycine		2	1	2			1	2	1	2	1	2
Fabaceae	*Hardenbergia violacea*	False Sarsaparilla							1					
Fabaceae	*Indigofera australis*	Australian Indigo			1									
Fabaceae	*Senna pendula* var. *glabrata*		*									2		
Fabaceae (Faboideae)	*Pultenaea parviflora*												x	

Note: 1 – **EP**: Endangered population under the TSC Act. **V**: Vulnerable under the TSC Act and the EPBC Act **, E:** endangered under the EPBC Act.

2 – *Cover abundance rankings within each survey area:* **1** Foliage sparsely or very sparsely present, cover less than 5%; **2** 1-5% Plentiful, foliage cover 1-5 %; **3** 5-25% foliage cover; **4** 26-50% foliage cover; **5** 51-75% foliage cover; **6** 76-100% foliage cover; **x –** opportunistic record.

Appendix Table 9 Plant species recorded in Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)

Family	Scientific Name	Common Name	Exotic	8	19	24	28	30	31	32	35	37	42
Acanthaceae	*Brunoniella australis*	Blue Trumpet		1		1		2		1	1		1
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*	Rock Fern				2			2		1		
Adiantaceae	*Pellaea falcata*	Sickle Fern											x
Alliaceae	*Agapanthus* sp.		*										x
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed									1		
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*			1							
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily				1	1		1				
Apiaceae	*Centella asiatica*	Indian Pennywort		2		2	2	2	1		2		1
Apocynaceae	*Araujia sericifera*	Moth Vine	*								1		
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	1					2				
Asteraceae	*Bidens subalternans*	Greater Beggar's Ticks	*							1			
Asteraceae	*Brachyscome aculeata*	Hill Daisy								1			
Asteraceae	*Cirsium vulgare*	Spear Thistle	*	1						1	1		1
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*								1		
Asteraceae	*Euchiton sphaericus*	Star Cudweed				1	1	1			1		
Asteraceae	*Gamochaeta americana*	Cudweed	*	1									
Asteraceae	*Gamochaeta purpurea*	Purple Cudweed	*			1					1		
Asteraceae	*Hypochaeris radicata*	Catsear	*				1				1		
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood							x				
Asteraceae	*Senecio madagascariensis*	Fireweed	*	2	1	1	2	1	2	1	2	2	1
Asteraceae	*Sonchus* sp.	Sowthistle	*							1			
Asteraceae	*Taraxacum officinale*	Dandelion	*	1	1		1	1				1	
Brassicaceae	*Lepidium* sp.	A Peppercress	*							1			
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell				1		1	1		1	1	
Chenopodiaceae	*Chenopodium album*	Fat Hen	*	1									
Chenopodiaceae	*Einadia hastata*	Berry Saltbush								3			
Chenopodiaceae	*Einadia nutans* subsp. *nutans*	Climbing Saltbush							2	1			
Chenopodiaceae	*Einadia polygonoides*	Knotweed Goosefoot							1				

Family	Scientific Name	Common Name	Exotic	8	19	24	28	30	31	32	35	37	42
Chenopodiaceae	*Einadia trigonos* subsp. *trigonos*								2	2			
Clusiaceae	*Hypericum gramineum*	Small St John's Wort		1	1		2				1		
Clusiaceae	*Hypericum perforatum*	St. Johns Wort	*		2								
Commelinaceae	*Commelina cyanea*	Native Wandering Jew							1	3	1		
Convolvulaceae	*Dichondra repens*	Kidney Weed				2			2	2	2		2
Cyperaceae	*Carex* sp.					2							
Cyperaceae	*Cyperus brevifolius*		*				1		1				
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge				1			1	1			
Cyperaceae	*Cyperus* sp.								1				
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge		2		2	2	2	1	1	1	1	1
Ericaceae	*Lissanthe strigosa*	Peach Heath				1							
Ericaceae	*Melichrus urceolatus*	Urn Heath										x	
Fabaceae	*Acacia baileyana*	Cootamundra Wattle											x
Fabaceae	*Acacia falcata*										1		
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea						x	x			x	
Fabaceae	*Desmodium varians*	Slender Tick-trefoil			1					2			
Fabaceae	*Glycine clandestina*	Twining glycine									1		
Fabaceae	*Glycine microphylla*	Small-leaf Glycine			1	1	1	1					
Fabaceae	*Glycine tabacina*	Variable Glycine		1	1	2	2	2	2	2	2		1
Fabaceae	*Pultenaea microphylla*	A Bush Pea				x							
Fabaceae	*Trifolium subterraneum*	Subterranean Clover	*				1						
Gentianaceae	*Centaurium* sp.		*									1	
Gentianaceae	*Schenkia australis*	Spike Centaury		1									
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia						1					
Lamiaceae	*Ajuga australis*	Austral Bugle									1		
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*					2		1			2		1
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush									1		
Loranthaceae	*Amyema pendulum* subsp. *pendulum*					x							
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*								1		

Family	Scientific Name	Common Name	Exotic	8	19	24	28	30	31	32	35	37	42
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*			1		1	1	3	1		1
Myrsinaceae	*Anagallis arvensis*	Scarlet Pimpernel	*		1								
Myrtaceae	*Eucalyptus moluccana*	Grey Box				1			2	1	1		
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum							4	4	3		
Myrtaceae	*Kunzea ambigua*	Tick Bush					x						
Myrtaceae	*Melaleuca sieberi*											x	
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree				x							
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	*				1				1		
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*							1	1		
Oxalidaceae	*Oxalis perennans*				1	1	1		1				1
Phyllanthaceae	*Phyllanthus virgatus*	Wiry Spurge					2				1		
Pittosporaceae	*Bursaria spinosa* subsp. *spinosa*	Native Blackthorn				1	4		2	4	3	3	
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	1			1		1	1			1
Poaceae	*Aristida ramosa*	Purple Wiregrass			2	4	2	2		1	3		
Poaceae	*Aristida vagans*	Threeawn Speargrass					2		2	2	2	1	
Poaceae	*Austrodanthonia racemosa* var. *racemosa*	A Wallaby Grass				2							
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*	3		3						1	
Poaceae	*Bothriochloa macra*	Red Grass			3			2		1			
Poaceae	*Briza subaristata*		*		2								1
Poaceae	*Chloris divaricata* var. *divaricata*	Slender Chloris				3							
Poaceae	*Chloris gayana*	Rhodes Grass	*			1			2				
Poaceae	*Chloris ventricosa*	Tall Chloris									2		
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass					1		1				
Poaceae	*Cynodon dactylon*	Common Couch		2	2		3	3	3			2	2
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass				1					1		
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*							2			
Poaceae	*Entolasia stricta*	Wiry Panic							1				
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		1									
Poaceae	*Eragrostis curvula*	African Lovegrass	*			1		1	3				1

Family	Scientific Name	Common Name	Exotic	8	19	24	28	30	31	32	35	37	42
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass				2	2	2	2		1		
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass			3	2	3			4	2		
Poaceae	*Panicum decompositum* var. *tenuius*							2	1				
Poaceae	*Paspalum dilatatum*	Paspalum	*	3	4	1	4	3		2		2	1
Poaceae	*Setaria parviflora*		*	2	3	3	3	3		2	1	3	2
Poaceae	*Sporobolus africanus*	Parramatta Grass	*								1		1
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass					2	2		1	3		
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass		2	1								
Poaceae	*Themeda australis*	Kangaroo Grass		5	4	2	4	5	4		2	5	6
Portulacaceae	*Portulaca oleracea*	Pigweed							2				
Ranunculaceae	*Clematis aristata*	Old Man's Beard									1		
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	*								1		
Rubiaceae	*Asperula conferta*	Common Woodruff		2				1					
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw					1						
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed											1
Rubiaceae	*Opercularia varia*	Variable Stinkweed								1			
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart									1		
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*						2				
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*							1	1		
Solanaceae	*Solanum prinophyllum*	Forest Nightshade							1	2	1		
Solanaceae	*Solanum sisymbriifolium*		*			1			1	1	1		
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia									2		
Sterculiaceae	*Brachychiton populneus*	Kurrajong									1		
Verbenaceae	*Verbena bonariensis*	Purpletop	*	1	2	2					2	1	
Verbenaceae	*Verbena hispida*	Rough Verbena	*		1								1
Verbenaceae	*Verbena rigida* var. *rigida*	Veined Verbena	*							1			

Note: 1 – *Cover abundance rankings within each survey area:* **1** Foliage sparsely or very sparsely present, cover less than 5%; **2** 1-5% Plentiful, foliage cover 1-5 %; **3** 5-25% foliage cover; **4** 26-50% foliage cover; **5** 51-75% foliage cover; **6** 76-100% foliage cover; **x** – opportunistic record.

Appendix Table 10 Plant species recorded in Good and Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529) and in Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Acanthaceae	*Brunoniella australis*	Blue Trumpet		2	2	2		1		3		1
Acanthaceae	*Brunoniella pumilio*	Dwarf Blue Trumpet					2					
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*	Rock Fern		1					1	1	2	2
Agavaceae	*Yucca aloifolia*	Spanish Bayonet	*							x		
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed		x	1							
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*									1
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed	*				1				1	
Amaranthaceae	*Nyssanthes diffusa*	Barbwire Weed					1					
Anthericaceae	*Caesia parviflora var. parviflora*									2		
Anthericaceae	*Caesia parviflora var. vittata*			2								
Anthericaceae	*Caesia sp.*						1				1	
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily		1								1
Apiaceae	*Daucus glochidiatus*	Native Carrot								x		
Apocynaceae	*Araujia sericifera*	Moth Vine	*			2		1		2		
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*							1		
Aspleniaceae	*Asplenium flabellifolium*	Bird's Nest Fern									1	
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*		2	2	1	2		1		1
Asteraceae	*Bidens subalternans*	Greater Beggar's Ticks	*	1	3	2		1				
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy								x		
Asteraceae	*Cassinia uncata*	Sticky Cassinia		x								
Asteraceae	*Cirsium vulgare*	Spear Thistle	*			1		1		1	1	
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*		2	1						
Asteraceae	*Conyza sumatrensis*	Tall fleabane	*								1	
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear					1				1	
Asteraceae	*Euchiton sphaericus*	Star Cudweed					1					

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy		1						1		
Asteraceae	*Senecio hispidulus*	Hill Fireweed								x		
Asteraceae	*Senecio madagascariensis*	Fireweed	*		1	1	2		2		1	1
Asteraceae	*Sigesbeckia orientalis subsp. orientalis*	Indian Weed			3	3	2	2				
Asteraceae	*Solenogyne bellioides*	Solengyne					1			x		
Asteraceae	*Soliva sessilis*	Bindyi	*									1
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*				1					1
Asteraceae	*Taraxacum officinale*	Dandelion	*						1			2
Asteraceae	*Vernonia cinerea*			2						1		
Asteraceae	*Vittadinia cuneata*	A Fuzzweed			1							
Boraginaceae	*Echium plantagineum*	Patterson's Curse	*								1	
Brassicaceae	*Lepidium sp.*	A Peppercress	*			1						
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell								x		
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell							1			
Campanulaceae	*Wahlenbergia stricta*	Tall Bluebell										1
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		2						1		1
Chenopodiaceae	*Einadia nutans subsp. nutans*	Climbing Saltbush		1	1		1			1		1
Chenopodiaceae	*Einadia polygonoides*	Knotweed Goosefoot			1							
Chenopodiaceae	*Einadia trigonos subsp. Trigonos*					3		3				1
Clusiaceae	*Hypericum gramineum*	Small St John's Wort				1			1			
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		x	2	2		3		1	2	1
Convolvulaceae	*Dichondra repens*	Kidney Weed		2	2	2	2	2		2	2	
Crassulaceae	*Crassula sieberiana*	Australian Stonecrop								x		
Cyperaceae	*Bolboschoenus caldwellii*										1	
Cyperaceae	*Carex inversa*	Knob Sedge			1							
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge			1	2	1					
Cyperaceae	*Cyperus sp.*									1		
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge							2			

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1								1
Ericaceae	*Lissanthe strigosa*	Peach Heath		1								
Fabaceae	*Acacia decurrens*	Black Wattle										3
Fabaceae	*Acacia elongata*	Swamp Wattle								x		
Fabaceae	*Acacia implexa*	Hickory Wattle		x								
Fabaceae	*Acacia parramattensis*	Parramatta Wattle		x								
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea		x								
Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil					1			1		
Fabaceae	*Desmodium varians*	Slender Tick-trefoil		1	2	1				1	2	1
Fabaceae	*Dillwynia sieberi*			1								
Fabaceae	*Glycine clandestina*	Twining glycine		1						x		1
Fabaceae	*Glycine microphylla*	Small-leaf Glycine					1	1	1	1		
Fabaceae	*Glycine tabacina*	Variable Glycine		2	1	1	1	1	1	1	2	2
Gentianaceae	*Centaurium sp.*		*						1			
Geraniaceae	*Geranium homeanum*									x	2	
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia		1								1
Lamiaceae	*Ajuga australis*	Austral Bugle								2		
Lamiaceae	*Mentha satureioides*	Native Pennyroyal				2						
Lamiaceae	*Plectranthus parviflorus*			x	3	1	2	2		2	2	
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1								2
Lomandraceae	*Lomandra filiformis subsp. filiformis*			1								
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush		1						1		
Lomandraceae	*Lomandra micrantha subsp. tuberculata*	Small-flowered Mat-rush										1
Loranthaceae	*Amyema gaudichaudii*											2
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*		1		1	1			1	
Malvaceae	*Sida cunninghamii*	Ridge Sida									1	
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*			3	2	3	1	1	2	1
Myoporaceae	*Eremophila debilis*	Amulla					2			2		

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark								x		
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark		3								1
Myrtaceae	*Eucalyptus moluccana*	Grey Box			4	4	4			4		
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum					1	4	2	3	1	
Myrtaceae	*Melaleuca decora*			4								4
Myrtaceae	*Melaleuca nodosa*			x								1
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	*	x	3	3		3		3	3	
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*									1
Oxalidaceae	*Oxalis perennans*				1	1	1		1			
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge		x								
Phyllanthaceae	*Phyllanthus virgatus*	Wiry Spurge								1	1	
Phytolaccaceae	*Phytolacca octandra*	Inkweed	*			1						1
Pittosporaceae	*Bursaria spinosa subsp. spinosa*	Native Blackthorn		3			1				1	3
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain			2	1	1			1	1	
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*			1	1		1		2	
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell									1	1
Poaceae	*Aristida ramosa*	Purple Wiregrass		3						1	3	2
Poaceae	*Aristida vagans*	Threeawn Speargrass		2							2	3
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass		2								
Poaceae	*Austrodanthonia sp.*	A Wallaby Grass									1	
Poaceae	*Austrodanthonia tenuior*	A Wallaby Grass										1
Poaceae	*Austrostipa rudis subsp. nervosa*	A Speargrass		4								
Poaceae	*Bothriochloa macra*	Red Grass			2		2		2		2	
Poaceae	*Chloris divaricata var. divaricata*	Slender Chloris				1						
Poaceae	*Chloris gayana*	Rhodes Grass	*						3			2
Poaceae	*Chloris truncata*	Windmill Grass								1	2	
Poaceae	*Chloris ventricosa*	Tall Chloris					3			3	2	
Poaceae	*Cynodon dactylon*	Common Couch							2		2	1

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass		1								
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*					2				
Poaceae	*Entolasia stricta*	Wiry Panic		2			1					1
Poaceae	*Eragrostis curvula*	African Lovegrass	*	1								1
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass		1			1	1	1	1	2	2
Poaceae	*Microlaena stipoides var. stipoides*	Weeping Grass		2		3	3	4		3	3	3
Poaceae	*Oplismenus aemulus*				1	2	2	3				
Poaceae	*Oplismenus imbecillis*					1		1				
Poaceae	*Panicum simile*	Two-colour Panic		1					2	2	1	
Poaceae	*Paspalum dilatatum*	Paspalum	*	1			1		2	1		
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*								2	
Poaceae	*Poa labillardierei*	Tussock									x	
Poaceae	*Setaria parviflora*		*				2	1	2		1	3
Poaceae	*Setaria pumila*	Pale Pigeon Grass	*	1					1			
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass		2			1					2
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass					2				2	
Poaceae	*Themeda australis*	Kangaroo Grass		1					5	2	2	
Polygonaceae	*Rumex brownii*	Swamp Dock						1			1	
Ranunculaceae	*Clematis glycinoides var. glycinoides*									x		
Rubiaceae	*Asperula conferta*	Common Woodruff					1			1	2	
Rubiaceae	*Coprosma quadrifida*	Prickly Currant Bush		x								
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed							1			
Rubiaceae	*Opercularia varia*	Variable Stinkweed		1								
Rubiaceae	*Pomax umbellata*	Pomax		1								
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart										1
Santalaceae	*Exocarpos strictus*	Dwarf Cherry		x								
Sapindaceae	*Dodonaea viscosa subsp. cuneata*	Wedge-leaf Hop-bush		1								
Solanaceae	*Cestrum parqui*	Green Cestrum	*									1

Family	Scientific Name	Common Name	Plot/transect									
			Exotic	1	2	21	36	38	39	40	41	43
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*		3	2	2					
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*		1	1	1					
Solanaceae	*Solanum prinophyllum*	Forest Nightshade			1	1	1	2		1		
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*			1	1	1				
Solanaceae	*Solanum pungetium*	Eastern Nightshade				1						
Solanaceae	*Solanum sisymbriifolium*		*	1		1						1
Verbenaceae	*Lantana camara*	Lantana	*		3					1		
Verbenaceae	*Verbena bonariensis*	Purpletop	*				1		1		1	
Vitaceae	*Clematicissus opaca*	Pepper Vine							x			1

Note: 1 – *Cover abundance rankings within each survey area:* **1** Foliage sparsely or very sparsely present, cover less than 5%; **2** 1-5% Plentiful, foliage cover 1-5 %; **3** 5-25% foliage cover; **4** 26-50% foliage cover; **5** 51-75% foliage cover; **6** 76-100% foliage cover; **x** – opportunistic record.

Appendix Table 11 Plant species recorded in Good and Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Acanthaceae	*Brunoniella australis*	Blue Trumpet		1	2		2	2	2	2	2	3		1
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*	Rock Fern					1				2		2	2
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed		1		1		2		1		2		
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*									1		
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed	*		1				1	1	1			
Anthericaceae	*Caesia parviflora var. parviflora*									1				
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily								1	1			
Apiaceae	*Centella asiatica*	Indian Pennywort		1	2		1	1			2	2		
Apocynaceae	*Araujia sericifera*	Moth Vine	*	1	1			1	2					
Apocynaceae	*Parsonsia straminea*	Common Silkpod			x									
Arecaceae	*Phoenix canariensis*	Canary Island Date Palm	*									x		
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*	3			2	1				1		
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	1				2	2	1			2	
Asteraceae	*Bidens subalternans*	Greater Beggar's Ticks	*	1	1	2	1		2					
Asteraceae	*Cirsium vulgare*	Spear Thistle	*	1	1	1		1		1				
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*	1				1						
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear											1	
Asteraceae	*Epaltes australis*	Spreading Nut-heads							x			1		
Asteraceae	*Gamochaeta calviceps*	Cudweed	*								1	1		
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy												1
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood										x		
Asteraceae	*Senecio madagascariensis*	Fireweed	*	1	1		1	1	1		1		1	1
Asteraceae	*Sigesbeckia orientalis subsp. orientalis*	Indian Weed							1					
Asteraceae	*Solenogyne bellioides*	Solengyne			1						1			
Asteraceae	*Soliva sessilis*	Bindyi	*											1
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*	1		1		1					1	1

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Asteraceae	*Vernonia cinerea var. cinerea*											1		
Asteraceae	*Vittadinia cuneata*	A Fuzzweed		1										
Asteraceae	*Vittadinia pustulata*	Fuzzweed						1			1			
Asteraceae	*Xanthium occidentale*	Noogoora Burr	*					1						
Basellaceae	*Anredera cordifolia*	Madeira Vine	*		x									
Brassicaceae	*Rorippa palustris*	Yellow Cress	*					1						
Cactaceae	*Opuntia stricta*	Common Prickly Pear, Smooth Pest Pear	*		1									
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell						1				1		
Casuarinaceae	*Casuarina glauca*	Swamp Oak		4	3	4			3					
Chenopodiaceae	*Atriplex prostrata*		*	1				1						
Chenopodiaceae	*Chenopodium album*	Fat Hen	*			1		1						2
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		2	1	1		1	1	1	1		2	2
Chenopodiaceae	*Einadia nutans subsp. nutans*	Climbing Saltbush		3	1			1					1	
Chenopodiaceae	*Einadia polygonoides*	Knotweed Goosefoot		1										1
Chenopodiaceae	*Einadia trigonos subsp. Trigonos*			2		2								
Clusiaceae	*Hypericum perforatum*	St. Johns Wort	*	1										
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		2	1	2	1	2		2			3	
Convolvulaceae	*Dichondra repens*	Kidney Weed		1	2	2	1	1	2	2		2		1
Crassulaceae	*Bryophyllum delagoense*	Mother of millions	*						1					
Cyperaceae	*Carex sp.*						1							
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge		1	1					2	1			1
Cyperaceae	*Cyperus polystachyos*			1				2				1		
Cyperaceae	*Eleocharis cylindrostachys*							2				2		
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge								1	1	1	1	1
Ericaceae	*Astroloma humifusum*	Native Cranberry									2			
Ericaceae	*Lissanthe strigosa*	Peach Heath					1							
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	*									x		
Fabaceae	*Acacia decurrens*	Black Wattle					3	2	1					

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Fabaceae	*Desmodium varians*	Slender Tick-trefoil					2		1					1
Fabaceae	*Dillwynia sieberi*							1						
Fabaceae	*Glycine microphylla*	Small-leaf Glycine			1	1	2		1	1		1		
Fabaceae	*Glycine tabacina*	Variable Glycine		1	2			1			1	2		
Fabaceae	*Senna pendula var. glabrata*		*					x						
Fabaceae	*Trifolium subterraneum*	Subterranean Clover	*					1						
Haloragaceae	*Myriophyllum variifolium*							2						
Juncaceae	*Juncus acutus subsp. acutus*	Sharp Rush	*								1			
Juncaceae	*Juncus usitatus*							1		1				
Juncaginaceae	*Triglochin microtuberosa*			2				2						
Lamiaceae	*Mentha satureioides*	Native Pennyroyal							1					
Lamiaceae	*Plectranthus parviflorus*						2		1					
Lemnaceae	*Lemna disperma*							2						
Lemnaceae	*Lemna sp.*				x									
Lobeliaceae	*Pratia purpurascens*	Whiteroot					1							
Lomandraceae	*Lomandra filiformis subsp. filiformis*				1			1					1	
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*	1										
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*	2	2	2	2	2	2	2	2	2	2	1
Marsileaceae	*Marsilea mutica*							2						
Myoporaceae	*Eremophila debilis*	Amulla		2	1	1		1		2				
Myrtaceae	*Angophora subvelutina*	Broad-leaved Apple					x							
Myrtaceae	*Eucalyptus amplifolia subsp. Amplifolia*				2		3	3		4				3
Myrtaceae	*Eucalyptus baueriana*	Blue Box			x									
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark			x				x			x	3	
Myrtaceae	*Eucalyptus moluccana*	Grey Box		4	4			4	4	4	2	4		1
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum			3	x	3					3		
Myrtaceae	*Kunzea ambigua*	Tick Bush									1			
Myrtaceae	*Melaleuca armillaris subsp. armillaris*	Bracelet Honey-myrtle										x		
Myrtaceae	*Melaleuca decora*												4	

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark			x	x				1	3			
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree		1	1	x	3			3			3	
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet	*				3							
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	*				1							
Oleaceae	*Notelaea longifolia*	Large Mock-olive			x									
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	*	3	1		3	2	4	2	3	4	2	
Onagraceae	*Ludwigia peruviana*		*	2										
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*	1		1								
Oxalidaceae	*Oxalis perennans*				1		1		1	1		1		1
Phormiaceae	*Dianella revoluta var. revoluta*	A Blue Flax Lily						1						
Phyllanthaceae	*Phyllanthus virgatus*	Wiry Spurge			1					1	1	1	1	
Pittosporaceae	*Bursaria spinosa subsp. spinosa*	Native Blackthorn		4	1	x	3	4	4	3	3	2		
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain									1			
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*			1	1			1				
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell		1							1			
Poaceae	*Aristida ramosa*	Purple Wiregrass		1	1			2		2	1	2	1	
Poaceae	*Aristida vagans*	Threeawn Speargrass		1							3		2	
Poaceae	*Austrodanthonia racemosa var. racemosa*	A Wallaby Grass		1	1			1						
Poaceae	*Austrodanthonia tenuior*	A Wallaby Grass									2			
Poaceae	*Bothriochloa macra*	Red Grass			1				1	2	2	1		1
Poaceae	*Bromus catharticus*	Praire Grass	*							1				
Poaceae	*Chloris divaricata var. divaricata*	Slender Chloris		2	2			1	2		2			1
Poaceae	*Chloris gayana*	Rhodes Grass	*					3		1			1	
Poaceae	*Chloris truncata*	Windmill Grass										1		
Poaceae	*Chloris ventricosa*	Tall Chloris								2	1	2		2
Poaceae	*Cortaderia selloana*	Pampas Grass	*										x	
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass							1	1				
Poaceae	*Cynodon dactylon*	Common Couch		2		1		2		2	2	3		2
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass									1			

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Poaceae	*Echinochloa crus-galli*	Barnyard Grass	*					1				2		
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass					1							
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass							1					
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*	2	1	2	2			1			2	2
Poaceae	*Entolasia marginata*	Bordered Panic								1				
Poaceae	*Entolasia stricta*	Wiry Panic		1			1							
Poaceae	*Eragrostis curvula*	African Lovegrass	*							1	1		2	
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass		1	1	1			1	1	2	2		
Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass			2			2			1	3		
Poaceae	*Microlaena stipoides var. stipoides*	Weeping Grass		3	2	3	4	2	4		2	3	4	4
Poaceae	*Oplismenus aemulus*						1		3					
Poaceae	*Oplismenus imbecillis*				1		2							
Poaceae	*Panicum simile*	Two-colour Panic									1			
Poaceae	*Paspalum dilatatum*	Paspalum	*		3	4	1	2	2	1	2			2
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*					1		1				
Poaceae	*Poa affinis*											1		
Poaceae	*Setaria parviflora*		*	2	2	2	1	2	2	2	3	2	2	1
Poaceae	*Setaria pumila*	Pale Pigeon Grass	*			3								
Poaceae	*Sporobolus africanus*	Parramatta Grass	*											1
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass									1			3
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass				1						1		
Poaceae	*Themeda australis*	Kangaroo Grass			3		2		2		1			
Polygonaceae	*Persicaria decipiens*	Slender Knotweed										x		
Polygonaceae	*Persicaria hydropiper*	Water Pepper						3						
Polygonaceae	*Rumex brownii*	Swamp Dock		1				1						
Proteaceae	*Grevillea robusta*	Silky Oak			x									
Ranunculaceae	*Clematis aristata*	Old Man's Beard			x									
Ranunculaceae	*Clematis glycinoides*	Headache Vine					2							
Rosaceae	*Rubus fruticosus sp. agg.*	Blackberry complex	*		x			1				x		

Family	Scientific Name	Common Name	Exotic	9	13	14	15	17	18	26	27	29	33	34
Rubiaceae	*Asperula conferta*	Common Woodruff			1									
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw		1			1		1		1			
Santalaceae	*Exocarpos strictus*	Dwarf Cherry						3						
Sapindaceae	*Dodonaea viscosa* subsp. *angustissima*	Narrow-leaf Hop-bush											x	
Solanaceae	*Cestrum parqui*	Green Cestrum	*					x				x		
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*	1	1					2				
Solanaceae	*Solanum laxum*	Potato Climber	*	1										
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*	1				1		1				
Solanaceae	*Solanum prinophyllum*	Forest Nightshade		1	1		2			1		1	1	
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*	1	1				1	1				
Solanaceae	*Solanum sisymbriifolium*		*						1	1		1		1
Solanaceae	*Solanum sp.*		*	1										
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia									1			
Verbenaceae	*Lantana camara*	Lantana	*				1		1					
Verbenaceae	*Verbena bonariensis*	Purpletop	*	1			1		1					
Verbenaceae	*Verbena hispida*	Rough Verbena	*					1	1					

Note: 1 – *Cover abundance rankings within each survey area:* **1** Foliage sparsely or very sparsely present, cover less than 5%; **2** 1-5% Plentiful, foliage cover 1-5 %; **3** 5-25% foliage cover; **4** 26-50% foliage cover; **5** 51-75% foliage cover; **6** 76-100% foliage cover; **x** – opportunistic record.

Appendix Table 12 Plant species recorded in Good condition artificial freshwater wetland on floodplain (HN630)

Family	Scientific Name	Common Name	Exotic	Targeted frog survey 2	Targeted frog survey 4	Targeted frog survey 5	Targeted frog survey 8	Targeted frog survey 9	Targeted frog survey 10	Targeted frog survey 11
Alismataceae	*Damasonium minus*	Starfruit			x					
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed								x
Apiaceae	*Centella asiatica*	Indian Pennywort								x
Cyperaceae	*Cyperus brevifolius*		*						x	
Cyperaceae	*Cyperus difformis*	Dirty Dora		x					x	
Cyperaceae	*Cyperus haspan subsp. haspan*				x					
Cyperaceae	*Cyperus polystachyos*				x					
Cyperaceae	*Cyperus sanguinolentus*							x		
Cyperaceae	*Eleocharis cylindrostachys*							x		
Cyperaceae	*Eleocharis sphacelata*	Tall Spike Rush					x		x	x
Cyperaceae	*Schoenoplectus validus*					x				
Haloragaceae	*Myriophyllum sp.*					x				
Haloragaceae	*Myriophyllum variifolium*							x		
Hydrocharitaceae	*Ottelia ovalifolia subsp. ovalifolia*	Swamp Lily		x		x				
Juncaceae	*Juncus acutus subsp. acutus*	Sharp Rush	*		x					
Juncaceae	*Juncus usitatus*			x	x	x	x	x		
Juncaginaceae	*Triglochin rheophila*			x						
Lobeliaceae	*Isotoma fluviatilis*	Swamp Isotome						x		
Marsileaceae	*Marsilea mutica*				x	x			x	x

Family	Scientific Name	Common Name	Exotic	Targeted frog survey 2	Targeted frog survey 4	Targeted frog survey 5	Targeted frog survey 8	Targeted frog survey 9	Targeted frog survey 10	Targeted frog survey 11
Myrtaceae	*Eucalyptus amplifolia subsp. Amplifolia*				x					
Myrtaceae	*Eucalyptus moluccana*	Grey Box			x					
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree		x						
Onagraceae	*Ludwigia peploides subsp. montevidensis*	Water Primrose				x				
Onagraceae	*Ludwigia peruviana*		*							x
Philydraceae	*Philydrum lanuginosum*	Frogsmouth			x	x				x
Poaceae	*Bothriochloa macra*	Red Grass						x		
Poaceae	*Cynodon dactylon*	Common Couch		x						
Poaceae	*Themeda australis*	Kangaroo Grass						x		
Polygonaceae	*Persicaria sp.*	Knotweed	*		x					
Potamogetonaceae	*Potamogeton crispus*	Curly Pondweed		x						
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi		x				x	x	x

Notes- 1. **x**: recorded.

Appendix Table 13 Plot/transect data

Vegetation Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regenera tion	Total length of fallen logs	Easting	Northing	Zone
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)														
HN528	Bench-mark	29	20.5-25.5	25.5-30.5	26.8-30.8	0-5	14.8-18.8	0	> = 0	1	> = 0			
	2	25	31	0.2	8	0	32	30	0	1	4	288802	6248373	56
	5	31	15.5	19	60	10	12	34	0	1	9	288973	6247709	56
	6	24	23	31	62	8	44	14	0	1	0	288791	6247303	56
	7	37	25	3.5	64	0	32	24	1	1	2	288762	6246421	56
	10	17	15.5	17.5	50	2	70	52	0	1	5.5	288486	6246492	56
	11	39	19	18.5	30	2	44	84	0	1	0	287178	6246508	56
	12	30	24	20	40	2	46	21	0	1	7.5	287940	6247231	56
	16	25	13	22.5	18	0	26	30	0	1	0	290521	6247693	56
	22	35	15.5	3	24	0	66	70	0	1	0	290384	6248799	56
	23	33	13	0.5	30	0	52	20	0	1	0	290020	6248327	56
	25	37	22	26.5	64	10	34	14	0	1	2	291230	6249070	56
	31	28	30	6	50	4	16	40	0	1	55	288224	6248287	56
	32	21	25	6.2	42	2	54	28	0	1	27	291216	6248011	56
	35	33	12.5	4	64	4	34	10	0	1	2	287696	6247808	56
	Avg.	29.6	20.3	12.7	43.3	3.1	40.1	33.6	0.1	1	8.1			
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)														
HN528	Bench-mark	29	20.5-25.5	25.5-30.5	26.8-30.8	0-5	14.8-18.8	0	> = 0	1	> = 0			
	8	11	0	0	60	0	8	76	0	1	2.5	288711	6246316	56
	19	11	0	0	50	0	6	82	0	1	0	285294	6246653	56
	24	27	4.5	0	60	0	4	62	0	1	2	291274	6248951	56
	28	20	0	22.5	62	2	16	64	0	1	0	287867	6248140	56
	30	18	0	0	54	58	0	6	0	1	0	288269	6248478	56

Vegetation Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regenera tion	Total length of fallen logs	Easting	Northing	Zone
	37	9	0	0.7	72	0	2	38	0	1	0	286697	6247210	56
	42	12	0	0	82	0	6	36	0	1	0	287673	6246850	56
	Avg.	15.4	0.6	3.3	62.9	8.6	6.0	52.0	0	1	0.6			
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)														
HN529	Bench-mark	29	18.5-23.5	20-30	23-31	0-5	11.75-19.75	0	> = 0	1	> = 0			
	20	19	12.5	0	38	2	54	42	0	1	2	285969	6246951	56
	21	20	27.5	1	32	0	48	44	1	1	23	286501	6246518	56
	36	30	15	0.2	68	0	24	40	0	1	22	286260	6246850	56
	38	15	13.5	9.5	88	0	28	24	0	1	23	286965	6246970	56
	40	42	19.5	23	82	0	30	26	0	1	12.5	288239	6246491	56
	Avg.	25.2	17.6	6.7	61.6	0.4	36.8	35.2	0.2	1	16.5			
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)														
HN529	Bench-mark	29	18.5-23.5	20-30	23-31	0-5	11.75-19.75	0	> = 0	1	> = 0			
	39	15	0	0.5	62	0	6	40	0	1	0	286389	6246721	56
	41	32	0	0	56	0	46	34	0	1	0	288059	6246493	56
	Avg.	23.5	0.0	0.3	59.0	0.0	26.0	37.0	0	1	0			
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)														
HN526	Bench-mark	24	27.5-32.5	21-31	24.45-30.45	0-10	24.45-30.45	0	> = 1	1	> = 50			
	9	31	22.5	3.5	14	0	34	76	0	1	65	288674	6245964	56
	13	39	17	6.8	24	0	40	78	0	1	0.5	291043	6246896	56
	15	27	13	17.5	80	2	22	20.5	3	1	22	290362	6246764	56
	17	34	16	25	62	38	4	30	2	1	6	290999	6249167	56
	18	24	23.5	13	34	62	2	36	0	1	57	285412	6246670	56
	26	27	18	19.5	16	70	0	30	0	1	32	288076	6248308	56

Vegetation Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
	29	32	17	0.5	36	18	0	16	1	1	30	287987	6247873	56
	33	15	6.5	49	40	0	26	32	1	1	0			56
	Avg.	28.6	16.7	16.9	38.3	23.8	16.0	39.8	0.9	1	26.6	288936.1	6247377.4	
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)														
HN526	Bench-mark	24	27.5-32.5	21-31	24.45-30.45	0-10	24.45-30.45	0	> = 1	1	> = 50			
	14	16	28.5	1.5	26	0	36	80	0	1	36	291160	6247177	56
	27	34	0	4.8	48	60	0	6	0	1	5	287973	6247981	56
	34	18	5	0	64	0	8	6	0	1	0	291563	6247266	56
	Avg.	22.7	11.2	2.1	46.0	20.0	14.7	30.7	0	1	13.7			
Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)														
HN512	Bench-mark	38	15.1-25.6	13.8-30.3	14.7-24.6	0-10	14.7-24.6	0	> = 0	1	> = 0			
	1	47	21.5	21.5	46	4	26	0	0	1	3	291848	6248951	56
Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)														
HN512	Bench-mark	38	15.1-25.6	13.8-30.3	14.7-24.6	0-10	14.7-24.6	0	> = 0	1	> = 0			
	43	32	0	22.5	24	0	4	4	0	1	4	291815	6249035	
Exotic grassland														
HN528	Bench-mark	0	-	-	-	-	-	0	> =	1	> =			
	3	9	0	0	50	0	2	64	0	1	0	288754	6248196	56
	4	14	0.5	0	20	0	2	88	0	1	0	288661	6247838	56
	Avg.	11.5	0.3	0.0	35.0	0.0	2.0	76.0	0	1	0			

Appendix Table 14 Fauna species recorded in broad habitat types at the airport site

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Fish										
Anguilla reinhardtii	Eel					O				
Gambusia holbrooki	Mosquito Fish	*				W				
Amphibians										
Pseudophryne bibronii	Bibron's Toadlet					O				
Litoria latopalmata	Broad-palmed Frog					O				W
Limnodynastes peronii	Brown-striped Frog					W				W
Crinia signifera	Common Eastern Froglet					OW	W		W	W
Litoria fallax	Eastern Dwarf Tree Frog							O		W
Litoria peronii	Peron's Tree Frog					OW	W			W
Uperoleia laevigata	Smooth Toadlet					W				W
Limnodynastes tasmaniensis	Spotted Grass Frog					OW	O	W		W
Litoria tyleri	Tyler's Tree Frog									W
Litoria verreauxii	Verreaux's Frog					W	W			W
Uperoleia rugosa	Wrinkled Toadlet							W		
Birds										
Anhinga novaehollandiae	Australasian Darter					O		W		O
Tachybaptus novaehollandiae	Australasian Grebe					O			O	O
Anas rhynchotis	Australasian Shoveler					O				
Falco longipennis	Australian Hobby				OW					O
Alisterus scapularis	Australian King-Parrot				O					
Cracticus tibicen	Australian Magpie				OW			W	O	O
Aegotheles cristatus	Australian Owlet-nightjar				O					

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Pelecanus conspicillatus	Australian Pelican				O					O
Anthus novaeseelandiae	Australian Pipit							O		O
Corvus coronoides	Australian Raven				O			O	O	O
Acrocephalus australis	Australian Reed-Warbler					O				
Aerodramus terraereginae	Australian Swiftlet							O		
Threskiornis molucca	Australian White Ibis					O				
Chenonetta jubata	Australian Wood Duck					O			O	O
Ceyx azureus	Azure Kingfisher					O		O		O
Geopelia humeralis	Bar-shouldered Dove						OW		O	
Manorina melanophrys	Bell miner				O		W		OW	W
Ixobrychus flavicollis	Black Bittern		V				O			
Milvus migrans	Black kite							O		
Cygnus atratus	Black Swan					OW				
Coracina novaehollandiae	Black-faced Cuckoo-shrike				O		O		O	O
Elseyornis melanops	Black-fronted Dotterel					O				O
Elanus axillaris	Black-shouldered Kite							O		O
Himantopus himantopus	Black-winged Stilt					O				O
Oxyura australis	Blue-billed Duck		V			O				
Falco berigora	Brown Falcon				O				O	O
Accipiter fasciatus	Brown Goshawk				W					
Coturnix ypsilophora	Brown Quail							O		
Cincloramphus cruralis	Brown Songlark									O
Acanthiza pusilla	Brown Thornbill				O					
Gallirallus philippensis	Buff-banded Rail				O					
Acanthiza reguloides	Buff-rumped Thornbill				O					
Ardea ibis	Cattle Egret			C,J		O		O		

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Anas castanea	Chestnut Teal					O			O	
Sturnus tristis	Common Myna	*			OW		O		O	O
Sturnus vulgaris	Common Starling	*			W	O				O
Ocyphaps lophotes	Crested Pigeon				OW		O	W	O	O
Platycercus elegans	Crimson Rosella				OW		O		O	O
Taeniopygia bichenovii	Double-barred Finch				OW		O		O	O
Gallinula tenebrosa	Dusky Moorhen				O	O			O	O
Artamus cyanopterus	Dusky Woodswallow							O		O
Tyto javanica	Eastern Barn Owl				OW					O
Ardea modesta	Eastern Great Egret					O				
Platycercus eximius	Eastern Rosella				O		O		O	O
Falcunculus frontatus frontatus	Eastern Shrike-tit				O					
Acanthorhynchus tenuirostris	Eastern Spinebill				OW					
Eopsaltria australis	Eastern Yellow Robin				O		O		O	O
Turdus merula	Eurasian Blackbird	*			O,Q		O			
Fulica atra	Eurasian Coot					O	O		O	O
Carduelis carduelis	European Goldfinch	*			O					
Petrochelidon ariel	Fairy Martin							W		O
Cacomantis flabelliformis	Fan-tailed Cuckoo						O			
Lichenostomus fuscus	Fuscous Honeyeater				W					
Eolophus roseicapillus	Galah				W	O				O
Pachycephala pectoralis	Golden Whistler				O		O			
Cisticola exilis	Golden-headed Cisticola					O		W		
Phalacrocorax carbo	Great Cormorant					O				O
Cracticus torquatus	Grey Butcherbird				OW		OW		O	O
Rhipidura albiscapa	Grey Fantail				O		O		O	O

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Colluricincla harmonica	Grey Shrike-thrush				OW		O			
Anas gracilis	Grey Teal					O	O			
Aythya australis	Hardhead					O			O	
Poliocephalus poliocephalus	Hoary-headed Grebe					O				O
Passer domesticus	House Sparrow	*						O		O
Microeca fascinans	Jacky Winter				O				O	
Gallinago hardwickii	Latham's Snipe			C,J,K		O				
Dacelo novaeguineae	Laughing Kookaburra				O		O		O	O
Phalacrocorax sulcirostris	Little Black Cormorant					O	O			
Cacatua sanguinea	Little Corella					W			O	
Hieraaetus morphnoides	Little Eagle		V		O			O		
Glossopsitta pusilla	Little Lorikeet		V		O					
Microcarbo melanoleucos	Little Pied Cormorant					O	O		O	
Corvus mellori	Little Raven				W	W	W	OW		
Anthochaera chrysoptera	Little Wattlebird				O					
Cacatua tenuirostris	Long-billed Corella				OW	O		W	O	O
Grallina cyanoleuca	Magpie-lark				OW	O	O		O	O
Vanellus miles	Masked Lapwing						OW	W	O	O
Dicaeum hirundinaceum	Mistletoebird				O					O
Falco cenchroides	Nankeen Kestrel									O
Nycticorax caledonicus	Nankeen Night Heron									O
Philemon corniculatus	Noisy Friarbird				W					
Manorina melanocephala	Noisy Miner				OW		OW		O	O
Oriolus sagittatus	Olive-backed Oriole				OW		O		OW	
Anas superciliosa	Pacific Black Duck					OW	O		O	O
Geopelia striata	Peaceful Dove				O					O

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Falco peregrinus	Peregrine Falcon				O					
Phalacrocorax varius	Pied Cormorant					O			O	O
Strepera graculina	Pied Currawong								O	
Malacorhynchus membranaceus	Pink-eared Duck					O				
Porphyrio porphyrio	Purple Swamphen					O	OW		O	O
Merops ornatus	Rainbow Bee-eater						W			
Trichoglossus haematodus	Rainbow Lorikeet				OW					
Anthochaera carunculata	Red Wattlebird								O	
Neochmia temporalis	Red-browed Finch				O		O	O		O
Psephotus haematonotus	Red-rumped Parrot				O					O
Pycnonotus jocosus	Red-whiskered Bulbul	*			O		OW		O	O
Myiagra inquieta	Restless Flycatcher				O					O
Columba livia	Rock Dove	*								O
Petroica rosea	Rose Robin				O					
Platalea regia	Royal Spoonbill					O				O
Rhipidura rufifrons	Rufous Fantail				O					
Pachycephala rufiventris	Rufous Whistler				O		O		O	O
Todiramphus sanctus	Sacred Kingfisher									O
Ptilonorhynchus violaceus	Satin Bowerbird				W					
Myzomela sanguinolenta	Scarlet Honeyeater				O					
Petroica boodang	Scarlet Robin		V		O					
Zosterops lateralis	Silvereye				OW		O	O		O
Pardalotus punctatus	Spotted Pardalote				W					O
Streptopelia chinensis	Spotted Turtle-Dove	*			O					O
Threskiornis spinicollis	Straw-necked Ibis					O		O		O

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Pardalotus striatus	Striated Pardalote				W					
Acanthiza lineata	Striated Thornbill				O		O		O	
Cacatua galerita	Sulphur-crested Cockatoo						W	W	O	O
Malurus cyaneus	Superb Fairy-wren				O				OW	O
Podargus strigoides	Tawny Frogmouth				O		O			O
Megalurus timoriensis	Tawny Grassbird									O
Petrochelidon nigricans	Tree Martin							O		
Myiagra sp.	unidentified Flycatcher				O					
Daphoenositta chrysoptera	Varied Sittella		V				O			
Aquila audax	Wedge-tailed Eagle							O		
Smicrornis brevirostris	Weebill				O			O		
Hirundo neoxena	Welcome Swallow					O		O		O
Haliastur sphenurus	Whistling Kite				O		O	O		
Haliaeetus leucogaster	White-bellied Sea-eagle			C	O	O				
Sericornis frontalis	White-browed Scrubwren				W		OW		O	
Egretta novaehollandiae	White-faced Heron					O			O	O
Ardea pacifica	White-necked Heron					OW		O	O	
Lichenostomus penicillatus	White-plumed Honeyeater				O					
Gerygone albogularis	White-throated Gerygone				O		O	O	O	O
Hirundapus caudacutus	White-throated Needletail			C,J,K				O		
Cormobates leucophaea	White-throated Treecreeper									O
Corcorax melanorhamphos	White-winged Chough				W,Q				O	O
Rhipidura leucophrys	Willie Wagtail				OW,Q	O	O		O	O

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Acanthiza nana	Yellow Thornbill				O		OW		O	O
Platalea flavipes	Yellow-billed Spoonbill					O			O	O
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				O		O		O	O
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo									O
Gastropods										
Bradybaena similaris	Asian trampsnail	*			O		O			
Austrorhytida cappillacea	Common Southern Carnivorous Snail				O					
Meridolum corneovirens	Cumberland Plain Land Snail		E		O		O			
Cantareus aspersa	Garden Snail	*			O	O	O	O		
Mammals										
Rattus rattus	Black Rat	*			O					H
Lepus capensis	Brown Hare	*			O,Q		O			O
Felis catus	Cat	*								O
Trichosurus vulpecula	Common Brushtail Possum				O		O			O
Pseudocheirus peregrinus	Common Ringtail Possum						O			
Canis lupus familiaris	Dog	*								O
Macropus giganteus	Eastern Grey Kangaroo							O		
Vulpes vulpes	Fox	*			O,Q	O	O			O
Capra hircus	Goat	*			O					
Mus musculus	House Mouse	*						O		
Oryctolagus cuniculus	Rabbit	*			O,Q		O	O	F,P	O
Wallabia bicolor	Swamp Wallaby				O,Q		O		O	
Chalinolobus morio	Chocolate Wattled Bat				U					U

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Mormopterus norfolkensis	East Coast Freetail Bat		V		U					
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V							U
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V							U
Mormopterus ridei	Eastern Freetail Bat				U					
Nyctophilus gouldi	Gould's Long-eared Bat									U
Chalinolobus gouldii	Gould's Wattled Bat				U					U
Pteropus poliocephalus	Grey-headed Flying-fox		V	V			O			O
Myotis macropus	Large-footed Myotis (pr)		V			U	U			
Vespadelus darlingtoni	Large Forest Bat (pr)				U					U
Nyctophilus geoffroyi	Lesser Long-eared Bat									U
Vespadelus vulturnus	Little Forest Bat									U
Tadarida australis	White-striped Freetail-bat				U		U			
Nyctophilus sp.					U					
Vespadelus sp.					U					
Reptiles										
Eulamprus tenuis	Barred-sided Skink									T
Lampropholis delicata	Dark-flecked Garden Sunskink							O	O	T
Tiliqua scincoides	Eastern Blue-tongue				O			O		
Pseudonaja textilis	Eastern Brown Snake				O			O		
Chelodina longicollis	Eastern Snake-necked Turtle					O				
Physignathus lesueurii	Eastern Water Dragon					O				O
Eulamprus quoyii	Eastern Water-skink					O	O			O

Scientific Name	Common Name	Exotic	TSC Status	EPBC Status	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land	SMEC (2014)	Biosis (1997)
Cryptoblepharus pulcher	Elegant Snake-eyed Skink				O		O			
Amphibolurus muricatus	Jacky Lizard				O					
Varanus varius	Lace Monitor				O				O	
Lampropholis guichenoti	Pale-flecked Garden Sunskink									T
Pseudechis porphyriacus	Red-bellied Black Snake					O		O		O

Note:

1. Broad habitat types refer to areas where these species were recorded during the current survey by GHD.
2. Species listings: O- Observed, W- Heard, OW- Observed and heard, Q- Camera, T- Trapped or netted, U- Ultrasonic recording, U? – ultrasonic recording (probable result); F- Tracks or scratchings, P- Scat, H- Hairs, feather or skin
3. Status listings: E- endangered species, V- vulnerable species, C- China-Australia Migratory Bird Agreement, J- Japan-Australia Migratory Bird Agreement, K- Republic of Korea-Australia Migratory Bird Agreement

Appendix D – Assessments of significance for MNES

Legislative requirement

The desktop assessment, field surveys and impact assessment included above have been used to identify MNES that are known or may occur at the airport site and that have the potential to suffer a significant impact. Assessments of significance have been prepared using the *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013a) for the following MNES of relevance to the airport:

- Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act and occurs at the airport site. A specific assessment of significance is provided below for impacts on this community, including the removal of 104.9 hectares of vegetation within the local occurrence of the community.
- *Pultenaea parviflora*, which is listed as a vulnerable species under the EPBC Act and occurs at the airport site. A specific assessment of significance is provided below for impacts on this species, including the removal of at least four individuals of the species and of known and potential habitat.
- The threatened flora species White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle, which are listed as endangered species and Small-flower Grevillea and Austral Toadflax, listed as vulnerable species. A general assessment of significance is provided below for potential impacts on these species, including the removal of potential habitat.
- The Grey-headed Flying-fox, which is listed as a vulnerable species under the EPBC Act and which has been observed at the airport site. A specific assessment of significance is provided below for impacts on this species, including the removal of foraging habitat.
- The Swift Parrot, which is listed as a critically endangered species under the EPBC Act and which may occur at the airport site during annual winter migrations. A specific assessment of significance is provided below for impacts on this species, including the removal of potential winter foraging habitat.
- The Greater Blue Mountains World Heritage Area (GBMWHA), which is located around ten kilometres to the west of the airport site and may be affected by potential indirect impacts.

Cumberland Plain Woodland Critically Endangered Ecological Community

Larger and better condition patches of Grey Box - Forest Red Gum grassy woodland on flats, Grey Box - Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest at the airport site comprise occurrences of Cumberland Plain Woodland. Cumberland Plain Woodland is listed as a critically endangered ecological community (CEEC) under the EPBC Act. Patches of woodland at the airport site that comprise an occurrence of Cumberland Plain Woodland are shown on Figure 6. There are 104.9 hectares of Cumberland Plain Woodland as defined under the EPBC Act at the airport site.

Derived native grassland and moderate/good –poor condition vegetation at the airport site does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines. This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA, 2010d). Patches with native tree cover greater than 10% but that are isolated from other native vegetation and are less than 0.5 hectares in area have also been excluded in accordance with the guidelines (DEWHA, 2010d).

Cumberland Plain Woodland, a CEEC.
According to the DoE (2013) 'significant impact criteria' for endangered or critically endangered ecological communities, an action is likely to have a significant impact on a community if there is a real chance or possibility that it will: **Reduce the extent of an ecological community**
Construction of the airport would directly reduce the extent of the ecological community through the removal of 104.9 hectares of Cumberland Plain Woodland in the stage one construction impact zone. This is a significant reduction in the extent of the ecological community in the locality and a notable reduction at the regional scale given the extent of historical clearing of Cumberland Plain Woodland. Less than 10% of the estimated pre-European extent of the vegetation types that collectively comprise this community remains (OEH, 2015c). Long term development at the airport site would further reduce the extent of the community by up to 46.4 hectares. Long term development would further increase the significance of impacts of Stage 1 and would comprise a significant impact in its own right.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
Construction of Stage 1 of the airport would contribute to fragmentation at a local and regional scale by removing patches of habitat, severing vegetated corridors and by creating an extensive, permanent footprint that would comprise a significant barrier to many species. The local occurrence of the community is in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for many fauna species, particularly those that are limited by dispersal abilities and habitat preferences. The suite of fauna species recorded in field surveys is dominated by generalist species of open country such as birds and bats, reflecting the fragmented nature of vegetation at the airport site (see Section 4.3.1). At a regional scale Cumberland Plain Woodland is severely fragmented, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches being smaller than 3 hectares (NSW Scientific Committee 2009). The construction of the airport would contribute to fragmentation at a regional scale by further removing patches of woodland, including a total of 104.9 hectares of Cumberland Plain Woodland remnants in patches that are at least five hectares in area. Larger patches have greater inherent value due to their rarity (DoE, 2015c). Construction of Stage 1 would create a gap in habitat that is around 1150 hectares in area and about 2 kilometres wide from north to south and almost 4 kilometres long from east to west. This area would be mostly inhospitable to fauna and would be a barrier to ecological processes such as dispersal, pollination and seed fall. Mobile, aerial fauna species that comprise part of the ecological community may continue to occur in areas of open space at the airport site and move around or through it. The airport will include specific design features to make it less hospitable to birds and bats to help mitigate the risk of plane collisions. The proposed runway, terminals, carpark and other built features would comprise a significant barrier to the majority of fauna species particularly in combination with security fences. Light, noise, aircraft and vehicle movement may further deter fauna species from crossing these gaps in habitat. Many generalist species of open country that currently occur at the airport site and the majority of component species in Cumberland Plain Woodland would not be able to move over or through the airport. Overall, despite the current patchy and fragmented distribution of vegetation at the airport site and in the locality, construction of Stage 1 would comprise a significant increase in the degree of fragmentation of Cumberland Plain Woodland. Long term development at the airport site would further increase the degree of fragmentation of the community in the locality and the region. A second runway and associated infrastructure would increase the gap in habitat at the airport site to a total area of up to 1700 hectares and would be around 2.5 kilometres wide from north to south. The realignment of The Northern Road, potential

future orbital road links, realigned transmission lines and future rail links to the airport would further isolate or fragment habitat.

These impacts on habitat connectivity would be partially mitigated by the retention of habitat in the proposed environmental conservation zone. The conservation zone is around 117.1 hectares in area, including around six hectares of Cumberland Plain Woodland out of a total of 56 hectares of woodland and forest. A further 60.3 hectares would be revegetated. It is placed around the perimeter of the airport site, encompassing the riparian corridors of Badgerys Creek and Duncans Creek and some moderate sized patches of Cumberland Plain Woodland. The environmental conservation zone would help to maintain opportunity for fauna movements via vegetated corridors around the airport site.

Adversely affect habitat critical to the survival of an ecological community

The community occurs on specific soil types within a restricted distribution that coincides with the Sydney region. The natural extent of the community has been extensively cleared and is subject to ongoing development pressure. All occupied habitat other than the smallest or most degraded remnants would be critical to the survival of the community. Any patches of the community that are greater than five hectares in area are considered inherently valuable due to their rarity (DoE 2015b). The local occurrence of the community at the site is in moderate to good condition and includes multiple continuous patches of vegetation of at least five hectares and up to around 50 hectares in area and as such comprises habitat critical to the survival of the community.

Modify or destroy abiotic (non-living) factors (such as water, nutrients of soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns

Construction of Stage 1 would include substantial earthworks and complete modification of abiotic factors in the Stage 1 construction impact zone. This is equivalent to the estimated reduction in extent of the community described above.

The airport design and land use plan includes measures to manage surface and groundwater that have been purposefully designed to avoid substantial alteration of surface water drainage patterns. A CEMP is recommended for construction of the airport, which would contain measures to reduce direct and indirect impacts (e.g. erosion and sedimentation) on native vegetation adjoining the airport site, including this community.

Any alterations as a result of construction of the airport are unlikely to result in destruction of abiotic conditions necessary for the ecological communities' survival outside of the airport site.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The project would remove native plants and displace or harm native animals that are component species of the community. Construction of Stage 1 of the airport is likely to comprise a significant reduction in the extent of this community in the locality. However the individual plants and animals affected within the Stage 1 construction impact zone are unlikely to be an ecologically significant proportion of any of the individual species that make up the broader occurrence of the community in the locality or region. The areas of floristically similar vegetation in the locality and region are likely to be sufficient to maintain viable local populations of the species that comprise the community. Construction of the airport may affect the species composition of patches of this community in the vicinity by promoting species that are more tolerant of edge habitats and/or noise, light and traffic. This is likely to include aggressive fauna species like the Noisy Miner that would tolerate these conditions and may occur at the expense of other species. The airport is unlikely to substantially modify the composition of any vegetation beyond the airport site and immediately adjoining areas. As such, the airport is not likely to cause a substantial change in the composition of the community outside of the direct disturbance footprint.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:

Assisting invasive species, that are harmful to the listed ecological community, to become established, or

Construction of the airport would involve a substantial area of vegetation removal and would create some new edges in vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles. Recommendations have been made in Section 8 to minimise the spread of weeds during construction.

A CEMP is recommended for the construction of the airport, which would contain measures to manage weeds and to reduce the risk of spreading weeds off site in soil or water. The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site.

Operation of the airport poses a biosecurity risk. There is the potential for the introduction of new species as a result of the transport of goods on aircraft. For example, the one record of Yellow Crazy Ants from New Zealand is likely to have been a transit passenger (on taro in air baggage) (Biosecurity New Zealand, undated). Invasion of Yellow Crazy Ants is listed as a key threatening process under the TSC Act (see Section 8.1). Any escaped novel species could potentially establish in nearby vegetated areas, or be transported to other areas of native vegetation with cargo, and impact the local native flora and fauna.

The final Airport Plan for Stage 1 and then for long term development at the airport site would include specific measures to manage weeds at the airport site, to mitigate biosecurity risks and to reduce the risk of off-site impacts. This plan would be integrated with Australian Government border control and biosecurity risk management measures. The proposed environmental conservation zone would provide a buffer between the airport and adjoining areas of native vegetation along its eastern, southern and western boundaries, including the riparian corridors of Badgerys Creek and Duncans Creek. The extent of native vegetation cover would be increased in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site. The airport would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations.

No invasive species that may cause the Cumberland Plain Woodland to decline are likely to become established in the locality as a result of the airport.

Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

Construction vehicles and equipment would cause a minor localized increase in the risk of hydrocarbon contamination or other pollutants for the duration of remediation activities. A CEMP is recommended for construction of the airport, which would contain measures to manage harmful substances and to avoid impacts on vegetation, soil or water. Any accidental mobilisation of harmful substances during construction would not be 'regular' (if at all) and is highly unlikely to kill or inhibit the growth of any species in the ecological community in areas adjoining the airport site.

The operation of the airport and associated transport and commercial activities would involve bulk fuel storage and is likely to include transport of harmful substances. Open space within the Stage 1 airport would be actively managed, which may include use of fertilisers and herbicides. Any such use, storage or transport of potential pollutants would be conducted under appropriate controls and with reference to relevant environmental legislation. Any inappropriate or illegal activities or accidental mobilisation of contaminants would not be 'regular' (if at all) and is highly unlikely to result in effects that would kill or inhibit the growth of species in the ecological community.

The proposed environmental conservation zone would provide a buffer between the airport and adjoining areas of native vegetation along its eastern, southern and western boundaries including the riparian corridors of Badgerys Creek and Duncans Creek. The environmental conservation zone increases the distance between potential sources of contamination such as runways, storage areas

and parking areas and these sensitive receptors. The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water quality or drainage patterns outside of the airport site. These measures would help to mitigate the risk of any impacts on the ecological community outside of the airport site.
Interfere with the recovery of an ecological community
The 'recovery plan decision' for Cumberland Plain Woodland is currently: 'Recovery Plan required, at the time of listing a recovery plan was in preparation for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (17/11/2009)' (DoE, 2015c). The main threats to Cumberland Plain Woodland are clearing for urban, industrial or rural development, the consequent fragmentation of native vegetation remnants, inappropriate grazing and fire regimes, weed invasion and the low level of protection in reserves (Threatened Species Scientific Committee, 2008b). The approved conservation advice lists priority recovery and threat abatement actions that can be taken to support the recovery of the community (Threatened Species Scientific Committee, 2018b). The following are relevant to the airport: 'Implement appropriate management regimes to maintain the biodiversity, including threatened species, of the ecological community' (Threatened Species Scientific Committee, 2008b). The project would permanently remove 104.9 hectares of vegetation within the local occurrence of the community for Stage 1 of the airport and a further 46.4 hectares for long term development. Construction of Stage 1 would create a gap in habitat that is around 1150 hectares in area and about 2 kilometres wide from north to south and almost 4 kilometres long from east to west. This would increase to up to 1600 hectares in area and 2.5 kilometres wide from north to south for the long term development at the airport site. The airport would significantly increase the degree of fragmentation of the community and its habitat in the locality and region. Construction of the airport would substantially interfere with the recovery of the community. In the longer term the proposed offset package would assist with the recovery of the community through the conservation and management of Cumberland Plain Woodland in offset sites (see Section 9.3).
Conclusion of Assessment of Significance:
Stage 1 of the airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland through a substantial reduction in the extent of the community and increase in the degree of fragmentation which would in turn result in a substantial negative effect on the potential for recovery of the community. Long term development at the airport site would further reduce the extent of the community, fragment habitat and interfere with its recovery. This additional reduction would further increase the significance of impacts of Stage 1 and would comprise a significant impact in its own right. The proposed offset package would compensate for these significant impacts and would assist with the recovery of the community through the conservation and management of Cumberland Plain Woodland in offset sites.

Pultenaea parviflora

Four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road by SMEC (2014) and these records were verified by GHD during the current field surveys (Figure 5D). This is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road at this location in 1999 (Biosis 1999; SMEC 2014). The former locations of the additional 64 individuals currently contain cleared, ploughed cropland or severely weed infested road edges and do not comprise occupied or potential habitat for this species (see photo in Table 26). Seed and cutting collections were made from this population by the Royal Botanic Gardens Trust on a number of occasions in 1990 and 1991, with the aim of testing propagation methods for the species and also ultimately replanting the species at the airport as part of landscaping works (RBGS 1992).

Pultenaea parviflora a vulnerable species
According to the DoE (2013a) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of an important population of a species
The Stage 1 construction impact zone includes at least four individuals comprising a local population of *Pultenaea parviflora.* Construction of the airport would also remove up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat for this species. These impacts may be partially mitigated by the proposed translocation of the four individuals at the airport site into an area of suitable habitat in the environmental conservation zone (see Section 8). Translocation may not provide assurance of survival and so the impact assessment and offset calculations assume the removal of all individuals in the construction impact zone. The known population of four plants at the airport site is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location in 1999 (Biosis 1999; SMEC 2014). The former locations of the additional 64 individuals currently contain cleared, ploughed cropland or severely weed infested road edges and do not comprise occupied or potential habitat for this species (see photo in Table 20). Seed and cutting collections were made from this population by the Royal Botanic Gardens Trust on a number of occasions in 1990 and 1991, with the aim of testing propagation methods for the species and also ultimately replanting the species at the airport as part of landscaping works (RBGS 1992). The EPBC Act assessment of significance guidelines 1.1 include specific criteria for assessing impacts on a vulnerable species, which primarily relate to impacts on an important population (DoE 2013a). An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • Key source populations either for breeding or dispersal. • Populations that are necessary for maintaining genetic diversity, and/or. • Populations that are near the limit of the species range (DoE 2013a). The population of *P. parviflora* at the airport site is not an important population because: • It is not identified in a recovery plan. • It would not be important for breeding or dispersal because it only includes four plants and it is in a comparatively isolated and poor quality patch of habitat that is surrounded by extensive areas of cleared cropland or grazing country.

Pultenaea parviflora a vulnerable species
• It is not important for maintaining genetic diversity because it only comprises four plants that are in close proximity and as such would be unlikely to contain much genetic diversity. Further, this genetic material has already been retained via the Royal Botanic Gardens Trust sampling and propagation programme (RBGS 1992). • This population is near the limit of the species range as it at the western extent of recognised outlier populations near Kemps Creek (OEH, 2015b). The majority of this population is associated with a parcel of land with tertiary gravel and shale/gravel transition habitat located at Kemps Creek around three kilometres to the east of the site (OEH, 2015a) that is to be set aside as an offset for the South West Growth Centres. The population at the airport site would make a very minor contribution to the viability of this population. The population of *P. parviflora* at the airport site would not be secure and would be unlikely to be maintained or increased if the airport was not constructed and the current situation continued. The four individuals in the remaining population are in a strip of highly modified vegetation less than three metres wide between a road and ploughed cropland. This strip is seriously infested with exotic perennial grasses and other environmental weeds as well as dense growth of Native Blackthorn. The four *P. parviflora* at the airport site are at risk due to competition for light, water or nutrients and/or accidental slashing or spraying in the short to medium term. Overall the population at the site has low viability and would make a minor contribution to the maintenance or recovery of the species and does not comprise an 'important population' as defined in the significant impact criteria for vulnerable species (DoE 2013a). Therefore the airport would not lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy of an important population
As described above the population of *Pultenaea parviflora* at the airport site is not an important population. Construction of the airport would reduce the area of occupation of the species in general by removing about 100m^2 of occupied habitat containing four plants.
Fragment an existing important population into two or more populations
As described above the population of *P. parviflora* at the airport site is not an important population. Construction of the airport would not fragment an existing population of the species in general into two or more populations because it would remove only about 100m^2 of occupied habitat containing four plants that is already completely isolated from other populations in the wider locality.
Adversely affect habitat critical to the survival of a species
There is no recovery plan for the species and no critical habitat has been formally identified (DoE, 2015b). The occupied habitat at the airport site comprises highly modified vegetation less than three metres wide between a road and ploughed cropland. This strip is infested with exotic perennial grasses and other environmental weeds as well as dense growth of Native Blackthorn. The habitat to be removed would make a minor contribution to the conservation and recovery of the species. As such, the airport would not adversely affect habitat critical to the survival of the species.

Pultenaea parviflora a vulnerable species
Disrupt the breeding cycle of an important population
As described above the population of *Pultenaea parviflora* at the airport site is not an important population. There is a population of *P. parviflora* at a parcel of land located at Kemps Creek around three kilometres to the east of the site (OEH, 2015a) that would probably comprise an important population given the number of plants present, area of habitat and its location since it is recognised as an outlier population of the species (OEH, 2015b). The project may affect the breeding cycle of the species in general by removing four individuals of the species and through a reduction in the extent of native vegetation that may provide shelter and food for pollinator species. Given the distance of the airport site from Kemps Creek these potential impacts would be highly unlikely to tangibly disrupt the breeding cycle of this important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The airport would require the removal of 141.8 hectares of potential habitat for *P. parviflora* in Stage 1 and up to 64.4 hectares of potential habitat for long term development at the airport site. Construction of the airport would also increase the degree of fragmentation of habitat for the species at the local and regional scale. The condition and quality of habitat varies across the airport site however the habitat containing the four individuals in the known population comprises a strip of highly modified vegetation less than three metres wide between a road and ploughed cropland. The four Pultenaea parviflora at the airport site are at risk due to competition for light, water or nutrients and/or accidental slashing or spraying in the short to medium term. Much of the remaining habitat at the airport site and surrounding locality is effectively isolated from these known plants and despite targeted surveys there is no evidence that these areas contain any additional P. parviflora individuals (Biosis 1999; SMEC 2014; OEH, 2015a). Construction and operation of the airport would not affect habitat for the known important population of the species at Kemps Creek because it around three kilometres away. Construction of the airport would affect habitat which, because of its condition and context, is likely to make a very minor contribution to the viability of Pultenaea parviflora. Given the above considerations the airport is not likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for P. parviflora to the extent that the species is likely to further decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Construction of the airport would involve a substantial area of vegetation removal and would create some new edges in vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles. Recommendations have been made in Section 8 to minimise the spread of weeds. A CEMP is recommended for the construction of the airport, which would contain measures to manage weeds and to reduce the risk of spreading weeds off site in soil or water. The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site. The final Airport Plan for Stage 1 and then for long term development at the airport site would include specific measures to manage weeds at the airport and to reduce the risk of off-site impacts. The proposed environmental conservation zone would provide a buffer between the airport and adjoining areas of native vegetation along its eastern, southern and western boundaries including the riparian corridors of Badgerys Creek and Duncans Creek. The extent of native vegetation cover would be increased in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site. The airport would have a

Pultenaea parviflora a vulnerable species
minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations. No invasive species that may cause *Pultenaea parviflora* to decline are likely to become established in the locality as a result of the airport.
Introduce disease that may cause the species to decline
The airport would be unlikely to increase the potential for significant disease vectors to affect this species. Diseases potentially affecting native vegetation in general at the airport site and adjacent areas include Root Rot Fungus (*Phytophthora cinnamomi*) and Myrtle Rust. To minimise the chance of introducing new plant pathogens, machinery would be washed down before moving from area to area and personnel excluded from walking through habitat areas unless necessary. Potential impacts are likely to be limited to the immediate construction footprint for the airport.
Interfere substantially with the recovery of the species
The recovery plan decision for the species is: 'Recovery Plan not required, included on the Not Commenced List (1/11/2009)' (DoE, 2015b). Construction of the airport would remove about 100m^2 of occupied habitat containing four plants that is already completely isolated from other populations. Construction of the airport would not interfere substantially with the recovery of the species.
Conclusion
Construction of Stage 1 of the airport would remove four individual *Pultenaea parviflora* comprising the known local population of the species at the airport site. The airport would also require the removal of 141.8 hectares of potential habitat for the species for Stage 1 and up to 64.4 hectares of potential habitat for long term development at the airport site. The population of *P. parviflora* at the site is not an 'important population' as defined in the significant impact criteria for vulnerable species (DoE 2013a) and is likely to have very low long-term viability under existing conditions. Therefore the airport would not result in any direct impacts on an important population of the species and would not interfere with the recovery of *P. parviflora.* Given the above considerations, the airport would not result in a significant negative impact on *P. parviflora*.

Threatened flora species with a moderate likelihood of occurrence

There is potential habitat for up to an additional five threatened flora species listed under the EPBC Act: Spiked Rice-flower (*Pimelea spicata*); Downy Wattle (*Acacia pubescens*); White-flowered Wax Plant (*Cynanchum elegans*); *Grevillea parviflora* subsp. *parviflora* and *Thesium australe*. Construction and operation of the airport would not affect any known populations of these threatened plants. Despite targeted surveys there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a). There is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site.

Threatened flora: the endangered species White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle; and the vulnerable species Small-flower Grevillea and Austral Toadflax.
According to the DoE (2013a) 'significant impact criteria' for threatened species, an action is likely to have a significant impact on a species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of a population of an endangered species or an important population of a vulnerable species
Construction and operation of the airport would not affect any known populations of these threatened plants. Despite targeted surveys there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a). There is a chance that these species may be present at the airport site in low numbers such as in areas of habitat that were not directly observed or in the soil seed bank. There is also a chance that these species could colonise this habitat at some point in the future. As such there is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site. The airport would remove potential habitat for these threatened plants as described below and would directly reduce the size of a population of a plant species if any individuals are present at the airport site. With regards to potential impacts on the vulnerable species Small-flower Grevillea and Austral Toadflax an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • Key source populations either for breeding or dispersal. • Populations that are necessary for maintaining genetic diversity, and/or. • Populations that are near the limit of the species range (DoE 2013a). The airport site is highly unlikely to contain an important population because: • It is not identified in any recovery plans. • It is not known to contain any individuals of these species despite targeted survey. If these species were present at the airport site in numbers large enough to be important for breeding or dispersal or maintaining genetic diversity, it is likely that they would have been detected. • A population at the airport site would not be near the limit of these species range Austral Toadflax is known from populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tableland as well as Tasmania, Queensland and in eastern Asia. Small-flower Grevillea is sporadically distributed throughout the Sydney Basin with sizeable populations around Picton, Appin and Bargo, the Cessnock - Kurri Kurri area, Holdsworthy, Castlereagh and from Putty to Wyong and Lake Macquarie on the Central Coast (OEH, 2015b). Overall any populations of these threatened plant species that may occur at the airport site are likely to be small and have relatively low viability and would make a minor contribution to the maintenance or recovery of these species. Removal of potential habitat or of individual plants that may be present at the airport site is unlikely to lead to a long-term decrease in the size of an important population of these species.

Threatened flora: the endangered species White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle; and the vulnerable species Small-flower Grevillea and Austral Toadflax.
Reduce the area of occupancy of an endangered species or an important population of a vulnerable species
As described above the airport would not affect an important population of Small-flower Grevillea or Austral Toadflax (if it would affect the species at all). Construction of the airport may, in general, reduce the area of occupancy of the five threatened plant species listed above by removing up to 247.8 hectares of potential habitat that may be occupied. Despite targeted surveys there is no evidence that these areas contain any individuals of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a) and so the actual area of occupied habitat that could be removed is likely to be considerably smaller. In the context of the regional distribution of these species, this quantum of impact would have a minor effect (if at all).
Fragment an existing population of an endangered species or an important population of a vulnerable species into two or more populations
As described above the airport would not affect an important population of Small-flower Grevillea or Austral Toadflax (if it would affect these species at all). Construction of the airport is highly unlikely to fragment an existing population of White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle into two or more populations because no individuals of these species are known from the site or adjoining areas despite targeted survey. The removal of any individuals or occupied habitat at the airport site would only affect individuals that are already relatively isolated from other populations.
Adversely affect habitat critical to the survival of a species
No critical habitat has been formally identified for any of these threatened plant species (DoE, 2015b). There is no evidence that the habitat at the airport site is of particular value or significance to these threatened plant species and there are around 10,014 hectares of similar shale woodland vegetation in the locality (NPWS, 2006; Tozer et al 2010). Given the absence of known populations, moderate condition and degree of fragmentation of the habitat to be removed it is likely to make a minor contribution to the conservation and recovery of these species. As such, the airport would not adversely affect habitat critical to the survival of these species.
Disrupt the breeding cycle of an endangered species or an important population of a vulnerable species
As described above the airport would not affect an important population of Small-flower Grevillea or Austral Toadflax (if it would affect these species at all). The project may affect the breeding cycle of the five threatened plant species listed above in general through a reduction in the extent of native vegetation that may provide habitat and movement opportunities for pollinator species. There are occasional records of these threatened plant species in the vicinity of the airport site but none within patches of connected vegetation (OEH 2015a) or any other evidence that the habitat at the airport site would be important to their breeding cycles. There are around 10,014 hectares of similar shale woodland vegetation in the locality (NPWS 2006; Tozer et al 2010) that provide refuge for pollinator species, potential habitat and at least partial connectivity for recruitment. The removal of vegetation at the airport site would be highly unlikely to tangibly disrupt the breeding cycle of any threatened plant populations outside of the site.

Threatened flora: the endangered species White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle; and the vulnerable species Small-flower Grevillea and Austral Toadflax.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The quantum of potential impacts on these threatened plants varies between species, based on their individual habitat requirements as follows: • White-flowered Wax Plant: up to 141.3 hectares of better quality potential habitat and a further 148.6 hectares of poor quality potential habitat. • Spiked Rice-flower: up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat.1 • Downy Wattle: up to 4.4 hectares of better quality potential habitat and a further 0.6 hectares of poor quality potential habitat. • Small-flower Grevillea: up to 4.4 hectares of better quality potential habitat and a further 0.6 hectares of poor quality potential habitat. • Austral Toadflax: up to 107.1 hectares of better quality potential habitat and a further 140.7 hectares of poor quality potential habitat. Construction of the airport would also increase the degree of fragmentation of habitat for the species at the local and regional scale. The condition and quality of habitat varies across the airport site however the majority is in moderate or poor condition. Despite targeted surveys there is no evidence that these areas contain any individuals of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a) and so the habitat is probably of limited value. Construction of the airport would involve a substantial area of vegetation removal and would create some new edges in vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules, erosion or sedimentation and generation of dust or other contaminants. A CEMP is recommended for the construction of the airport, which would contain measures to manage weeds and to manage indirect and off site impacts. The final Airport Plan for Stage 1 and then for long term development at the airport site would include specific measures to manage weeds at the airport site, to mitigate biosecurity risks and to reduce the risk of off-site impacts. This plan would be integrated with Australian Government border control and biosecurity risk management measures. The airport is unlikely to substantially affect any habitat for these threatened plants outside the construction impact zone. Given the above considerations the project is not likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for these threatened plants to the extent that these species are likely to further decline.
Result in invasive species that are harmful to a threatened species becoming established in the species' habitat
Construction of the airport would involve a substantial area of vegetation removal and would create some new edges in vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles. Recommendations have been made in Section 8 to minimise the spread of weeds. A CEMP is recommended for the construction of the airport, which would contain measures to manage weeds and to reduce the risk of spreading weeds off site in soil or water. The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site.

Threatened flora: the endangered species White-flowered Wax Plant, Spiked Rice-flower and Downy Wattle; and the vulnerable species Small-flower Grevillea and Austral Toadflax.
The proposed environmental conservation zone would provide a buffer between the airport and adjoining areas of native vegetation along its eastern, southern and western boundaries including the riparian corridors of Badgerys Creek and Duncans Creek. The extent of native vegetation cover would be increased in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site. The airport would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations. No invasive species that may cause these threatened plant species to decline are likely to become established in the locality as a result of the airport.
Introduce disease that may cause the species to decline
The airport would be unlikely to increase the potential for significant disease vectors to affect this species. Diseases potentially affecting native vegetation in general at the airport site and adjacent areas include Root Rot Fungus (*Phytophthora cinnamomi*) and Myrtle Rust. To minimise the chance of introducing new plant pathogens, machinery would be washed down before moving from area to area and personnel excluded from walking through habitat areas unless necessary. Potential impacts are likely to be limited to the immediate construction footprint for the airport.
Interfere substantially with the recovery of the species
Construction of the airport would increase the degree of fragmentation of habitat for the species at the local and regional scale. The condition and quality of habitat varies across the airport site however the majority is in moderate or poor condition. Despite targeted surveys there is no evidence that these areas contain any individuals of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a) and so the habitat is probably of limited value and any populations of these species that may be present would probably have limited viability. The removal of potential habitat for these threatened plants and individuals that may be present is unlikely to substantially interfere with the recovery of these species.
Conclusion
Construction and operation of the airport would not affect any known populations of these threatened plants. Despite targeted surveys there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (Biosis 1999; SMEC 2014; OEH, 2015a). There is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site. Any populations of these threatened plant species at the airport site are likely to have relatively low viability and would make a minor contribution to the maintenance or recovery of these species. The airport is unlikely to interfere with the recovery of any of these threatened plant species. Based on the above considerations the airport would not result in a significant negative impact on these threatened plant species.

Grey-headed Flying-fox

Grey-headed Flying-foxes (*Pteropus poliocephalus*) roost and breed in large colonies (camps). All the flying-fox camps in eastern Australia are linked into one population and numbers in any one camp are influenced by food availability and the requirements of mating and raising young. Fluctuations in the size of a camp can vary week by week, month by month or in some cases from one night to the next, and reflect the nomadic nature of Grey-headed Flying-foxes. There are at least seven camps mapped within 20 kilometres of the airport site, including to the north, east and south, and many more within a 50 kilometre radius. There are no camps on site or in the immediate vicinity of the airport site that would be directly impacted.

The Grey-headed Flying-fox is a highly mobile species which regularly travels up to 50 kilometres in a night to forage, and has been shown to make migratory movements of almost 1000 kilometres within a year (Churchill 2008, Webb and Tidemann 1996).

Grey-headed Flying-foxes were observed flying over the airport site and would forage at the site when eucalypts are in flower. The primary food source for Grey-headed Flying-foxes is blossom from *Eucalyptus* species and related genera but in some areas it also utilises a wide range of rainforest fruits (Eby and Law 2008).

All native woodland and forest at the airport site provides foraging habitat for this species. Dominant canopy species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Grey Box and Forest Red Gum are identified as significant species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering (0.67). This species flowers in late winter and spring, partly during the 'food bottleneck' (Eby and Law 2008). Grey Box has low productivity and reliability (0.35). It flowers in late summer and early autumn. Broad-leaved Ironbark has high productivity but is an unreliable flowerer (0.54). It flowers in summer and early autumn, providing forage habitat during the breeding period (Eby and Law 2008). Habitat at the airport site is thus somewhat productive during food bottlenecks, and would contribute to habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

Flying-foxes are one of the more common aerial fauna species hit by aircraft in Australia and NSW. There is therefore a potential for mortality of individuals from aircraft strike, although the risk is much lower than in tropical areas, where there are larger numbers and mass movements. In addition, the airport is not located in close proximity to a camp or a concentrated highly productive foraging resource, and as such no large movements of bats are likely to occur at the airport. Given these points, there is only a low risk of mortality of individuals as a result of aircraft strike (Avisure 2015) given the scattered, patchy nature of food resources surrounding the airport. Mortality rates are unlikely to be of a magnitude that would lead to a long-term decrease in the size of an important population of the species.

Grey-Headed Flying-fox, a vulnerable species.
According to the DoE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of an important population of a species
All of the Grey-headed Flying-fox populations in eastern NSW are linked and hence can be considered one important population.

Grey-Headed Flying-fox, a vulnerable species.
Impacts that could lead to the long-term decrease in the size of an important population of the Grey-headed Flying-fox relate to the loss or disturbance of camp sites and roosting/breeding habitat and the loss of critical foraging habitat within a 50 kilometre radius of local camps. As noted above, this is the expected maximum foraging distance of the species from a roost site (Eby 1996). The airport site does not contain a roosting camp of the Grey-headed Flying-fox but is located within 50 kilometres of multiple known camps located in the Sydney basin, and construction would remove woodland and forest that would provide foraging habitat when trees are in flower. Individuals from various roost camps are likely to forage in native woodland and forest at the airport site when trees are flowering. Construction of Stage 1 of the airport will result in the direct loss of approximately 141.8 hectares of native woodland and forest vegetation, including eucalypts that flower in the food bottle neck and the breeding period for the Grey-headed Flying-fox, and that contribute to critical habitat for the species as defined by in the recovery plan (DECC 2009). Long term development at the airport site would lead to further loss of 64.4 hectares of foraging habitat. Cumulative and facilitated development in the locality would follow as a result of construction, resulting in further clearing of foraging habitat for the species. The airport would require the removal of 141.8 hectares of foraging habitat (native woodland and forest vegetation) for Stage 1, and an additional 64.4 hectares of foraging habitat for long term development, which is a large area of foraging habitat in an already highly fragmented rural landscape. Further development of the locality would follow as a result of construction of the airport, resulting in further clearing of foraging habitat for the species. The proportion of habitat to be removed for Stage 1 is about 0.70 per cent of the available habitat (native woodland and forest vegetation) in the locality, and a much smaller proportion of the available habitat within 50 kilometres of local roost sites. Extensive areas of foraging habitat are located within the Greater Blue Mountains World Heritage Area to the west of the airport site. Patches of native vegetation in the airport site are already highly fragmented. Construction of the airport would increase existing fragmentation of foraging habitat in a mainly agricultural landscape by impacting on patches of native vegetation but would not create a barrier to the species' existing ability to move through the area. Loss of habitat will increase the distances between habitat patches and that may impact energy costs in particular during periods when food is scarce. The airport site comprises a substantial area of foraging habitat for the Grey-headed Flying-fox that would be lost as a result of construction of the Stage 1 area. These habitat areas contribute to foraging resources at critical times in the lifecycle of the species, and when considered in the context of further loss from long term development at the airport site, and other facilitated and cumulative impacts in the locality, this clearing could contribute to the long-term decline of the Grey-headed Flying-fox important population. There is a potential for mortality of individuals from aircraft strike, although the risk is low given the location of the airport, lack of camps in close proximity, and lack of a concentrated highly productive foraging resource in the area. Mortality rates are unlikely to be of a magnitude that would lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy of an important population
The project will not directly impact on any known roost camps in the locality. The impacts of construction of the airport on the Grey-headed Flying-fox population would be primarily confined to loss of foraging habitat caused by direct clearing of native vegetation during the construction phase, and with facilitated and cumulative impacts of long term development in the locality, the reduction in foraging habitat in the area would further reduce available habitat in the locality. Patches of native vegetation in the airport site are already highly fragmented. Construction of the airport would increase existing fragmentation of foraging habitat in a mainly agricultural landscape by impacting on patches of native vegetation but would not create a barrier to the species' existing ability to move through the area. There is some potential for loss of individuals on occasion through aircraft strike, however the risk of this is considered low (Avisure 2015).

Grey-Headed Flying-fox, a vulnerable species.
In terms of occupancy, the airport would not directly impact any camp sites, but would reduce the current are of foraging habitat in the short term and the long-term. Bats will still move through the area as the airport would not create a barrier and mortality through aircraft strike is low. As such, the overall occupancy area of the population would not change, but within the locality the foraging area would be reduced.
Fragment an existing important population into two or more populations
The project will not have any direct impact on local camps. Patches of native vegetation in the airport site are already highly fragmented. Construction of the airport would increase existing fragmentation of foraging habitat in a mainly agricultural landscape by impacting on patches of native vegetation but would not create a barrier to the species' existing ability to move through the area. As discussed above, while the airport represents a risk of aircraft strike of individuals, it would not be an impermeable barrier to their movement. Highly mobile species such as the Grey-headed Flying-fox are expected to be less impacted by fragmentation and this species is well-adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. This species' typically exhibits very large home ranges and Grey-headed Flying-foxes are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby 1996). The project would therefore not fragment an existing important population of the Grey-headed Flying-fox into two or more populations.
Adversely affect habitat critical to the survival of a species
In the draft recovery plan for the Grey-headed Flying-fox (DECCW 2009), foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to the survival of the species. These criteria include natural habitat that is: • Productive during winter and spring, when food bottlenecks have been identified. • Known to support populations of >30,000 individuals, within an area of 50 kilometre radius. • Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May). • Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes. • Known to be continuously occupied as a camp site.
In addition, it is not possible to predict what localities will be productive in which months, and therefore what localities will provide essential habitat for the species. All foraging habitat has the potential to be productive during general food shortages and to therefore provide a resource critical to survival (DECCW 2009). No roost camp has been identified within the airport site, and the local camps would not be directly impacted by construction of the airport. Construction of the airport would remove 141.8 hectares of potential habitat for Stage 1 and additional 64.4 hectares during development for future stages. Eucalypt species present at the airport site are not particularly productive during the 'food bottleneck' or the breeding season and may support individuals from various local camps when the trees are in flower but are not likely to support the population as a whole. As such, the foraging habitat present at the airport site is not explicitly critical habitat.

Grey-Headed Flying-fox, a vulnerable species.
The airport site comprises a substantial area of foraging habitat for the Grey-headed Flying-fox that would be lost as a result of construction of the Stage 1 area. These habitat areas contribute to foraging resources at critical times in the lifecycle of the species, and may be provide critical resources during food shortages. In this sense, habitat at the airport provides a resource critical to survival. When considered in the context of further loss from long term development at the airport site, and other facilitated and cumulative impacts in the locality, this clearing could contribute to the long-term decline of the Grey-headed Flying-fox important population. Given the size of foraging habitat at the airport site, and area of habitat that would be lost through cumulative and facilitated impacts, the airport does have the potential to affect habitat critical to the long-term survival of the species.
Disrupt the breeding cycle of an important population
No roost camps are present at the airport site. Construction of the airport would not have a direct impact on any local roost camps. The airport would require the removal of 141.8 hectares of foraging habitat for Stage 1, and an additional 64.4 hectares of foraging habitat for long term development, which is a large area of foraging habitat in an already fragmented rural landscape. Stage 1 would result in the loss of 0.70 percent of foraging habitat in the locality. The airport site may support individuals from various local camps when the trees are in flower, but is not likely to be critical to the survival of the population. Grey-headed Flying-foxes would feed occasionally at the airport site, but given the limited productivity of the vegetation that would be removed, would not depend solely on these foraging habitats. The project site would not form an impermeable barrier to the movement of individuals of this species between roost sites and foraging grounds, however individuals flying across the airport site and approaches may be at risk of mortality from aircraft strike, although this is considered a low risk (Avisure 2015). While the airport would remove a large area of foraging habitat and facilitate further removal of habitat in the locality, there would be no direct impact on breeding camps and the risk of aircraft strike is low. As such the airport is not likely to disrupt the breeding cycle of the local population of this highly mobile species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The airport would require the removal of 141.8 hectares of foraging habitat for Stage 1, and an additional 64.4 hectares of foraging habitat for long term development, which is a large area of foraging habitat in an already fragmented rural landscape. The proportion of habitat to be removed for Stage 1 is 0.70 per cent of the available habitat in the locality, and a much smaller proportion of the available habitat within 50 kilometres of local roost sites. Construction and operation of the airport would not isolate areas of foraging habitat for this highly mobile species, although there is a low risk of mortality from aircraft strike. There is limited potential for indirect impacts such as edge effects on foraging habitat given that few large patches intersect the Stage 1 or airport site boundaries. Any patches that do intersect these boundaries are already subject to substantial edge effects. The project will not directly impact on any local roost camps. The loss and/or modification of foraging habitat is not likely to disrupt the breeding cycle of the local population of this highly mobile species given the extent of suitable foraging habitat within a 50 kilometres radius of local camps. The airport site comprises a substantial area of foraging habitat for the Grey-headed Flying-fox that would be lost as a result of construction of the Stage 1 area. These habitat areas contribute to foraging resources at critical times in the lifecycle of the species, and when considered in the context of further loss from long term development at the airport site, and other facilitated and

Grey-Headed Flying-fox, a vulnerable species.
cumulative impacts in the locality, this clearing could contribute to the long-term decline of the Grey-headed Flying-fox.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Weed species have been recorded throughout the airport site. Construction and operation of the airport are unlikely to increase the incidence of weeds or spread weeds to such as extent that remaining foraging habitat for the Grey-headed Flying-fox is impacted by weeds. Mitigation measures to minimise the spread of weeds would be included in the CEMP (see Section 9.2). The airport is not likely to introduce feral animals to the area or encourage the spread of feral animals that may impact Grey-headed Flying-foxes.
Introduce disease that may cause the species to decline
There are no known disease issues affecting this species that are relevant to the airport. The airport would be unlikely to increase the potential for significant disease vectors to affect this species. Diseases potentially affecting native vegetation in the airport site and adjacent areas include Root Rot Fungus (*Phytophthora cinnamomi*) and Myrtle Rust. These diseases could affect Grey-headed Flying-fox habitat as they affect plants in the plant family Myrtaceae. To minimise the chance of introducing plant pathogens, machinery would be washed down before moving from area to area and personnel, vehicles and plant would be excluded from habitat areas unless necessary.
Interfere substantially with the recovery of the species
The project would not directly impact on any local roost camps for the local population and no impacts on the breeding success of the local population are anticipated. The draft recovery plan for the Grey-headed Flying-fox (DECCW 2009) identifies the protection of foraging resources as a key recovery objective. The airport would be located in a highly cleared landscape, and would involve the removal of small patches of somewhat productive native vegetation. In total, 141.8 hectares of foraging habitat would be removed for Stage 1, and an additional 64.4 hectares of foraging habitat for long term development. Overall, the airport site comprises a substantial area of foraging habitat for the Grey-headed Fling-fox that would be lost as a result of construction of the Stage 1 area. These habitat areas contribute to foraging resources at critical times in the lifecycle of the species, and when considered in the context of further loss from long term development at the airport site, and other facilitated and cumulative impacts in the locality, this clearing could interfere with the recovery of the species in the locality.
Conclusion
While the airport would not directly impact any breeding camps, the airport is likely to have a significant impact on the Grey-headed Flying-fox as: • Construction of the airport would remove 141.8 hectares of potential habitat for Stage 1 which represents 0.70 per cent of the potential foraging habitat for the Grey-headed Flying-fox within the locality • These areas of habitat contribute to the availability of foraging resources for local camps when resources are scarce and at critical lifecycle stages • The airport will further fragment foraging habitat within an already highly fragmented landscape

Grey-Headed Flying-fox, a vulnerable species.
• Cumulative and facilitated development in the locality would follow as a result of construction, resulting in further clearing of foraging habitat for the species. An offset package has been prepared for the airport to compensate for these significant impacts (see Section 9.3). This would include the protection and management of Grey-headed Flying-fox habitat at offset sites in perpetuity. 46.8 hectares of habitat would be retained in the conservation zone along Badgerys Creek and in the western portion of the airport site.

Swift Parrot

The Swift Parrot (*Lathamus discolor*) breeds in Tasmania. The principal over-wintering habitat for the Swift Parrot on the Australian mainland is the box-ironbark forests and woodlands inland of the Great Dividing Range in Victoria and NSW. Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Grey Box (*Eucalyptus moluccana*) and Red Bloodwood (*Corymbia gummifera*) are important nectar sources in coastal parts of the non-breeding range. Commonly used lerp infested trees include Inland Grey Box (*Eucalyptus microcarpa)*, Grey Box (*Eucalyptus moluccana)* and Blackbutt (*Eucalyptus pilularis)*. Forest Red Gum (*Eucalyptus tereticornis*) is also considered a feed tree in coastal areas, including the Sydney Metro and Hawkesbury-Nepean areas (Saunders and Tzaros 2011). The occurrence of Swift Parrots at foraging sites is largely linked with the abundance of lerp, nectar and non-aggressive competitors (Swift Parrot Recovery Team 2001). It has been found to preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees (Saunders and Tzaros 2011).

The Swift Parrot returns to some foraging sites on a cyclic basis depending on food availability. In a recent study, over half of all foraging sites in the study were used repeatedly, signifying their potential conservation value (Swift Parrot Recovery Team 2001). Landscapes with winter foraging habitat included scattered trees, remnant vegetation and continuous forests, and within these, Swift Parrots foraged at length on lerp and nectar from a variety of tree species. The occurrence of Swift Parrots at foraging sites was largely linked with the abundance of lerp, nectar and non-aggressive competitors (Swift Parrot Recovery Team 2001).

The feed trees Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*) are the dominant canopy species in the airport site. Much of the airport site is vegetated with relatively young regrowth which are not the preferred foraging habitat for the species, although some patches containing large, old-growth trees are also present. The airport site is thus likely to be low quality winter foraging habitat for the Swift Parrot although it may provide shelter or supplementary foraging resources for migrating individuals.

There are eight records of the Swift Parrot in the locality, but the species has not been recorded during current surveys which were undertaken when the species was known to be present in the Sydney basin, and when appropriate eucalypts were flowering. There are scattered records of this species across the Cumberland Plain, but limited evidence of any concentration of records at any locations (OEH 2015a). In addition, there are very few records of the species in south west Sydney. There are no records of the species in the area bounded by the M4 motorway, The Northern Road, the M7 and Camden Valley Way. Local records are from Mulgoa and Mulgoa Nature Reserve to the north-west, the Western Sydney Parklands at Cecil Hills to the east and Cobbitty to the south. These records are all located about 8-10 kilometres from the airport site. There are no previous records (last 30 years) from within the airport site or immediate surrounds. GHD obtained atlas records from both OEH and BirdLife Australia. A number of BirdLife atlas locations are situated within the airport site boundary. No records of the

Swift Parrot were located at any of these sites. A broad-scale habitat map prepared for the Greater Southern Sydney Region (DECC 2007) identifies the largest area of habitat within the Burragorang Valley, with smaller patches around Glenmore, west of Liverpool, and around Wedderburn.

Swift Parrot *Lathamus discolor*, a critically endangered species.
According to the DoE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of a population
The Swift Parrot occurs as a single population, which migrates annually from breeding grounds in Tasmania to winter foraging grounds on the western slopes and coastal plains of mainland eastern Australia. The critical resources necessary for maintaining the life cycle of the species are suitable habitat within breeding and wintering grounds. The study area contains areas of eucalypt forest supporting winter flowering tree species that constitute suitable winter feeding habitat for migrating individuals of the Swift Parrot. Construction of the airport has the potential to reduce breeding success, through removing foraging resources critical to the survival of breeding adult birds during the winter season. Grey Box (Eucalyptus moluccana) and Forest Red Gum (E. tereticornis) are important feed trees in the Sydney region and occur throughout woodland vegetation at the airport site, although many of these trees are young regrowth, which reduces their current value for the species. The airport would require the removal of 141.8 hectares of potential foraging habitat for the Swift Parrot in Stage 1, and an additional 64.4 hectares of foraging habitat for long term development. The proportion of habitat to be removed for Stage 1 is 0.70 per cent of the available habitat in the locality, and a much smaller proportion of the available habitat in the region. No individuals were observed during targeted surveys and there are few records of the Swift Parrot in the locality. All records are located about 8-10 kilometres from the airport site. Records were obtained from both OEH (2015a) and BirdLife Australia (2015). In addition, broad-scale habitat mapping prepared for the Greater Southern Sydney Region (DECC 2007) identifies the largest area of habitat on the Cumberland Plain within the Burragorang Valley, with smaller patches around Glenmore, west of Liverpool, and around Wedderburn. Native vegetation at the airport site comprises small to moderate sized patches, separated by large areas of cleared agricultural land, and dominated by aggressive competitors such as the Noise Miner. Based on these points, it is likely that the airport site is not an important foraging area for the species. Loss of foraging habitat, specifically winter-flowering eucalypt trees that are essential for maintaining the health of the population during its annual winter migration to mainland Australia, could reduce breeding success. Reduced food availability could lead to reduced health and lower survival rates for the return migration to Tasmania in spring. As noted above, the airport site is not likely to be an important foraging area for the species. The loss of vegetation at the airport site is not likely to impact the overall health of the migrating population. Operation of the airport could result in mortality of individuals from aircraft strike. Given the species only occurs in western Sydney for a part of the year, are transient, and tend to move in small flocks, the risk of aircraft strike is low. The operation of the airport would not create a permanent barrier to the movement of individuals across the airport site. Although the airport would require the removal of 141.8 hectares of low quality winter foraging habitat for Stage 1, and 64.4 hectares for long term development, the proportion of habitat to be removed is small in comparison with existing habitat within the Sydney Basin Bioregion. Evidence gathered on the movements of the species also suggest that visits to the coastal forests are not consistent every year and depend on flowering of the Box-Ironbark woodlands on the south western slopes of NSW and Victoria (Swift Parrot Recovery Team 2001). Swift Parrots tend to return to good quality habitat areas year after year. There are only few records of the species in the locality, suggesting that the area is not important winter foraging habitat. Hence, the loss of small, generally young regrowth patches of foraging habitat within

Swift Parrot *Lathamus discolor*, a critically endangered species.
the airport site would not be likely to reduce the health and condition of individual birds such that migration (on the return journey to Tasmania in spring) is disrupted to the extent that it would interfere with the life cycle of the species. On the basis of the above considerations, the construction of the airport is unlikely to lead to a long-term decrease in the size of a population of the Swift Parrot.
Reduce the area of occupancy of the species
The distributional range of the Swift Parrot extends from Tasmania through parts of Victoria and NSW to southeast Queensland. Within this range, the area of occupancy for the species would include breeding grounds in Tasmania, migration routes and foraging habitats on mainland Australia. The impacts of construction of the airport on the Swift Parrot population would be primarily confined to loss of foraging habitat caused by direct clearing of native vegetation during the construction phase, and with facilitated and cumulative impacts of long term development in the locality, the reduction in foraging habitat in the area would further reduce available habitat in the locality. Patches of native vegetation in the airport site are already highly fragmented. Construction of the airport would increase existing fragmentation of foraging habitat in a mainly agricultural landscape by impacting on patches of native vegetation but would not create a barrier to the species' existing ability to move through the area. There is some potential for loss of individuals on occasion through aircraft strike, however the risk of this is considered low. There is no evidence that the species occurs at the airport site, and there are only few records from the locality, suggesting the area is not important foraging habitat for the species. The loss of potential foraging habitat would represent only a minor fraction of the area of occupancy of the Swift Parrot within the region and a smaller fraction of its entire area of occupancy. The airport would thus have minor impacts on small areas of potential habitat for this species, and would not reduce its area of occupancy to any material extent.
Fragment an existing population into two or more populations
The Swift Parrot is a highly mobile species that routinely traverses large expanses of open water and open country, including Bass Straight, agricultural land and other clearings during its annual migration. The species is not resident in western Sydney, rather is a transient visitor in winter when appropriate eucalypt species are in flower. The Swift Parrot would rely on 'stepping stones' of suitable foraging and roosting habitat during migrations and is thought to prefer 'corridors' of woodland vegetation over which to traverse. Clearing of vegetation for the airport would reduce the incidence of small patches of vegetation, but would not remove a corridor of woodland vegetation. The dispersal or movement of the Swift Parrot across the landscape is unlikely to be affected as clearings created by the airport would not isolate habitat with respect to this species. As such, the airport would not fragment an existing population into two or more populations. Furthermore, retention of vegetation in conversation areas, in particular the Badgerys Creek corridor, would maintain stepping stones of habitat in the area.
Adversely affect habitat critical to the survival of a species
The Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) notes the key habitats for the species comprise habitats which are used for nesting, used by large proportions of the Swift Parrot population, are used repeatedly between seasons, or are used for prolonged periods of time. Habitat critical to the survival of the Swift Parrot includes those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot. There is a lack of records of the species in the study area and few records known in the wider locality. Habitat in the locality is thus not likely to be important to the species. Individuals may however forage on occasion within the airport site as winter-flowering eucalypts are present. Potential habitat in the airport site is of low quality for the species, given that much of it is young regrowth and aggressive competitors such as Noisy Miners are dominant species at the site. Potential habitat may contribute to maintaining the condition and health of parrots sufficient for them to make the return flight to Tasmania during the spring migration, if

Swift Parrot *Lathamus discolor*, a critically endangered species.
individuals forage at the airport site. Habitat present may be more important in some years than others such as when resources are scarce inland during drought periods. The loss of 141.8 hectares of woodland or forest containing winter flowering eucalyptus species would represent an estimated loss of 0.70 per cent of accessible foraging habitat within a 10 kilometres radius of the airport boundary. A further 64.4 hectares would be removed for long term development. The stands of winter flowering gums within the study area would represent a small proportion of the total area of winter flowering habitat available within the region. Although the airport would contribute to the incremental loss of potential foraging habitat for the Swift Parrot within coastal NSW, this habitat is unlikely to be critical to the survival of this species, given that much of it is young regrowth and aggressive competitors such as the Noisy Minor dominate much of the site.
Disrupt the breeding cycle of a population
Breeding does not occur on mainland Australia. Adult birds would only occur within the study area as part of seasonal foraging behaviour during winter. The area of potential foraging habitat to be removed is restricted to various fragmented patches of eucalypt woodland, often dominated by young regrowth with few old trees. This habitat loss may decrease the availability of winter forage for individuals that disperse nomadically throughout the region during winter, if foraging occurs at the airport site. The reduced availability of potential foraging habitat, particularly during poor flowering seasons and/or drought periods, could theoretically reduce the health and condition of adult birds, which could in turn, lead to poor condition and reduced breeding success. However, the habitats in the study area are not considered critical to the Swift Parrot (see above) and it is unlikely that the condition and health of individuals that may forage in the study area on occasion would be compromised to the extent that breeding success of individuals would be affected. Furthermore, the airport would not fragment a population of the Swift Parrot or create a barrier to local or regional movements of the species between foraging and breeding areas. Given the above points, the airport is unlikely to disrupt the breeding cycle of a population of Swift Parrot.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The Swift Parrot is a highly mobile species that routinely traverses large expanses of open water and open country, including Bass Straight, agricultural land and other clearings during its annual migration. There is no evidence that the species occurs at the airport site, and there are only few records from the locality, suggesting the area is not important foraging habitat for the species. The airport would require the removal of 141.8 hectares of low quality foraging habitat for the Swift Parrot in Stage 1, and an additional 64.4 hectares of foraging habitat for long term development. Potential habitat in the airport site is of low quality for the species, given that much of it is young regrowth and aggressive competitors such as Noisy Miners are dominant species at the site. Clearing of vegetation for the airport would reduce the incidence of small patches of vegetation, but would not remove a corridor of woodland vegetation. The dispersal or movement of the Swift Parrot across the landscape is unlikely to be affected as clearings created by the airport would not isolate habitat with respect to this species. Given that there is no evidence of the species in the airport site, that there are few records in the locality, only low quality potential habitat would be removed, and the airport would not isolate habitat with respect to this species, the airport is not likely to modify, destroy, remove, isolate or decrease habitat such that the species would decline.

Swift Parrot *Lathamus discolor*, a critically endangered species.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Weed species have been recorded throughout the airport site and in adjacent areas. During construction there is potential for noxious and invasive weeds to be spread via earthworks and clearing activities, from seeds and other propagules in the soil and on vegetative material. Measures to manage invasive weed species and rehabilitate disturbed areas would be implemented via the CEMP to reduce the potential for weeds to become established in areas of potential habitat, including the conservation areas and other vegetation proximate or downstream of the airport site.

The airport is not likely to introduce feral animals to the area or encourage the spread of feral animals that may impact the Swift Parrot.

Introduce disease that may cause the species to decline

Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species (DECC 2005a) is listed as a key threatening process under the EPBC Act. The Swift Parrot is an endangered psittacine species. The airport is unlikely to introduce or spread the Psittacine circoviral (beak and feather) disease because construction staff and equipment would not come into contact with any birds, or otherwise act as a vector for the disease.

Diseases potentially affecting native vegetation in the airport site and surrounds include Root Rot Fungus (Phytophthora cinnamomi) and Myrtle Rust. Phytophthora and Myrtle Rust could affect Swift Parrot habitat as they both affect plants in the plant family Myrtaceae. To minimise the chance of introducing new plant pathogens, machinery would be washed down before moving from area to area and personnel, vehicles and plant would be excluded from habitat areas unless necessary.

Interfere with the recovery of the species

Habitat loss is listed as a current threat to the Swift Parrot in the Recovery Plan (Saunders and Tzaros 2011). The airport would require the removal of 141.8 hectares of low quality potential foraging habitat for Stage 1, and an additional 64.4 hectares of potential foraging habitat for long term development. This habitat loss will decrease the availability of winter forage for individual parrots that may disperse nomadically through the study area during winter. It may further increase interspecific competition with aggressive species such as the Noisy Miner and Bell Miner in adjacent areas. However, given the habitat to be removed comprises only a minor proportion of potential habitat present in the locality, the airport site is not considered to support critical habitat for this species, the low numbers of records in the locality and lack of evidence of the species at the airport site, the airport is unlikely to interfere with the recovery of the species.

Conclusion

The airport is unlikely to have a significant impact on the Swift Parrot as:

- The species does not breed in NSW.
- There is no evidence to date that the airport site represents critical or important foraging habitat for the species. There are no records from the site and few from the locality.
- Potential habitat includes small patches of mainly regenerating woodland, which is not preferred foraging habitat for this species. Only small areas of mature vegetation would be removed.
- Aggressive competitors such as the Noisy Miner are the dominant bird species over much of the site.
- The airport is unlikely to create a barrier to movements.
- The potential for bird strike mortality is low.

Greater Blue Mountains World Heritage Area

The GBMWHA consists of 1.03 million hectares of sandstone plateaux, escarpments and gorges dominated by temperate eucalypt forest. It is noted for the diversity of eucalypts associated with its wide range of habitats as well as significant numbers of rare or threatened species, including endemic and evolutionary relict species (such as the Wollemi Pine). A significant proportion of the Australian continent's biodiversity occur in the area (UNESCO 2015). The GBMWHA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas (DECC 2009b).

An assessment of significance is provided below with a focus on impacts on the biodiversity values of the GBMWHA.

<table>
<tr><th>Greater Blue Mountains World Heritage Area</th></tr>
<tr><td>The World Heritage values for which the GBMWHA was listed include:
Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
Important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.
It is noted for the diversity of eucalypts associated with its wide range of habitats as well as significant numbers of rare or threatened species, including endemic and evolutionary relict species.</td></tr>
<tr><td>According to the significant impact guidelines (DEWHA 2013), an action is likely to have a significant impact on the World Heritage values of a declared World Heritage property (or the National Heritage values of a National Heritage place) if there is a real chance or possibility that it will cause:
one or more of the World Heritage/National Heritage values to be lost
one or more of the World Heritage/National Heritage values to be degraded or damaged, or
one or more of the World Heritage/National Heritage values to be notably altered, modified, obscured or diminished</td></tr>
<tr><td>The airport would be located approximately 8 kilometres from the eastern edge of the GBMWHA. The GBMWHA covers a vast area, much of which is located well away from the airport. There would be no direct impacts resulting from the construction of the proposed airport on any areas of the GBMWHA. The construction of the airport would not modify or inhibit ecological processes within the area. The proposed airport has been designed to minimise adverse changes in hydrology and water quality. Design and mitigation measures are proposed to manage water quality (such as detention basins and appropriate sediment fencing). Any indirect impacts potentially associated construction (eg sedimentation or introduction of pollutants into waterways) are likely to be negligible given the distance between the proposed airport and the GBMWHA, the small area of the GBMWHA that could potentially be impacted, and appropriate design and mitigation measures to minimise the risk of off-site impacts during construction.

Based on these considerations there is no real chance or possibility that natural heritage values will be lost or significantly adversely modified as a result of construction of the airport.

Potential operational impacts are unlikely to impact the World Heritage or National Heritage values to such a degree that these would be lost or significantly, degraded or damaged or modified based on the following key considerations with respect to potential indirect impacts:
Noise: Aircraft noise would impact a relatively small area of the GBMWHA under proposed flight paths. This would be a novel impact in these areas, but is not</td></tr>
</table>

Greater Blue Mountains World Heritage Area
expected to be substantial impact as there would be no low-flying aircraft over the GBMWHA. Aircraft would be at heights generally greater than 5,000 feet with maximum noise levels typically below 55 dBA, (Wilkinson Murray 2015b) which is likely to be below threshold to disturb fauna behaviours (refer to Section 8.2.5). Fauna resident under the proposed flight paths are likely to become habituated to the elevated noise levels in the long term. • Water quality: A portion of the GBMWHA fronts the Nepean River downstream of its confluence with Duncans Creek. Changes to water quality and hydrology at the airport site have a very low potential to impact water quality in this portion of the GBMWHA. Bio-retention basins would be installed to treat surface runoff before it leaves airport site, and additional mitigation measures will further improve water quality leaving the airport site. There may be changes to flows in Duncans Creek as a result of changes to topography and diversion of flows in this direction. Given the generally poor quality of aquatic habitats in and downstream of the airport site, the small changes in flows are unlikely to have a substantial impact on fish habitat in downstream areas. Impacts on the water quality of the GBMWHA near where Duncans Creek flows into the Nepean River are therefore highly unlikely, particularly given and the distance between the airport site and the portion of the GBMWHA that fronts the Nepean River (refer to Section 8.2.5). • Air quality: Changes to air quality are unlikely given the prevailing wind directions. Any changes to air quality would be temporary and localised. Occasional changes to air quality as a result of wind changes are not likely to impact biodiversity values in the GBMWHA (refer to Section 8.2.5). • Fuel jettisoning: fuel jettisoning over the GBMWHA would be extremely rare, and no fuel would reach the ground. Fuel jettisoning is therefore unlikely to interfere with any ecosystem processes, result in the substantial degradation of habitat, or reduce the viability of any flora or fauna species (refer to Section 8.2.5). • Aircraft crashes: Aircraft traffic would increase emissions of NO_2, PM_{10}, $PM_{2.5}$, CO, SO_2, and air toxics. The highest off-site concentrations of the air quality metrics evaluated were generally predicted to occur to the north and north-east of the proposed airport due to the prevalence of south-westerly winds. As such, these emissions are generally unlikely to affect air quality over the GBMWHA, as it is located to the west of the airport site. Occasional changes to air quality as a result of wind changes would be temporary and localised, and are not likely to impact ecological processes in the GBMWHA. • Although very unlikely, operation of the proposed airport could result in an aircraft crashing within the GBMWHA. An aircraft crash would mainly cause localised damage to a relatively small area of the GBMWHA. This would be an extremely rare event, if it happens at all (refer to Section 8.2.5). • Greenhouse gas emissions: the construction and operation of the proposed airport will contribute to greenhouse gas emissions. Climate change in general is likely to impact biodiversity values within the GBMWHA, potentially changing the species composition and distribution in the long-term. The emissions from the construction and operation of the proposed airport itself, however, are not likely to have a significant impact on the GBMWHA, as it is only a minor part of a much larger and more wide-spread issue (refer to Section 8.2.5).

Greater Blue Mountains World Heritage Area
Given the above points, the construction and operation of the airport is unlikely to result in one or more of the World Heritage/National Heritage values to be lost, degraded or damaged, or notably altered, modified, obscured or diminished. The proposed airport would not result in a reduction in the diversity of eucalypts or alter biological processes.
With respect to the specific biological and ecological values an action is likely to have a significant impact on a World Heritage property or National Heritage Place if there is a real chance or possibility that the action will:
• **modify or inhibit ecological processes in a National Heritage place** • **reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property/National Heritage place** • **cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property/National Heritage place,**
The construction of the airport will not occur within the GBMWHA and would not directly modify or inhibit ecological processes within the area. Parts of the airport site west of the Northern Road drain to Duncans Creek, which drains to the Nepean River. Construction and operation of the airport could result in reduced water quality as a result of erosion, sedimentation and introduction of pollutants into the waterway, as well as changes to flow regimes in Duncans Creek. The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site. Additional mitigation measures are proposed to manage water quality to further minimise downstream impacts. Given the distance between the airport and the small area of the GBMWHA that is located adjacent to the Nepean River near the airport, and the inclusion of specific design elements and mitigation measures, any impacts would likely have dissipated by the time the water reaches the GBMWHA. Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences (Barber et al 2009). Low-flying aircraft can cause flight response in some species, causing them to abandon nests, and other species are known to avoid higher elevation areas where noise levels are higher, potentially resulting in fragmentation of habitat (Ellis, Ellis, & Mindell, 1991; Landon et al 2003). Most of these impacts occur when noise levels are high (greater than 65 dB), and given the height at which flights are likely to be, these impacts are unlikely. While background noise would increase under the flight tracks, fauna are likely to become habituated to the elevated noise levels in the long term (Anderson et al 1996; Conomy et al 1998) as aircraft would not be flying at low altitudes over the GBMWHA. Operation of aircraft is highly unlikely to permanently alter foraging or breeding behaviour of any fauna species. Any impacts would be localised, with impacts occurring under the main flight paths. The majority of fauna within the vast GBMWHA would not be impacted by aircraft noise. Noise levels are not likely to alter the composition of fauna communities in the GBMWHA. Changes to air quality are unlikely given the prevailing wind directions. Any changes to air quality would be temporary and localised. Occasional changes to air quality as a result of wind changes are not likely to impact biodiversity values in the GBMWHA. Construction and operation of the airport would increase carbon emissions, through clearing of vegetation, and operation of vehicles and aircraft. Climate change in general is likely to impact biodiversity values within the GBMWHA, potentially changing the species composition and distribution in the long-term. The airport itself, however, is not likely to have a significant impact on the GBMWHA, as it is only a minor part of a much larger and more wide-spread issue. Impacts resulting from fuel jettisoning and aircraft crashes are highly unlikely (see above). Given the above points, the potential for noise impacts and water and air quality impacts are unlikely to modify or inhibit ecological processes, reduce the diversity or modify the composition of plant and animal species, or cause a long-term reduction in rare, endemic or unique plant or animal populations or species in the GBMWHA.

Greater Blue Mountains World Heritage Area
• **fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property/National Heritage place.**
The construction of the airport will not occur within the GBMWHA. There will be no direct impacts on native vegetation or flora or fauna habitats as a result of construction of the airport. No areas of habitat for rare, endemic or unique animal populations or species would be fragmented, isolated or substantially damaged. Noise would not be at a level that would cause fauna to avoid certain areas, thus potentially fragmenting habitat (refer to Section 8.2.5).
• **involve construction of buildings, roads, or other structures, vegetation clearance, or other actions with substantial, long-term or permanent impacts on relevant values, and**
The construction of the airport will not occur within the GBMWHA. As such, the airport would not involve clearing of vegetation within the GBMWHA, and would not result in any permanent impacts such as the construction of roads, buildings or other structures. Potential indirect impacts resulting from operation of the airport are unlikely to result in any substantial, long-term or permanent impacts on biodiversity values of the GBMWHA, as has been detailed above.
• **introduce noise, odours, pollutants or other intrusive elements with substantial, long-term or permanent impacts on relevant values.**
Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences (Barber et al 2009). These impacts tend to occur at high decibel levels, such as from low-flying-aircraft. While background noise would increase under the flight paths, fauna are likely to become habituated to the elevated noise levels in the long term (Anderson et al 1996; Conomy et al 1998) as aircraft would not be flying at low altitudes over the GBMWHA. The airport would be located approximately 8 kilometres from the eastern edge of the GBMWHA. The GBMWHA covers a vast area, much of which is located well away from the airport. Parts of the airport site west of the Northern Road drain to Duncans Creek, which drains to the Nepean River. Design and mitigation measures for the airport would minimise the risk of reduced water quality as a result of erosion, sedimentation and introduction of pollutants into the waterway. Given the distance between the airport and the small area of the GBMWHA that is located adjacent to the Nepean River near the airport, and the inclusion of specific design elements and mitigation measures, any impacts would likely have dissipated by the time the water reaches the GBMWHA. Changes to air quality are unlikely given the prevailing wind directions. Any changes to air quality would be temporary and localised. Occasional changes to air quality as a result of wind changes are not likely to impact biodiversity values in the GBMWHA. Fuel jettisoning over the GBMWHA would be extremely rare, and no fuel is likely to reach the ground. Fuel jettisoning is therefore unlikely to interfere with any ecosystem processes, result in the substantial degradation of habitat, or reduce the viability of any flora or fauna species.
Conclusion
The proposed airport is not likely to have a significant impact on the biodiversity values of the GBMWHA given: • There would be no direct impact on the GBMWHA • Indirect impacts associated with the construction and operation of the airport are unlikely to result in the loss or significant modification of biological diversity or biological processes within the GBMWHA, given: – Potential impacts on fauna within the GBMWHA as a result of noise are unlikely to result in changes to species behaviour or habitat use

Greater Blue Mountains World Heritage Area
– Potential impacts on the GBMWHA as a result of changes to air quality are likely to be negligible given the distance to the GBMWHA and prevailing wind conditions – The airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns and water quality outside of the airport site. – While greenhouse gas emissions will increase as a result of the construction and operation of the airport, this is unlikely to directly result in the loss of biological diversity or biological processes within the GBMWHA.

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